Servicing and Stormwater Management Report – 114 Richmond Road Phase 2A/2B

Project #160400864

May 6, 2022

Prepared for:

Ashcroft Homes

Prepared by:

Stantec Consulting Ltd.

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1.0 INTRODUCTION

Stantec Consulting Ltd. has been commissioned by Ashcroft Homes to prepare the following servicing study in support of a proposal to develop Phase 2 of the 114 Richmond Road property. The property is situated on the south side of Richmond Road at the southwest quadrant at the intersection of Richmond Road and Leighton Terrace, and terminating at Byron Avenue. The site is located in the City of Ottawa and is indicated in **Figure 1**. The 2.22 ha site was previously convent land. The existing convent building and much of the land has been deemed a heritage site and is to be preserved. The site development plan used for the purpose of this servicing brief consists of three (3) development phases as indicated on **Drawing SP-1**. Phase 1 of the site plan has been previously approved and constructed, and consists of three 9-storey condominium towers and renovation of the existing convent building into a primarily commercial facility. The current site plan for Phase 2A consists of one multi-storey residential building (Building B). The future Phase 2B includes two additional multi-storey residential buildings C and D. The servicing study herein considers ultimate buildout of the development.

Figure 1: Overall Development Location Plan

2.0 BACKGROUND

Documents referenced in preparation of the design for the 114 Richmond Road (Phase 2A/2B) Development include:

- Geotechnical Investigation – Proposed Residential Development Phases 2– 114 Richmond Road, Patersongroup Consulting Engineers, March 20, 2019.
- City of Ottawa Sewer Design Guidelines, City of Ottawa, October 2012.
- City of Ottawa Design Guidelines – Water Distribution, City of Ottawa, July 2010.
- Assessment of Adequacy of Public Services Report – Proposed Development at 114 Richmond Road, Trow Associates Inc., March 12, 2010.
- 114 Richmond Road – Potable Water Servicing Analysis, Stantec Consulting Ltd., August 2011.
- Serviceability Report – Ashcroft Homes – 114 Richmond Road, Stantec Consulting Ltd., June 26, 2013.

3.0 WATER SUPPLY SERVICING

3.1 BACKGROUND

The analysis below considers both Phase 2A and 2B of a multi-phased development as indicated in **Figure 1**. The site is located on the south side of Richmond Road and north of the intersection of Byron and Kensington Avenue. The proposed development comprises two residential apartment buildings, a 9-storey addition to the existing on-site convent building, and subsurface parking areas. The site is to be serviced via 200mm watermain stub constructed as part of Phase 1, as well as a second proposed 250mm service connection to the watermain within Byron Avenue. The full development is fed by the 300mm watermains on Richmond Road and Byron Avenue, and looped internally through on-site buildings. Connection to Richmond Road was completed with the approved Phase 1 of the development, and connection to the Byron Avenue main is proposed along with Phase 2A/2B.

The site is located within the City's Pressure Zone 1W. Proposed ground elevations of the site vary from approximately 67.7m to 71.5m. Under normal operating conditions, hydraulic gradelines vary from approximately 114.1m to 108.4m based on boundary conditions previously provided by the City of Ottawa. A potable water servicing analysis was previously performed by Stantec for Phase 1 of the development, and is detailed in **Appendix A.2**

3.2 WATER DEMANDS

Water demands for the development were estimated using the Ministry of Environment's Design Guidelines for Drinking Water Systems (2008) and the City of Ottawa's Water Distribution Guidelines (2010). A daily rate of 2.5 l/m^2 of commercial space was used for the proposed site. It is predicted that such facilities will be operated 12 hours per day. Residential demands were estimated at 280 L/cap/day in consideration of a 1-bed apartment density of 1.4 ppu, a 2-bed apartment density of 2.1 ppu, and an average apartment population density of 1.8 ppu. See **Appendix A.1** for detailed domestic water demand estimates.

The average day demand (AVDY) for the entire site (including the existing Phase 1) was determined to be 3.80 L/s. The maximum daily demand (MXDY) is estimated to be 9.49 L/s. The peak hour demand (PKHR) totals 20.89 L/s.

The previous potable water servicing analysis based assumptions for fire flow requirements on calculations per the 1999 FUS Guidelines (**Appendix A.2**), and had determined the maximum required fire flows for on-site buildings to be 250L/s. Based on current (2020) FUS Guidelines for the proposed buildings with calculation sheets also included in **Appendix A.2**, the maximum required fire flow for the site would be 167L/s, which is well within the previously assessed fire flow requirements.

3.3 HYDRAULIC MODEL RESULTS

A hydraulic model of the water supply system was previously created by Stantec based on boundary conditions at Phase 1 of the development to assess the proposed watermain layout under the above demands and during fire flow scenarios. Results of the hydraulic modeling demonstrate that adequate flows are available for the subject site, with on-site pressures ranging from **52 psi** to **66 psi** under normal operating conditions. These values are within the normal operating pressure range as defined by MECP and City of Ottawa design guidelines (desired 50 to 70 psi and not less than 40 psi). Results of the hydraulic model analysis can be found in **Appendix A.2**.

A fire flow analysis was carried out using the hydraulic model to determine the anticipated amount of flow that could be provided for the proposed development under maximum day demands and fire flow requirements. Results of the modeling analysis indicate that flows in excess of 15,000L/min (250 l/sec) can be delivered while still maintaining a residual pressure of 140 kPa (20 psi). Results of the hydraulic modeling are included for reference in **Appendix A.2**.

3.4 SUMMARY OF FINDINGS

Based on the results of the hydraulic analysis, the proposed water servicing will provide sufficient capacity to sustain required domestic demands and fire flows such that normal operating pressures remain within City of Ottawa required limits. The model indicates that this rate can be achieved at all locations while still maintaining the minimum residual pressure per City requirements.

4.0 WASTEWATER SERVICING

4.1 BACKGROUND

The proposed development includes Phases 2A and 2B of the multi-phased development as indicated in **Figure 1**. The site is located on the south side of Richmond Road and west of Leighton Terrace. Wastewater servicing for Phase 2A/2B of the development will be extended from the 375mm diameter sewer constructed as part of Phase 1 (**Drawing SSP-1**). The sanitary sewer within the development lands discharges to an existing 375mm diameter sanitary sewer running along Richmond Road, which outlets in turn to the 450mm diameter sewer running north on Patricia Avenue.

For detailed information regarding the wastewater servicing for the Phase 1 area, please refer to the *Serviceability Report – Ashcroft Homes – 114 Richmond Road* (Stantec, June 2013).

4.2 DESIGN CRITERIA

As outlined in the City of Ottawa Sewer Design Guidelines and the MOECP's Design Guidelines for Sewage Works, the following criteria were used to calculate estimated wastewater flow rates and to size the sanitary sewers:

- Minimum Velocity – 0.6 m/s (0.8 m/s for upstream sections)
- Maximum Velocity – 3.0 m/s
- Manning roughness coefficient for all smooth wall pipes – 0.013
- Minimum size – 200mm dia. for residential areas, 250mm for commercial areas
- Average Wastewater Generation (Commercial) – 28,000L/ha/day
- Average Wastewater Generation (Residential) – 280L/cap/day
- Peak Factor (Commercial) – 1.5 (if Commercial over 25%+ contributing area, 1.0 otherwise)
- Peak Factor (Residential) – Per Harmon's w/ correction factor of 0.8
- Extraneous Flow Allowance – 0.33 l/s/ha (conservative value)
- Manhole Spacing – 120 m
- Minimum Cover – 2.5m

4.3 PROPOSED SERVICING

The proposed site will be serviced by gravity sewers which will direct the wastewater flows from the entire development site (approx. 15.3 L/s with allowance for infiltration) to the existing 375mm diameter sanitary sewer. As basement levels of the proposed underground parking structure lie below the connecting 375mm sewer, drains from these areas will be required to be pumped up to the existing gravity sewer stub. The proposed drainage pattern is detailed on **Drawing SA-1**. A sanitary sewer design sheet for the proposed service lateral is included in **Appendix B.1**. Full port backwater valves are to be installed on all sanitary

services within the site to prevent any potential surcharge from the downstream sanitary sewer from impacting the proposed property.

As outlined in the Serviceability Report for Phase 1 of the 114 Richmond Road site, an anticipated peak flow rate from the development was determined to be 21.5L/s, which was well within the available capacity within downstream sewers on Patricia Avenue. Based on revised sanitary sewer peak flow parameters per updates to the City's Sewer Design Guidelines, the estimated peak flow rate from the development is well within that of the approved serviceability study (see excerpts in **Appendix B.2**).

5.0 STORMWATER MANAGEMENT

5.1 OBJECTIVES

The objective of this stormwater management plan is to determine the measures necessary to control the quantity/quality of stormwater released from the proposed development to criteria established within the previously approved serviceability report for the site, and to provide sufficient detail for approval and construction.

5.2 SWM CRITERIA AND CONSTRAINTS

Criteria were established by combining current design practices outlined by the City of Ottawa Design Guidelines (2012), through the report titled Assessment of Adequacy of Public Services Report" by Trow Associates (March 2010), and through consultation with City of Ottawa staff. The following summarizes the criteria, with the source of each criterion indicated in brackets:

General

- Use of the dual drainage principle (City of Ottawa).
- Wherever feasible and practical, site-level measures should be used to reduce and control the volume and rate of runoff. (City of Ottawa)
- Assess impact of 100-year event outlined in the City of Ottawa Sewer Design Guidelines on major & minor drainage system (City of Ottawa)
- No quality control criteria have been previously identified for the subject site (Stantec, Trow)

Storm Sewer & Inlet Controls

- Size storm sewers to convey 5-year storm event under free-flow conditions using City of Ottawa I-D-F parameters (City of Ottawa).
- Site discharge rates for each storm event to be restricted to 5-year storm event pre-development rates with a maximum pre-development C coefficient of 0.45, and time of concentration of 23.8 minutes (**205L/s**) (Stantec, Trow).
- Proposed site to discharge the existing 300mm diameter storm sewer within the Daly Avenue ROW at the northern boundary of the subject site (City of Ottawa).
- 100-year Storm HGL to be a minimum of 0.30 m below building foundation footing (City of Ottawa).

Surface Storage & Overland Flow

- Building openings to be a minimum of 0.15m above the 100-year water level (City of Ottawa)
- Maximum depth of flow under either static or dynamic conditions shall be less than 0.35m (City of Ottawa)

- Balance of flows in excess of allowable release rate up to and including the 100-year storm event to be detained on-site. (Stantec, Trow)
- Provide adequate emergency overflow conveyance off-site for events beyond the 100-year storm (City of Ottawa)
- Where possible, major flow from the site is to be safely conveyed by surface routing towards Leighton Terrace and Richmond Road. (Stantec)

5.3 STORMWATER MANAGEMENT

The Modified Rational Method was employed to assess the rate and volume of runoff generated during post-development conditions. The site was subdivided into subcatchments (subareas) tributary to stormwater controls as defined by the location of inlet control devices. A summary of subareas and runoff coefficients is provided in **Appendix C.2**, and **Drawing SD-1** indicates the stormwater management subcatchments. C coefficient values have been increased by 25% for the post-development 100-year storm event based on MTO Drainage Manual recommendations. Rational method storm sewer design sheets have been supplied as part of **Appendix C.1**.

5.3.1 Allowable Release Rate

Based on prior consultation with City of Ottawa staff during Phase 1 of the development, the peak post-development discharge from the subject site is to be limited to that of the 5-year event discharge under pre-development conditions, to a maximum discharge coefficient C of 0.45 at a time of concentration of 23.8 minutes (see report excerpts in **Appendix C.3**) Peak flow rates have been calculated using the rational method as follows:

Q = 2.78 CiA
Where: Q = peak flow rate, L/s
A = drainage area, ha
I = rainfall intensity, mm/hr (per Ottawa IDF curves)
C = site runoff coefficient

The target release rate for the site is summarized in **Table 1** below:

Table 1: Target Release Rates

Design Storm	Target Flow Rate (L/s)
All Events	205

5.3.2 Storage Requirements

The site requires quantity control measures to meet the restrictive stormwater release criteria. It is proposed that rooftop storage via restricted roof release in combination with the subsurface storage pipe constructed in Phase 1, as well as a proposed storage cistern to reduce site peak outflow to target rates.

5.3.2.1 Rooftop Storage

It is proposed to retain stormwater on the building rooftops by installing restricted flow roof drains. The following calculations assume the proposed roofs will be equipped with standard Watts Model R1100 Accuflow Roof Drains. Design for Roof A is as per the approved Phase 1 Stormwater Management Report for the development.

Watts Drainage “Accutrol” roof drain weir data has been used to calculate a practical roof release rate and detention storage volume for the rooftops. It should be noted that the “Accutrol” weir has been used as an example only, and that other products may be specified for use, provided that the total roof drain release rate is restricted to match the maximum rate of release indicated in Table 2, and that sufficient roof storage is provided to meet (or exceed) the resulting volume of detained stormwater. Proposed drain release rates have been calculated based on the Accutrol weir setting defined in the table below. Storage volume and controlled release rate are summarized in **Table 2**:

Table 2: Roof Control Areas

Design Storm	Roof Area ID	Depth (mm)	Accutrol Setting (%)	Discharge (L/s)	Volume Stored (m^3)
5-Year	ROOF A (Existing)	27	N/A	9.2	44.2
	ROOF B1	111	25% Open	2.5	9.9
	ROOF B2	113	50% Open	2.1	9.9
	ROOF C	112	50% Open	7.1	30.4
	ROOF D1	112	50% Open	5.1	23.1
	ROOF D3	108	25% Open	1.6	5.1
	ROOF D5	111	25% Open	1.6	6.5
100-Year	ROOF A (Existing)	51	N/A	17.4	83.6
	ROOF B1	148	25% Open	2.8	23.0
	ROOF B2	150	50% Open	2.5	22.3
	ROOF C	148	50% Open	8.7	68.7
	ROOF D1	149	50% Open	6.3	52.1
	ROOF D3	145	25% Open	1.9	12.1
	ROOF D5	148	25% Open	1.9	15.2

5.3.2.2 Uncontrolled Catchments

Due to grading constraints, some subcatchments were designed without a storage component. These areas flow offsite uncontrolled to Richmond Road and Byron Avenue, and are not tributary to the on-site storm sewer outlet. Areas that discharge offsite without entering the proposed stormwater management system must be compensated for in areas with controls, as drainage will re-enter storm sewers tributary

to Richmond Road further downstream of the site. **Table 3** summarizes the peak uncontrolled 5 and 100-year catchment release rates for areas that are non-tributary to the outlet sewer:

Table 3: Peak Uncontrolled (Non-Tributary) Release Rate

Design Storm	Area ID	Area (ha)	C	Tc (min)	Intensity (mm/hr)	Qrelease (L/s)
5-Year	UNC1	0.09	0.80	10	104.19	20.9
5-Year	UNC2	0.056	0.64	10	104.19	10.4
100-Year	UNC1	0.09	1.00	10	178.56	44.7
100-Year	UNC2	0.056	0.80	10	178.56	22.2

5.3.2.3 Surface Storage

Surface drainage directed to proposed CB 500 is proposed to be restricted prior to further control by the downstream 3000mm x 1500mm superpipe within the previously constructed Phase 1 of the development. Additional control is necessary to ensure peak inflow rates do not cause surcharge of the downstream system. Flow control will be provided by a proposed IPEX Tempest 95mm ICD (slide type) to be installed at the outlet invert of the catch basin. Storage volumes and controlled release rates for the catch basin are summarized below. It is of note that head over the ICD decreases during larger storm events due to increasing water elevations within the downstream storage pipe.

Design Storm	Area IDs	Tributary Area (ha)	Design Head (m)	Elevation (m)	Discharge (L/s)	$V_{required}$ (m^3)	$V_{available}$ (m^3)
5-Year	A4	0.062	1.38	67.97	21.1	0.0	0.5
100-Year	A4	0.062	1.19	68.17	19.6	6.7	7.0

5.3.2.4 Subsurface Storage

Per the modified rational method calculations included as part of **Appendix C.2**, the remainder of the site is to be directed towards either the existing 3000mm x 1500mm storage pipe, or a proposed subsurface cistern sized to meet the target peak discharge rate for the during the 100-year event.

Storage volumes for the existing storage pipe and associated structures were previously determined within the approved development Phase 1 stormwater management report. A change in diameter to the ICD downstream of the superpipe is required to suit the current development plan catchment area and imperviousness.

It is anticipated that the subsurface cistern will be located below the outlet sewer invert elevation and will be required to be pumped to the gravity sewer outlet at the discharge rate specified. Storage volumes and controlled release rates for the two systems are summarized below:

Table 4: Controlled Tributary Area (3000mm x 1500mm Superpipe)

Design Storm	Area IDs	Tributary Area (ha)	Design Head (m)	Elevation (m)	Discharge (L/s)	$V_{required}$ (m^3)	$V_{available}$ (m^3)
5-Year	A1, A3, A4, EXT2	1.003	0.66	65.97	29.1	122.0	292.2
100-Year	A1, A3, A4, EXT2	1.003	1.67	66.98	46.3	292.0	292.2

Table 5: Controlled Tributary Area (Cistern)

Design Storm	Area IDs	Tributary Area (ha)	Design Head (m)	Discharge (L/s)	$V_{required}$ (m^3)	$V_{available}$ (m^3)
5-Year	COURT, A2, B3-B6, D2, D4, EXT1	0.654	-	50.0	54.1	190.0
100-Year	COURT, A2, B3-B6, D2, D4, EXT1	0.654	-	50.0	188.1	190.0

5.3.3 Results

Table 6 demonstrates the proposed stormwater management plan and demonstrates adherence to target peak outflow rates for the site.

Table 6: Summary of Total 5 and 100-Year Event Release Rates

	5-Year Peak Discharge (L/s)	100-Year Peak Discharge (L/s)
Uncontrolled	31	67
Controlled - Roof	29	42
Controlled – Surface / Subsurface	79	96
Total	**139**	**205**
Target	**205**	**205**

6.0 GRADING AND DRAINAGE

The proposed development including Phase 1 measures approximately 2.23ha in area. The topography across the site is a gradual slope draining from south to north with a difference in elevation of approximately 3m. A detailed grading plan (see **Drawing GP-1**) has been provided to satisfy the stormwater management requirements, adhere to any permissible grade raise restrictions (see **Section 10.0**) for the site, and provide for minimum cover requirements for storm and sanitary sewers where possible. Site grading has been established to provide emergency overland flow routes required for stormwater management in accordance with City of Ottawa requirements.

The subject site maintains emergency overland flow routes for flows deriving from storm events in excess of the maximum design event to the proposed municipal rights-of-way at the southern and northern boundaries of the development, and ultimately to Richmond Road and Byron Avenue as depicted in **Drawing GP-1.** Existing rear yards along the western and eastern boundary of the site that previously drained onto the subject site area will be maintained.

7.0 UTILITIES

As the subject site is bound to the east and west by an existing residential area / commercial main street, and by municipal right-of-ways to the north, south, and east, Hydro, Bell, Gas and Cable servicing for the proposed development should be readily available. Pole mounted Hydro infrastructure may exist along the western property line, and will be relocated prior to development. It is anticipated that existing infrastructure will be sufficient to provide a means of distribution for the proposed site. Exact size, location and routing of utilities will be finalized after design circulation.

8.0 APPROVALS

Environmental Compliance Approvals (ECAs, formerly Certificates of Approval (CofA)) under the Ontario Water Resources Act are not expected to be a requirement for Phases 2A/2B of the development as approval was previously obtained for storm and sanitary sewers connecting to Richmond Road / Leighton Terrace as part of Phase 1. The Phase 2A/2B property is of non-industrial use, and discharges to approved sewer stubs constructed as part of Phase 1 designed to accommodate the current phase. Conservation Authority clearance will be required along with site plan approval for the development.

9.0 EROSION CONTROL DURING CONSTRUCTION

Erosion and sediment controls must be in place during construction. The following recommendations to the contractor will be included in contract documents.

1. Implement best management practices to provide appropriate protection of the existing and proposed drainage system and the receiving water course(s).
2. Limit extent of exposed soils at any given time.
3. Re-vegetate exposed areas as soon as possible.
4. Minimize the area to be cleared and grubbed.
5. Protect exposed slopes with plastic or synthetic mulches.
6. Provide sediment traps and basins during dewatering.
7. Install sediment traps (such as SiltSack® by Terrafix) between catch basins and frames.
8. Plan construction at proper time to avoid flooding.

The contractor will, at every rainfall, complete inspections and guarantee proper performance. The inspection is to include:

9. Verification that water is not flowing under silt barriers.
10. Clean and change silt traps at catch basins.

Refer to **Drawing ECDS-1** for the proposed location of silt fences, straw bales and other erosion control structures.

10.0 GEOTECHNICAL INVESTIGATION AND ENVIRONMENTAL ASSESSMENT

A geotechnical Investigation Report was prepared by Patersongroup dated March, 2019. The report summarizes the existing soil conditions within the entirety of the development and construction recommendations. For details which are not summarized below, please see the original Paterson report.

Subsurface soil conditions within the subject area were determined from 5 boreholes distributed across the development. In general, soil stratigraphy consisted of topsoil underlain by glacial till, followed by limestone bedrock. Bedrock/inferred bedrock elevations range from depths of 8.7 to 10.7m below ground surface. Groundwater Levels were measured in July 2010, and vary in elevation from 1.02m to 2.22m below ground surface.

No grade raise limitations were identified for the subject site.

The required pavement structure for proposed hard surfaced areas are outlined in **Table 7 and 8** below:

Table 7: Pavement Structure – Car only Parking Areas

Thickness (mm)	Material Description
50	Wear Course – HL 3 or Superpave 12.5 Asphaltic Concrete
150	Base – OPSS Granular A Crushed Stone
300	Subbase - OPSS Granular B Type II
-	Subgrade – Either fill, in situ soil, or OPSS Granular B Type I or II material placed over in situ soil or bedrock.

Table 8: Pavement Structure – Access Lanes and Heavy Truck Parking Areas

Thickness (mm)	Material Description
40	Wear Course – HL-3 or Superpave 12.5 Asphaltic Concrete
50	Binder Course – HL-8 or Superpave 19.0 Asphaltic Concrete
150	Base – OPSS Granular A Crushed Stone
400	Subbase - OPSS Granular B Type II
-	Subgrade – Either fill, in situ soil or OPSS Granular B Type I or II material placed over in situ soil or bedrock.

11.0 CONCLUSIONS

11.1 WATER SERVICING

Based on the supplied boundary conditions for existing watermains and estimated domestic and fire flow demands for the subject site, it is anticipated that the proposed servicing in this development will provide sufficient capacity to sustain the required domestic demands and emergency fire flow demands of the proposed site. Fire flows greater than those required per FUS Guidelines are available for this development.

11.2 SANITARY SERVICING

The proposed sanitary sewer network is sufficiently sized to provide gravity drainage of the site. The proposed development will be serviced by a network of gravity sewers which will direct wastewater flows to the existing 375mm dia. sanitary sewer stub constructed as part of Phase 1. The proposed drainage outlet to the north has sufficient capacity to receive sanitary discharge from the site based on the findings of the Serviceability Report for Phase 1 of the development.

11.3 STORMWATER SERVICING

The proposed stormwater management plan is in compliance with the goals specified previously through consultation with the City of Ottawa for Phase 1 of the development. An on-site subsurface storage cistern, superpipe, and associated ICDs have been proposed to limit peak storm sewer inflows to downstream storm sewers to 205L/s as determined by background reports. The downstream receiving sewer has sufficient capacity to receive runoff volumes from the site based on the findings of the Serviceability Report for Phase 1 of the development.

11.4 GRADING

Grading for the site has been designed to provide an emergency overland flow route as per City requirements and reflects the recommendations made in the Geotechnical Investigation Report prepared by Patersongroup. Erosion and sediment control measures will be implemented during construction to reduce the impact on existing facilities.

11.5 UTILITIES

Utility infrastructure exists within the Richmond Road and Byron Avenue ROWs at the northern and southern boundaries of the proposed site. It is anticipated that existing infrastructure will be sufficient to provide a means of distribution for the entirety of the development. Exact size, location and routing of utilities will be finalized after design circulation.

11.6 APPROVALS/PERMITS

An MECP Environmental Compliance Approval is not expected to be required as approval was obtained for the receiving storm and sanitary sewers as part of Phase 1. Conservation Authority clearance will be required along with site plan approval for the development. No other approval requirements from other regulatory agencies are anticipated.

APPENDICES

Appendix A : HYDRAULIC ANALYSIS

A.1 DOMESTIC WATER DEMANDS

114 Richmond Road - Domestic Water Demand Estimates

Densities as per City Guidelines:

Singles	3.4	ppu
Townhomes	2.7	ppu
1 Bed Apt	1.4	ppu
2 Bed Apt	2.1	ppu
Average Apt	1.8	ppu

Area ID	Demand at Node	# of Units	Population	Commercial Area	Daily Rate of Demand (L/cap/day)	Daily Rate of Demand (L/m^2/day)	Avg Day Demand		Max Day Demand[1]		Peak Hour Demand[2]	
							(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Phase 1	-	294	412	2138	280	2.5	80.0	1.33	200.1	3.33	440.2	7.34
Phase 2 (B)	-	187	328	0	280	2.5	63.7	1.06	159.3	2.65	350.4	5.84
Phase 2 (C+D)	-	309	433	0	280	2.5	84.1	1.40	210.3	3.50	462.6	7.71
Total Site :		**1172**					**227.85**	**3.80**	**569.63**	**9.49**	**1253.18**	**20.89**

Average day water demand for residential areas: 280 L/cap/d

The City of Ottawa water demand criteria used to estimate peak demand rates for residential areas are as follows:

1 maximum day demand rate = 2.5 x average day demand rate for residential

2 peak hour demand rate = 2.2 x maximum day demand rate for residential

Water demand criteria used to estimate peak demand rates for retail areas are as follows:

1 maximum day demand rate = 1.5 x average day demand rate

2 peak hour demand rate = 1.8 x maximum day demand rate

A.2 POTABLE WATER HYDRAULIC ANALYSIS

114 Richmond Road - Potable Water Servicing Analysis

Prepared by:

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Project No. 160400864

April 10, 2013

Executive Summary

The following report identifies and evaluates the proposed water distribution system for a mixed-use development located in the central/western area of the City of Ottawa's water distribution system. The proposed 114 Richmond Road development is located between Richmond Road and Byron Avenue in Zone 1W of the City of Ottawa water distribution system. The current development consists of two phases. Phase 1 features 3 nine-storey mixed-use residential and commercial buildings. Phase 2 includes 2 nine-storey residential buildings and 4 four-storey residential buildings. Phases 1 and 2 will house approximately 1278 people upon completion.

The modeling results show that the proposed water distribution network is capable of servicing the proposed mixed-use development with suitable flows and pressures under typical demands (average day, peak hour) and under emergency fire flow demands (maximum day + fire flow).

Questions or comments regarding the analysis presented may be directed to the undersigned.

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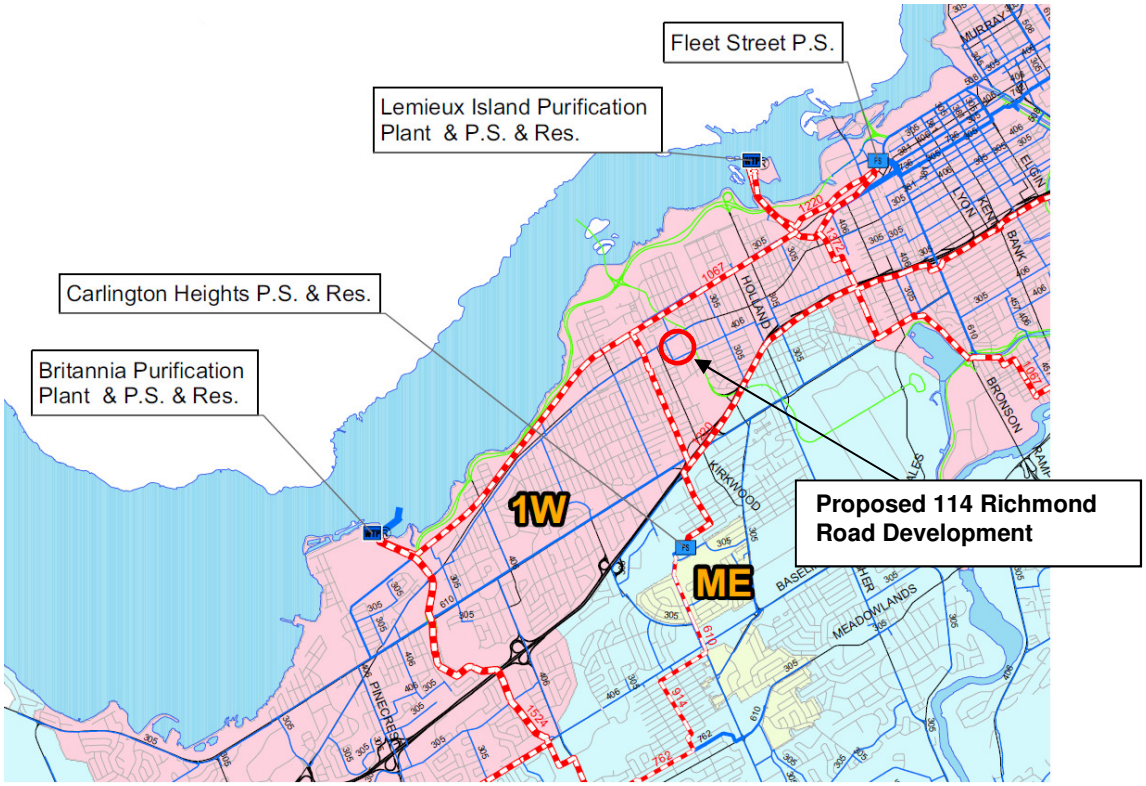
1.0 Potable Water Analysis

1.1 BACKGROUND

Stantec Consulting Ltd. (Stantec) has undertaken a hydraulic analysis of the potable water servicing for the proposed 114 Richmond Road development. This predominantly residential development will include multiple mixed-use high-rise buildings as well as a senior condominium development and a senior living facility. An existing heritage building on the site will also be preserved and renovated for residential and commercial use.

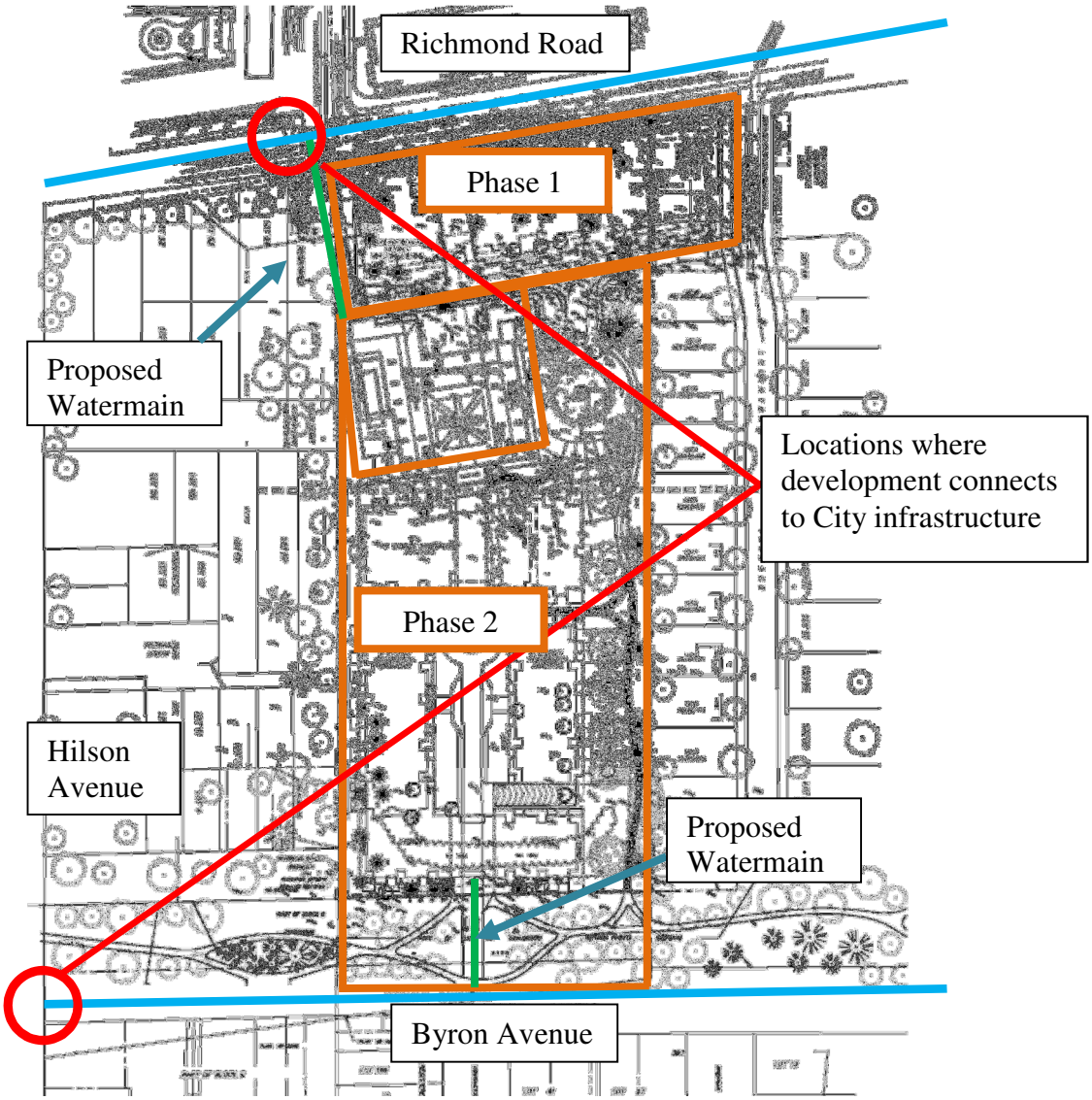
The proposed site is located between Richmond Road and Byron Avenue as shown on **Figure 1-1**. It is part of Zone 1W of the City of Ottawa water distribution system. This zone is fed by the Britannia, Lemieux Island and Fleet Street Pumping Stations. Also located in this zone, the Carlington Heights Reservoir provides balancing storage for peak flows and demands.

Figure 1-1: Proposed Development at 114 Richmond Road



The proposed servicing plan (shown on **Figure 1-2**) includes tying into the existing 300mm diameter watermain on Richmond Road during the first phase of the development and subsequently tying the existing 300mm diameter watermains on Hilson Avenue and Byron Avenue in the second phase of the development. The proposed watermains are to be of 250mm in diameter.

Figure 1-2: Proposed Servicing Plan



Phase 1 includes 3 mixed-use nine-storey buildings. A total of 291 residential units and 33,352 sq. ft. of commercial space will be created during Phase 1.

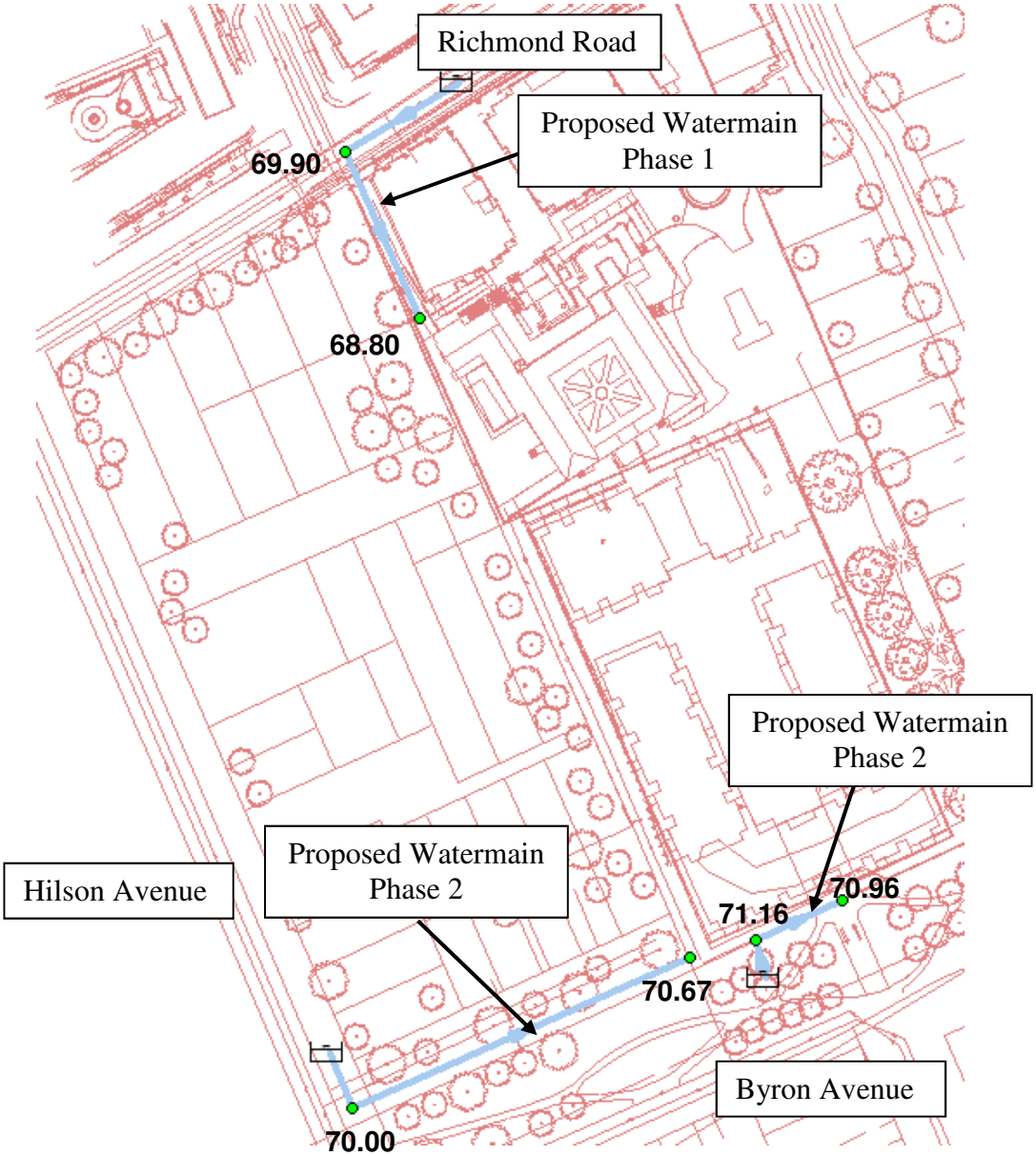
Phase 2 will encompass 4 four-storey buildings dedicated to senior living and 2 nine-storey building for residential use. A total of 419 residential units are created during Phase 2.

The watermain from Richmond Road will supply water to buildings constructed in Phase 1 and the watermains from Hilson Avenue and Byron Avenue will supply water to buildings constructed in Phase 2.

1.2 GROUND ELEVATIONS

The existing ground elevations of the proposed development range from approximately 68.80m and 72.20m. The elevations shown on **Figure 1-3** were interpolated from elevations provided as part of the boundary conditions from the City of Ottawa and assigned to the nodes in the hydraulic model.

Figure 1-3: Ground elevations (m) in area of proposed development



1.3 ALLOWABLE PRESSSURES

The City of Ottawa Water Distribution Design Guidelines state that the design objective for system pressures under normal demand conditions (i.e. average day, maximum day and peak hour) shall remain between the range of 275 to 690 kPa (40 to 100 psi) at the ground elevation in the streets (i.e. at hydrant level). Under emergency fire flow conditions, the minimum pressure in the distribution system is allowed to drop to 140 kPa (20 psi).

1.4 EXISTING & PROPOSED WATERMAIN NETWORK

Potable water supply for Phase 1 will be provided by the existing 300mm diameter watermain on Richmond Road through a 250mm service line. Phase 2 will be serviced off two existing 300mm diameter watermains, one on Hilson Avenue and one on Byron Avenue through 250mm service lines, respectively (**Figure 1-3**).

New watermains were added to the hydraulic model to simulate the proposed distribution system. Hazen-Williams coefficients ("C-Factors") were applied to the new watermain in accordance with the City of Ottawa's Water Distribution Design Guidelines:

Table 1: C-Factors used for applied watermain based on pipe diameter

Pipe Diameter (mm)	C-Factor
150	100
200 to 300	110
350 to 600	120
> 600	130

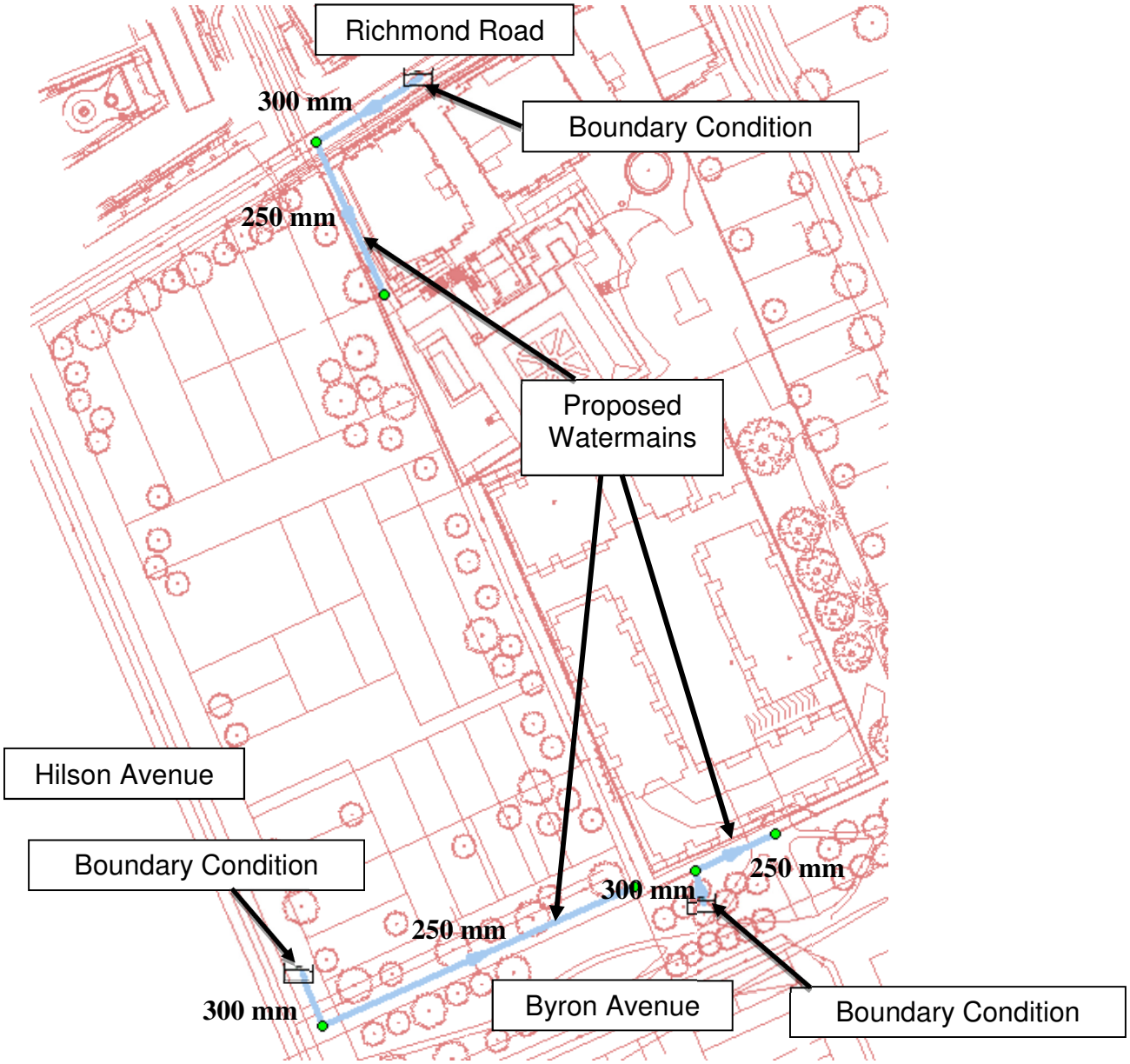
1.5 BOUNDARY CONDITIONS

The hydraulic model used for this analysis was created by Stantec. The boundary conditions provided by the City were based on computer model stimulations and are summarized in **Table 2**. Fixed head reservoirs simulating these boundary conditions were placed on Richmond Road, Hilson Avenue, and Byron Avenue near the proposed servicing watermains as shown in **Figure 1-4**.

Table 2: Boundary conditions based on computer model stimulations

Phase	Location	AVDY (m)	PKHR (m)	MXDY+FF (m)
1	Richmond Road	114.2	108.5	105.1
2	Byron Avenue	114.9	108.1	106.1
2	Hilson Avenue	114.9	108.1	106.1

Figure 1-4: Existing and Proposed watermain network pipe diameters



1.6 WATER DEMAND

Water demands for the development were estimated using the City of Ottawa's Water Distribution Design Guidelines. The estimated household size of an average apartment is **1.8 persons**. Therefore, the total projected population for the proposed mixed-use development shall be of **1278 people** for Phase 1 and 2 of development.

For residential developments, the average day per capita water demand is **350 L/(cap*d)**. The average day demand of a commercial space of the "Shopping Center" type is **2,500 L/(1,000m^2/d)**.

Based on these design guidelines, it is estimated that Phase 1 of the development will generate an average day residential demand of 2.12 L/s while the commercial demand will be equivalent to 0.09 L/s and an overall demand of 2.21 L/s. The average day residential demand for Phase 2 will be 3.06 L/s with no commercial demands. The demand for Phase 2 was allocated such that 50% will be distributed from Hilson Avenue and 50% will be distributed from Byron Avenue.

For maximum daily demand, residential demands were multiplied by a factor of 2.5 times average day demand and commercial demands were multiplied by a factor of 1.5 times average day demand. **Table 3** provides a summary of the demand allocation for various scenarios (see **Figure 1-5** for location of proposed nodes).

Table 3: Population and demand projections for proposed development for Phase 1 and Phase 2.

Model Node	Building	People	Commercial Area (sq. ft.)	Demand		Total Demand		
				Residential (L/s)	Commercial (L/s)	AVDY (L/s)	MXDY (L/s)	PKHR (L/s)
J3	A	524	23015	2.12	0.09	2.21	5.44	11.91
J6	0.5B+0.5C+0.5D	377	0	1.53	0.00	1.53	3.82	8.40
J8	0.5B+0.5C+0.5D	377	0	1.53	0.00	1.53	3.82	8.40
					Total	3.74	9.26	20.31

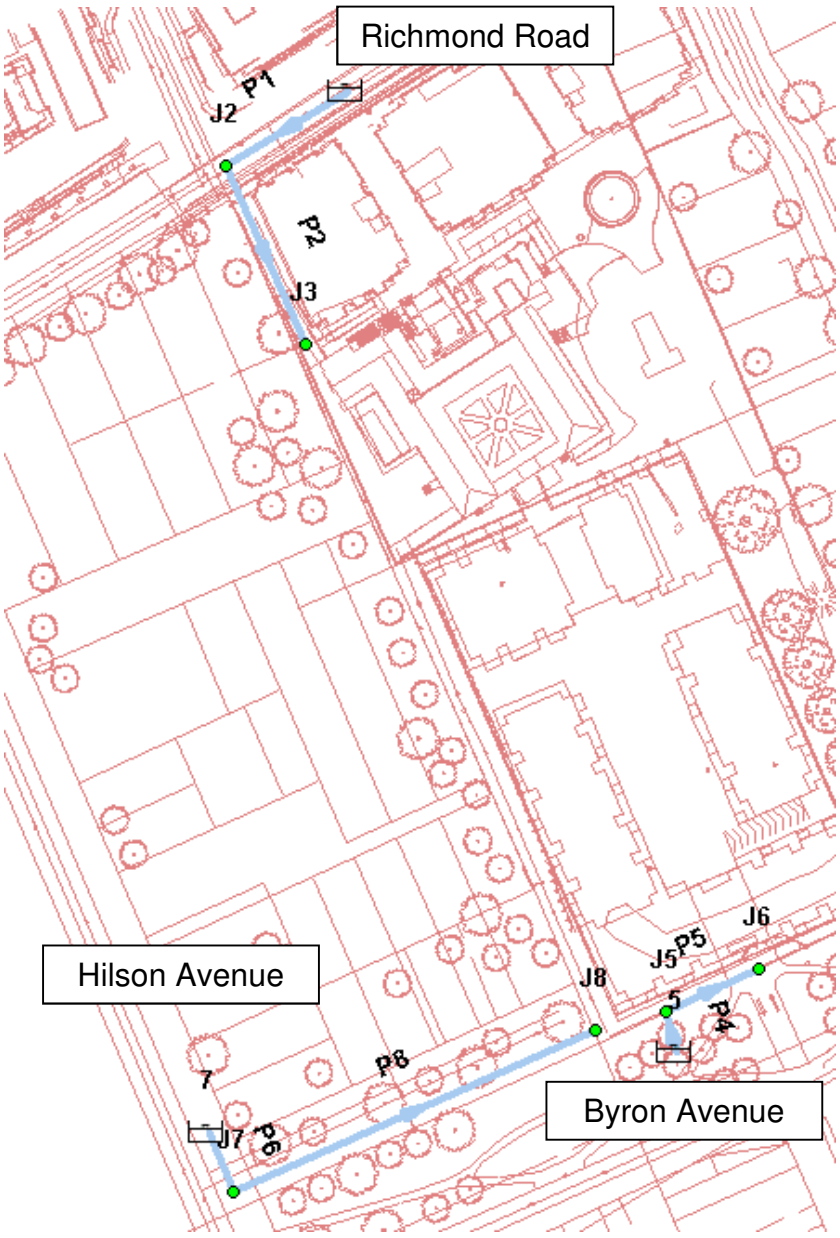
Phase 1
Phase 2

1.7 HYDRAULIC MODEL RESULTS

The software package used to carry out the analysis was H_2OMAP Water by MWHSoft. The model was tested under three different domestic demand conditions: average day (AVDY), peak hour (PKHR) and one emergency condition: maximum day plus fire (MXDY + FF).

Figure 1-5 provides the IDs of each of the proposed junctions and pipes inputted into the hydraulic model. These IDs are used to present the results in tabular format in the following sections.

Figure 1-5: Junction and Pipe IDs



1.7.1 Average Day

Table 4a and **Table 4b** present the model output results for the average day demand analysis. As shown, the typical operating pressures are anticipated to range between 427 kPa (62 psi) and 455 kPa (66 psi) based on the local ground elevations and pipe hydraulic conditions. The resulting pressures are within the allowable pressure range of 40 to 100 psi (275 kPa to 690 kPa) as recommended by the City of Ottawa's Water Distribution Design Guidelines.

Table 4a: Average Day Model Node Output Results

Node ID	Demand (L/s)	Elevation (m)	Head (m)	Pressure (psi)
J2	0.00	68	114	66
J3	2.21	69	114	65
J5	0.00	71	115	62
J6	1.53	71	115	62
J7	0.00	70	115	64
J8	1.53	71	115	63

Phase 1
Phase 2

Table 4b: Average Day Model Pipe Output Results

Pipe ID	From	To Node	Length	Diameter	Roughness	Flow (L/s)	Velocity (m/s)	Headloss	HL/1000
P1	1	J2	34.22	300	110	2.21	0.03	0.0	0.01
P2	J2	J3	45.97	250	110	2.21	0.05	0.0	0.02
P4	5	J5	10.01	300	110	1.53	0.02	0.0	0.00
P5	J5	J6	24.34	250	110	1.53	0.03	0.0	0.01
P6	7	J7	15.20	300	110	1.53	0.02	0.0	0.00
P8	J7	J8	93.77	250	110	1.53	0.03	0.0	0.01

1.7.2 Peak Hour

Table 5a and **Table 5b** present the model output results for the peak hour demand analysis. As shown in the results, typical operating pressures are anticipated within the range of 365 kPa (53 psi) to 400 kPa (58 psi) based on the local ground elevations and pipe hydraulic conditions. The resultant pressures are within the allowable pressure range of 40 to 100 psi (275 kPa to 690 kPa) as recommended by the City of Ottawa's Water Distribution Design Guidelines.

Table 5a: Peak Hour Model Node Output Results

Node ID	Demand (Lpm)	Elevation (m)	Head (m)	Pressure (psi)
J2	0.00	68	108	58
J3	11.91	69	108	56
J5	0.00	71	108	53
J6	8.40	71	108	53
J7	0.00	70	108	54
J8	8.40	71	108	53

Phase 1
Phase 2

Table 3b: Peak Hour Model Pipe Output Results

Pipe ID	From Node	To Node	Length (m)	Diameter (mm)	Roughness	Flow (L/s)	Velocity (m/s)	Headloss (m)	HL/1000 (m/km)
P1	1	J2	34.22	300	110	11.91	0.17	0.01	0.17
P2	J2	J3	45.97	250	110	11.91	0.24	0.02	0.41
P4	5	J5	10.01	300	110	8.40	0.12	0.00	0.09
P5	J5	J6	24.34	250	110	8.40	0.17	0.01	0.22
P6	7	J7	15.20	300	110	8.40	0.12	0.00	0.09
P8	J7	J8	93.77	250	110	8.40	0.17	0.02	0.22

1.7.3 Maximum Day + Fire Flow Results

The City of Ottawa's design guidelines for water distribution systems require a minimum pressure of 140 kPa (20 psi) to be maintained at all points in the distribution system under a condition of maximum day and fire flow demand.

Historically, the City of Ottawa has used a fire flow of 15,000 L/min (250 L/s) as a fire flow objective for mixed-use & high density residential development for sizing watermains. However as per the 2010 City of Ottawa Design Guidelines for Water Distribution Systems: "When calculating the fire flow requirements and affected pipe sizing, designers shall use the method developed by the Fire Underwriters Survey (FUS)."

In regards to high rise buildings, the FUS guidelines do not have a limitation with respect to a maximum number of floors (i.e. building height) in the calculation. Without a floor limitation, the FUS formula results in fire flow requirements that is much greater than the City's fire flow objective.

In developing FUS fire flow requirements for high rise buildings, it is recommended to consider the definition of a "*building"* per the building code. According to the Ontario Building Code Section 1.1.3.2:

"If portions of a *building* are completely separated by a vertical fire separation, that has a fire-resistance rating of at least 1h and that extends by a vertical fire separation that has a fire-resistance rating of at least 1 h and that extends through all storeys and service spaces of the separate portions, each separated portion may be considered to be a separate building for the purpose of determining building height if each separated portion is not more than three storeys in building height and is used only for residential occupancies, and the unobstructed path of travel for a fire fighter from the nearest street to one entrance to each separated portion is not more than 45m."

The fire flow calculated based on FUS and in accordance to OBC Section 1.1.3.2 (for "*building*" height i.e. 3 floors max with vertical fire separations) was determined to be 10,000 L/min and

12,000 L/min for Phase 1 and Phase 2, respectively. Sample calculations are included in **Section 2**.

It should be noted for comparison that the calculated FUS fire flows are approximately two times the maximum water supply requirements for sprinkler systems (5678 L/min) per the National Fire Protection Agency guideline NFPA 13.

A hydraulic analysis was carried out using the hydraulic model to determine the anticipated amount of flow that could be provided at each of the nodes in the proposed development under maximum day demands while still maintain a residual pressure of 140 kPa (20 psi). This was accomplished using a steady-state maximum day demand scenario along with the automated fire flow simulation feature of the software.

Table 6a shows the fire flow analysis according to the historical fire flow objective value of 15,000 L/min and **Table 6b** shows the fire flow analysis according to FUS and OBC fire separation. The results presented show that a fire flow of greater than 15,000 L/min is achievable while still maintaining a residual pressure greater than 140kPa (20psi), thereby satisfying both fire flow conditions. For details on FUS and OBC calculation methods see **Section 2**.

Table 6a: Maximum Day Fire Flow Results Based on the City of Ottawa Objective

Node ID	Static Demand (L/s)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)
J3	5.44	52	105	15,000	41
J6	3.82	50	106	15,000	45
J8	3.82	50	106	15,000	39

Phase 1 Phase 2

Table 6b: Maximum Day Fire Flow Results Based on the FUS and OBC fire separations

Node ID	Static Demand (L/s)	Static Pressure (psi)	Static Head (m)	Fire-Flow Demand (Lpm)	Residual Pressure (psi)
J3	5.44	52	105	10,000	47
J6	3.82	50	106	12,000	47
J8	3.82	50	106	12,000	39

1.8 SUMMARY OF FINDINGS

The proposed mixed-use development is located in an area of the City's water distribution system that has sufficient capacity to provide both the required domestic and emergency fire flows. Based on computer modeling results, the objective fire flow of 15,000 L/min and those based on FUS in accordance with OCB section 1.1.3.2 are achievable for this development using the alignment and sizing of the watermains shown on **Figure 1-3**.

The minimum pressure modeled **365kPa (53 psi)** is within the recommended design guidelines for minimum pressure and the maximum pressure modeled **455 kPa (66 psi)** does not exceed the maximum allowable pressure.

The high-rise buildings will experience additional pressure loss due to the height of the buildings for the nine-storey buildings and will therefore require additional pumping at the building to maintain minimum pressures to each unit.

2.0 Fire Flow Calculations

2.1 FIRE UNDERWRITER'S SURVEY (FUS)

According the FUS (1999), the required fire flow is calculated using the following equation:

$$Fire\ Flow = 220C\sqrt{A} \quad 2.1$$

Where:
F = required fire flow (L/min)
C = coefficient related to the type of construction
A= total floor area excluding the basement (m^2)

Fire flow can be reduced if the building consists of a sprinkler system and can be reduced **or** increased based on fire hazards of the building and separation between buildings. The calculated fire flow should not exceed 45,000 L/min nor be less than 2,000 L/min.

Although, the buildings are more than three storeys high, the following FUS fire flow calculations are in accordance to the OBC section 1.1.3.2. in which "each separated portion is not more than three *storeys in building height*…".

Figures 2-1, 2-2, 2-2, and **2-4** represent the fire flow calculations for buildings A, B, C, and D, respectively. Fire flow values shown are rounded to the nearest thousandth. In addition, all buildings were classified as ordinary construction and non-combustible for reduction/increases due to factors that affect burning.

Figure 2-1: FUS Fire Flow Calculations for Building A

FUS Fire Flow Calculations

Calculations Based on 1999 Publication "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey (FUS)

Stantec Project #: 160400864
Project Name: 114 Richmond Rd
Date: February 12, 2013
Data input by: Val Hoang
Fire Flow Calculation #: 1
Building Type/Description/Name: Bldg A

Notes: The proposed building is a 9 storey high rise

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (< 2 hrs)	0.7				
			Fire resistive construction (> 2 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, etc.)	1	Units	
			Townhouse - indicate # of units	3				
			Other (Comm, Ind, etc.)	1				
2.2	# of Storeys	Number of Floors/ Storeys in the Unit (do not include basement):			3	3	Storeys	
3	Enter Ground Floor Area of One Unit	Enter Ground Floor Area (A) of One Unit Only :			1,041	3,123	Area In Square Meters (m^2)	
		Measurement Units	Square Feet (ft^2)	0.09290304	Square Metres (m2)			
			Square Metres (m^2)	1				
			Hectares (ha)	10000				
4	Obtain Required Fire Flow without Reductions	Required Fire Flow(without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						12,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Non-combustible	-0.25	N/A	9,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Complete Automatic Sprinkler Protection	-0.3	Complete Automatic Sprinkler Protection	-0.3	N/A	-2,700
			None	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	3.1 to 10.0m	0.2	0.4	m	3,600
			East Side	30.1 to 45.0m	0.05			
			South Side	20.1 to 30.1m	0.1			
			West Side	30.1 to 45.0m	0.05			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						10,000
		Total Required Fire Flow (above) in L/s:						167
		Required Duration of Fire Flow (hrs)						2.00
		Required Volume of Fire Flow (m^3)						1,200

Figure 2-2: FUS Fire Flow Calculations for Building B

FUS Fire Flow Calculations

Calculations Based on 1999 Publication "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey (FUS)

Stantec Project #: 160400864
Project Name: 114 Richmond Rd
Date: February 12, 2013
Fire Flow Calculation #: 1
Building Type/Description/Name: Bldg B
Data input by: Val Hoang

Notes: The proposed building is a 9 storey high rise.

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	**Choose Frame Used for Construction of Unit**	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (< 2 hrs)	0.7				
			Fire resistive construction (> 2 hrs)	0.6				
		Floor Space Area						
2	**Choose Type of Housing (if TH, Enter Number of Units Per TH Block)**	Type of Housing	Single Family	1	Other (Comm, Ind, etc.)	1	Units	
			Townhouse - indicate # of units	3				
			Other (Comm, Ind, etc.)	1				
2.2	**# of Storeys**	Number of Floors/ Storeys in the Unit (do not include basement):			3	3	Storeys	
3	**Enter Ground Floor Area of One Unit**	Enter Ground Floor Area (A) of One Unit Only :			1,399	4,197	Area in Square Meters (m^2)	
		Measurement Units	Square Feet (ft^2)	0.09290304	Square Metres (m2)			
			Square Metres (m^2)	1				
			Hectares (ha)	10000				
4	**Obtain Required Fire Flow without Reductions**	Required Fire Flow(without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						**14,000**
5	**Apply Factors Affecting Burning**	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	**Choose Combustibility of Building Contents**	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Non-combustible	-0.25	N/A	**10,500**
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	**Choose Reduction Due to Presence of Sprinklers**	Sprinkler reduction	Complete Automatic Sprinkler Protection	-0.3	Complete Automatic Sprinkler Protection	-0.3	N/A	**-3,150**
			None	0				
5.3	**Choose Separation Distance Between Units**	Exposure Distance Between Units	North Side	10.1 to 20.0m	0.15	0.4	m	**4,200**
			East Side	20.1 to 30.1m	0.1			
			South Side	30.1 to 45.0m	0.05			
			West Side	20.1 to 30.1m	0.1			
6	**Obtain Required Fire Flow, Duration & Volume**	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**12,000**
		Total Required Fire Flow (above) in L/s:						**200**
		Required Duration of Fire Flow (hrs)						**2.50**
		Required Volume of Fire Flow (m^3)						**1,800**

Figure 2-3: FUS Fire Flow Calculations for Building C

FUS Fire Flow Calculations

Calculations Based on 1999 Publication "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey (FUS)

Stantec Project #: 160400864
Project Name: 114 Richmond Rd
Date: February 12, 2013
Fire Flow Calculation #: 1
Building Type/Description/Name: Bldg C
Data input by: Val Hoang

Notes: The proposed building is a 5 storey high rise.

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
1	Choose Frame Used for Construction of Unit	**Framing Material**						
		Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (< 2 hrs)	0.7				
			Fire resistive construction (> 2 hrs)	0.6				
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	**Floor Space Area**						
		Type of Housing	Single Family	1	Other (Comm, Ind, etc.)	1	Units	
			Townhouse - indicate # of units	3				
			Other (Comm, Ind, etc.)	1				
2.2	# of Storeys	Number of Floors/ Storeys in the Unit (do not include basement):			3	3	Storeys	
3	Enter Ground Floor Area of One Unit	Enter Ground Floor Area (A) of One Unit Only :			1,635	4,905	Area in Square Meters (m^2)	
		Measurement Units	Square Feet (ft^2)	0.09290304	Square Metres (m2)			
			Square Metres (m^2)	1				
			Hectares (ha)	10000				
4	Obtain Required Fire Flow without Reductions	Required Fire Flow(without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						15,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Non-combustible	-0.25	N/A	11,250
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Complete Automatic Sprinkler Protection	-0.3	Complete Automatic Sprinkler Protection	-0.3	N/A	-3,375
			None	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	30.1 to 45.0m	0.05	0.2	m	2,250
			East Side	45.1m or greater	0			
			South Side	10.1 to 20.0m	0.15			
			West Side	45.1m or greater	0			
6	Obtain Required Fire Flow, Duration & Volume	***Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:***						**10,000**
		Total Required Fire Flow (above) in L/s:						**167**
		Required Duration of Fire Flow (hrs)						**2.00**
		Required Volume of Fire Flow (m^3)						**1,200**

Figure 2-4: FUS Fire Flow Calculations for Building D

FUS Fire Flow Calculations

Calculations Based on 1999 Publication "*Water Supply for Public Fire Protection*" by Fire Underwriters' Survey (FUS)

Stantec Project #: 160400864
Project Name: 114 Richmond Rd
Date: February 12, 2013
Fire Flow Calculation #: 1
Building Type/Description/Name: Bldg D
Data input by: Val Hoang

Notes: The proposed building is a 9 storey high rise.

Table A: Fire Underwriters Survey Determination of Required Fire Flow - Long Method

Step	Task	Term	Options	Multiplier Associated with Option	Choose:	Value Used	Unit	Total Fire Flow (L/min)
		Framing Material						
1	Choose Frame Used for Construction of Unit	Coefficient related to type of construction (C)	Wood Frame	1.5	Ordinary construction	1	m	
			Ordinary construction	1				
			Non-combustible construction	0.8				
			Fire resistive construction (< 2 hrs)	0.7				
			Fire resistive construction (> 2 hrs)	0.6				
		Floor Space Area						
2	Choose Type of Housing (if TH, Enter Number of Units Per TH Block)	Type of Housing	Single Family	1	Other (Comm, Ind, etc.)	1	Units	
			Townhouse - indicate # of units	3				
			Other (Comm, Ind, etc.)	1				
2.2	# of Storeys	Number of Floors/ Storeys in the Unit (do not include basement):			3	3	Storeys	
3	Enter Ground Floor Area of One Unit	Enter Ground Floor Area (A) of One Unit Only :			1,732	5,196	Area in Square Meters (m^2)	
		Measurement Units	Square Feet (ft^2)	0.09290304	Square Metres (m2)			
			Square Metres (m^2)	1				
			Hectares (ha)	10000				
4	Obtain Required Fire Flow without Reductions	Required Fire Flow(without reductions or increases per FUS) (F = 220 * C * √A) Round to nearest 1000L/min						16,000
5	Apply Factors Affecting Burning	**Reductions/Increases Due to Factors Affecting Burning**						
5.1	Choose Combustibility of Building Contents	Occupancy content hazard reduction or surcharge	Non-combustible	-0.25	Non-combustible	-0.25	N/A	12,000
			Limited combustible	-0.15				
			Combustible	0				
			Free burning	0.15				
			Rapid burning	0.25				
5.2	Choose Reduction Due to Presence of Sprinklers	Sprinkler reduction	Complete Automatic Sprinkler Protection	-0.3	Complete Automatic Sprinkler Protection	-0.3	N/A	-3,600
			None	0				
5.3	Choose Separation Distance Between Units	Exposure Distance Between Units	North Side	30.1 to 45.0m	0.05	0.2	m	2,400
			East Side	45.1m or greater	0			
			South Side	30.1 to 45.0m	0.05			
			West Side	20.1 to 30.1m	0.1			
6	Obtain Required Fire Flow, Duration & Volume	*Total Required Fire Flow, rounded to nearest 1000 L/min, with max/min limits applied:*						11,000
		Total Required Fire Flow (above) in L/s:						183
		Required Duration of Fire Flow (hrs)						2.25
		Required Volume of Fire Flow (m^3)						1,485

Stantec

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160400864
Project Name: Q-West Phase 2 - Building B
Date: 5/10/2022
Fire Flow Calculation #: 1
Description: 9-Storey Residential

Notes: Separated from existing 3 storey building B portions via firewall

Step	Task	Notes								Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type II - Noncombustible Construction / Type IV-A - Mass Timber Construction								0.8	-
2	Determine Effective Floor Area	Sum of Two Largest Floors + 50% of Six Additional Floors					Vertical Openings Protected?			NO	-
		1782	1782	1782	1680	1680	1205	1205	1156	7918	-
3	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min								-	14000
4	Determine Occupancy Charge	Limited Combustible								-15%	11900
5	Determine Sprinkler Reduction	Conforms to NFPA 13								-30%	-4760
		Standard Water Supply								-10%	
		Not Fully Supervised or N/A								0%	
		% Coverage of Sprinkler System								100%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	Firewall / Sprinklered ?		-	-
		North	10.1 to 20	51.7	3	> 100	Type I-II - Unprotected Openings	YES		0%	1190
		East	20.1 to 30	12.7	2	21-49	Type V	NO		2%	
		South	3.1 to 10	62	4	> 100	Type I-II - Unprotected Openings	YES		0%	
		West	10.1 to 20	36	2	61-80	Type III-IV - Unprotected Openings	NO		8%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min									8000
		Total Required Fire Flow in L/s									133.3
		Required Duration of Fire Flow (hrs)									2.00
		Required Volume of Fire Flow (m^3)									960

Stantec

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160400864
Project Name: Q-West Phase 2 - Building C
Date: 5/10/2022
Fire Flow Calculation #: 2
Description: 4-Storey Residential

Notes:

Step	Task	Notes							Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type III - Ordinary Construction / Type IV-C - Mass Timber Construction							1	-
2	Determine Effective Floor Area	Sum of All Floor Areas							-	-
		1780	1780	1780	1780				7120	-
3	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min							-	19000
4	Determine Occupancy Charge	Limited Combustible							-15%	16150
5	Determine Sprinkler Reduction	Conforms to NFPA 13							-30%	-6460
		Standard Water Supply							-10%	
		Not Fully Supervised or N/A							0%	
		% Coverage of Sprinkler System							100%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	Firewall / Sprinklered ?	-	-
		North	10.1 to 20	23	4	81-100	Type I-II - Unprotected Openings	YES	0%	0
		East	> 30	0	0	0-20	Type V	NO	0%	
		South	> 30	0	0	0-20	Type V	NO	0%	
		West	10.1 to 20	82	4	> 100	Type I-II - Unprotected Openings	YES	0%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min								10000
		Total Required Fire Flow in L/s								166.7
		Required Duration of Fire Flow (hrs)								2.00
		Required Volume of Fire Flow (m^3)								1200

Stantec

FUS Fire Flow Calculation Sheet - 2020 FUS Guidelines

Stantec Project #: 160400864
Project Name: Q-West Phase 2 - Building D
Date: 5/10/2022
Fire Flow Calculation #: 3
Description: 9-Storey Residential

Notes:

Step	Task	Notes								Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Type II - Noncombustible Construction / Type IV-A - Mass Timber Construction								0.8	-
2	Determine Effective Floor Area	Sum of Two Largest Floors + 50% of Six Additional Floors					Vertical Openings Protected?			NO	-
		2025	2025	2025	1639	1639	1308	1308	1308	8663.5	-
3	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min								-	15000
4	Determine Occupancy Charge	Limited Combustible								-15%	12750
5	Determine Sprinkler Reduction	Conforms to NFPA 13								-30%	-5100
		Standard Water Supply								-10%	
		Not Fully Supervised or N/A								0%	
		% Coverage of Sprinkler System								100%	
6	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall		Firewall / Sprinklered ?	-	-
		North	3.1 to 10	62	4	> 100	Type I-II - Unprotected Openings		YES	0%	1913
		East	10.1 to 20	82	4	> 100	Type I-II - Unprotected Openings		YES	0%	
		South	> 30	0	0	0-20	Type V		NO	0%	
		West	3.1 to 10	10	2	0-20	Type V		NO	15%	
7	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min									10000
		Total Required Fire Flow in L/s									166.7
		Required Duration of Fire Flow (hrs)									2.00
		Required Volume of Fire Flow (m^3)									1200

Appendix B: SANITARY SEWER

B.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION: **Q-WEST PHASE 2**

DATE: 5/10/2022
REVISION: 2
DESIGNED BY: DT
CHECKED BY: MJS

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160400864

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	280 l/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	28,000 l/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 l/ha/day	MANNINGS n	0.013
PEAKING FACTOR (ICI >20%):	1.5	INDUSTRIAL (LIGHT)	35,000 l/ha/day	BEDDING CLASS	B
PERSONS / SINGLE	1.4	INSTITUTIONAL	28,000 l/ha/day	MINIMUM COVER	2.50 m
PERSONS / TOWNHOME	2.1	INFILTRATION	0.33 l/s/Ha	HARMON CORRECTION FACTOR	0.8
PERSONS / APARTMENT	1.8				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE							
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA	APARTMENT UNITS 1 BED	2 BED	STD.	POP.	CUMULATIVE AREA	POP.	PEAK FACT.	PEAK FLOW	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	PEAK FLOW	TOTAL AREA	ACCU. AREA	INFILT. FLOW	FLOW	LENGTH	DIA	MATERIAL	CLASS	SLOPE	CAP. (FULL)	CAP. V PEAK FLOW	VEL. (FULL)	VEL. (ACT.)
			(ha)					(ha)			(l/s)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(l/s)	(ha)	(ha)	(l/s)	(l/s)	(m)	(mm)			(%)	(l/s)	(%)	(m/s)	(m/s)
SITE	STUB	1A	0.00	93	94	603	1413	0.00	1413	3.16	14.5	0.21	0.21	0.00	0.00	0.00	0.00	0.00	0.00	2.01	2.01	0.1	2.22	2.22	0.7	15.3	3.5	375	PVC	SDR 35	1.00	162.3	**9.41%**	1.54	0.80
	1A	1	0.00	0	0	0	0	0.00	1413	3.16	14.5	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.01	0.1	0.00	2.22	0.7	15.3	34.2	375	PVC	SDR 35	1.00	162.3	**9.41%**	1.54	0.80
																												375							

B.2 BACKGROUND REPORT EXCERPTS (SANITARY SEWER)

3.0 Water Servicing

A Potable Water Servicing Study was prepared by Stantec Consulting on February 12, 2013 and revised on April 10, 2013 to reflect servicing changes. A 250mm watermain connection is proposed within Richmond Road to service phase 1 of the development. The remaining development area will be serviced with a 250mm watermain connection in Hilson Avenue and another 250mm connection in Byron Avenue. The report outlines estimated water demands and residual pressures under average day, maximum day and peak hour demand conditions. The report indicates that minimum pressures are maintained during all demand scenarios. Fire flow calculations as per the Fire Underwriters Survey (FUS) indicate a required fire flow of 250L/s. The hydraulic analysis indicated that the proposed water servicing could provide the required fire flow while meeting minimum pressure requirements of 20psi (140kPa). Due to additional losses in the high rise buildings, additional pumping will be required at these buildings to maintain minimum pressures to each unit.For the detailed report see **Appendix D**.

4.0 Wastewater Servicing

As illustrated on **Drawing SP-1**, a 250mm diameter sanitary sewer exists within Richmond Road which flows easterly towards the intersection of Richmond Road and Leighton Terrace. A 450mm diameter sanitary sewer exists at the intersection of Patricia Avenue and Richmond Road which runs northerly down Patricia Avenue. This existing sanitary sewer is a 450mm diameter pipe with a slope of minimum 1%. Based upon the size and slope of the existing pipe it is determined that this sewer has a flow capacity of 300 l/s. The existing sanitary service lateral from the existing building within the 114 Richmond Road property is currently serviced through this outlet at Patricia Avenue and will be removed.

It is proposed that the development will be constructed in 3 separate phases. The first Phase of the development will consist of construction of three - nine storey mixed use buildings and renovations to the existing 3 storey building. The second phase will consist of construction of 5 buildings consisting of residential and mixed use. The third phase will consist of 1 building with a mix of residential and commercial use. The entire site will be serviced through one connection onto Richmond Road. Residential unit counts and commercial areas were determined from the October 22, 2012 site plan and stats prepared by Roderick Lahey Architects in **Appendix A** of this report.

It is proposed to service the entire development through a new 375mm diameter sanitary sewer connection to Richmond Road. The servicing for the first phase will be connected within the building mechanical room via the 375mm diameter pipe, as illustrated in **Drawing SP-2**. The transition between PVC material and cast iron will occur within the building and will be designed

by the mechanical engineer. The cast iron sewer will continue southerly within the Phase 1 building servicing corridor and exit the foundation wall. This 375mm diameter sanitary sewer will be extended within a common trench, with the storm and utilities, along the westerly property edge to service the Phase 2 and 3 developments. The 375mm diameter sewer will be constructed between two existing manholes in Richmond Road, as indicated on Drawing SP-1. It is proposed to install a 1200mm diameter manhole within the Richmond road right of way which will connect to the existing 450mm diameter sanitary through the existing manhole located at the intersection of Patricia Avenue and Richmond Road. As there is insufficient room for the placement of a monitoring manhole for phase 1 commercial, a monitoring port will be placed within the outlet sewer pipe for the commercial areas.

A sanitary drainage area plan and sanitary sewer design sheets were prepared by Novatech Engineering Consultants on behalf of the City of Ottawa in May 2005, which identified the 114 Richmond road property tributary to the Patricia Avenue sanitary sewer. (See **Appendix C**.)

The calculations outlined below represent the flows anticipated for each phase of this development.

Phase 1

The City of Ottawa's Sewer Design Guidelines for commercial development indicate the allocation of capacity in the receiving sanitary sewer required.

Total Site Area = 0.829ha
Peaking Factor Commercial 1.5
Commercial Average Peak Flow = 50000 L/gross ha/d
Commercial Operational Flow = 17000 L/gross ha/d
Infiltration Rate = 0.28 L/s/ha
Total Infiltration Flow = (Area x infiltration rate) = 0.23 L/s
Total Flow = (Peak Flow x Site Area /86400) x Peak Factor + Infiltration Flow
Total Flow as per guidelines = 0.95 L/s.

By implementing the City of Ottawa's sewer design guidelines the following sanitary flows are calculated for the proposed condominium development.

Residential (Apartment)	Population	= 276 units x 1.8 persons/unit = 497 people
		= 497 x 350 L/c/d
		≈ 2.01 L/s average residential sanitary flow using a peaking factor of 4;
		≈ 8.05 L/s

Total peak sewage flow for commercial and residential Phase 1 ≈ 9.00 L/s

Phase 2

The City of Ottawa's Sewer Design Guidelines for commercial development indicate the allocation of capacity in the receiving sanitary sewer required.

Total Commercial Area = 0.49ha
Infiltration area = 0.45ha
Peaking Factor Commercial 1.5
Commercial Average Peak Flow = 50000 L/gross ha/d
Commercial Operational Flow = 17000 L/gross ha/d
Infiltration Rate = 0.28 L/s/ha
Total Infiltration Flow = (Area x infiltration rate) = 0.13 L/s
Total Flow = (Peak Flow x Site Area /86400) x Peak Factor + Infiltration Flow
Total Flow as per guidelines = 0.56 L/s.

By implementing the City of Ottawa's sewer design guidelines the following sanitary flows are calculated for the proposed condominium development.

Residential (Apartment)

1 Bedroom:

Population 282 units x 1.4 person/unit
= 394.8 persons
(394.8 persons x 350L/p/d)/86400s/day
= 1.60 L/s average residential sanitary flow
using a peaking factor of 4;
= 6.40 L/s

2 Bedroom:

Population 138 units x 2.1 person/unit
= 289.8
(193.2 persons x 350L/p/d)/86400s/day
= 1.17
using a peaking factor of 4;
= 4.70 L/s

Total peak sewage flow for commercial and residential Phase 2 ≈ **11.66L/s**

Phase 3

The City of Ottawa's Sewer Design Guidelines for commercial development indicate the allocation of capacity in the receiving sanitary sewer required.

Total Commercial Area = 0.26ha
Infiltration area = 0.26ha
Peaking Factor Commercial 1.5
Commercial Average Peak Flow = 50000 L/gross ha/d
Commercial Operational Flow = 17000 L/gross ha/d
Infiltration Rate = 0.28 L/s/ha
Total Infiltration Flow = (Area x infiltration rate) = 0.07 L/s
Total Flow = (Peak Flow x Site Area /86400) x Peak Factor + Infiltration Flow
Total Flow as per guidelines = 0.30 L/s.

By implementing the City of Ottawa's sewer design guidelines the following sanitary flows are calculated for the proposed condominium development.

Residential (Apartment)

1 Bedroom:

Population 24 units x 1.4 person/unit
= 33.6 persons
(33.6 persons x 350L/p/d)/86400s/day
= 0.14 L/s average residential sanitary flow
using a peaking factor of 4;
= 0.54 L/s

Total peak sewage flow for commercial and residential Phase 3 ≈ **0.84L/s**

Total anticipated peak flow from phase 1, 2 and 3 is approximately **21.5L/s**

A review of the downstream sanitary sewers was completed from the intersection of Patricia Avenue and Richmond Road to the connection to the West Nepean Collector located at the intersection of Island Park Drive and Scott Street (approx 320 metres).

Included in **Appendix C** is a sanitary sewer design sheet that was prepared for the City of Ottawa in 2005 during the reconstruction of Richmond Road. In the design sheet associated sanitary drainage area plan, the proposed site is denoted as area B3.

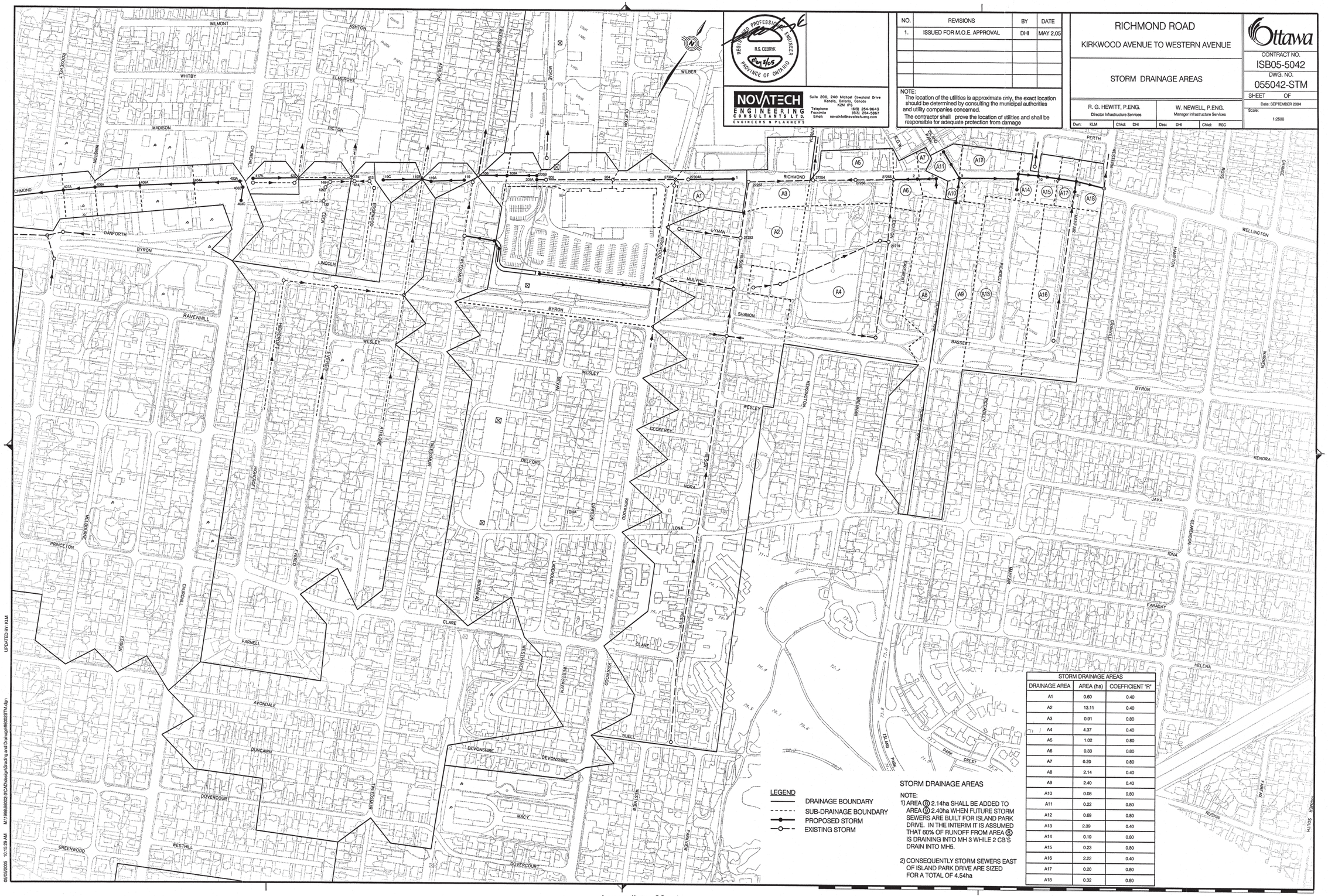
This information was expanded to include additional sanitary areas on Patricia Avenue to the collector sewer. The estimated sewage flows into the existing manhole at the intersection of

Patricia Avenue and Richmond Road are 73 L/sec (existing) + 23 L/sec (114 Richmond Rd). Additional commercial flows and residential flows of 17 L/sec are accumulated along Patricia Avenue.

An existing 450mm & 750mm sanitary sewer is present on Patricia Avenue, with a slope of between 1% and 2%. Based on this the minimum capacity for a 450mm sanitary sewer at 1.0% is 300 L/sec.

The total estimated sewage flows along Patricia Avenue including the new flows from the development of 114 Richmond Road are 111 L/sec. As the capacity of the existing 450mm sanitary sewer is approximately 300 L/sec the receiving sanitary sewer has adequate capacity to convey the necessary flow generated as a result to the proposed development.

Refer to **Appendix C** of this report for sanitary sewer design sheet and drainage areas indicating downstream flows within the 450mm diameter at Patricia Avenue indicating capacity within the receiving sewer for the 114 Richmond Road Development.



REGISTERED PROFESSIONAL ENGINEER
R.S. CEBRYK
PROVINCE OF ONTARIO

NOVATECH ENGINEERING CONSULTANTS LTD.
ENGINEERS & PLANNERS

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Kanata, Ontario, Canada
K2M 1P6
Telephone (613) 254-9643
Facsimile (613) 254-5867
Email: novatech@novatech-eng.com

NO.	REVISIONS	BY	DATE
1.	ISSUED FOR M.O.E. APPROVAL	DHI	MAY 2,05

NOTE:
The location of the utilities is approximate only, the exact location should be determined by consulting the municipal authorities and utility companies concerned.
The contractor shall prove the location of utilities and shall be responsible for adequate protection from damage

RICHMOND ROAD

KIRKWOOD AVENUE TO WESTERN AVENUE

STORM DRAINAGE AREAS

Ottawa

CONTRACT NO.
ISB05-5042
DWG. NO.
055042-STM
SHEET OF
Date: SEPTEMBER 2004
Scale:
1:2500

R. G. HEWITT, P.ENG.
Director Infrastructure Services

W. NEWELL, P.ENG.
Manager Infrastructure Services

Dwn: KLM | Chkd: DHI | Des: DHI | Chkd: RSC

UPDATED BY: KLM
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LEGEND
- DRAINAGE BOUNDARY
- SUB-DRAINAGE BOUNDARY
- PROPOSED STORM
- EXISTING STORM

STORM DRAINAGE AREAS

NOTE:
1) AREA (A) 2.14ha SHALL BE ADDED TO AREA (A) 2.40ha WHEN FUTURE STORM SEWERS ARE BUILT FOR ISLAND PARK DRIVE. IN THE INTERIM IT IS ASSUMED THAT 60% OF RUNOFF FROM AREA (A) IS DRAINING INTO MH 3 WHILE 2 CB'S DRAIN INTO MH5.

2) CONSEQUENTLY STORM SEWERS EAST OF ISLAND PARK DRIVE ARE SIZED FOR A TOTAL OF 4.54ha

STORM DRAINAGE AREAS

DRAINAGE AREA	AREA (ha)	COEFFICIENT "R"
A1	0.60	0.40
A2	13.11	0.40
A3	0.91	0.80
A4	4.37	0.40
A5	1.02	0.80
A6	0.33	0.80
A7	0.20	0.80
A8	2.14	0.40
A9	2.40	0.40
A10	0.08	0.80
A11	0.22	0.80
A12	0.69	0.80
A13	2.39	0.40
A14	0.19	0.80
A15	0.23	0.80
A16	2.22	0.40
A17	0.20	0.80
A18	0.32	0.80

98002STM.dgn 05/05/2005 10:15:29 AM

STORM SEWER DESIGN SHEET

DESIGNED BY : DHI
CHECKED BY : RSC

PROJECT: Richmond Road
DEVELOPER: City of Ottawa

DATE: 2-May-05
REVISION:

LOCATION			AREA (ha)			INDIV	ACCUM	TIME OF	RAINFALL	PEAK FLOW	PROPOSED SEWER							
STREET	FROM M.H.	TO M.H.	R= 0.40	R = 0.60	R= 0.80	2.78 AR	2.78 AR	CONC (min)	INTENSITY (mm/hr)	Q (l/s)	TYPE OF PIPE	PIPE SIZE (mm)	PIPE ID (mm)	GRADE %	LENGTH (m)	CAPACITY (L/s)	FULL FLOW VELOCITY	TIME OF FLOW (min)
Richmond Road	1	27304 A	0.600			0.67	0.67	10.00	122.14	81.5	DR 35	300	299	1.47	71.5	116.6	1.66	0.72
Richmond Road (sized for current conditions)	3	2	1.280		0.200	1.87	1.87	10.00	122.14	228.3	CONC	525	533	0.30	27.5	245.2	1.10	0.42
Richmond Road	2	27255			0.330	0.73	2.60	10.42	119.61	311.2	CONC	525	533	0.50	32.7	316.6	1.42	0.38
Leighton Terrace	*27219*	*27255*	*4.370*			*4.86*	*4.86*	*16.50*	*79.00*	*383.9*	*CONC*	*525*	*533*	*1.62*	*75.0*	*569.9*	*2.55*	*0.49*
Richmond Road	*27255*	*27254*			*1.020*	*2.27*	*9.00*	*16.50*	*92.50*	*832.1*	*CONC*	*600*	*610*	*0.80*	*128.4*	*574.9*	*1.96*	*1.09*
Hilson Avenue	*27252*	*27253*	*13.110*			*14.58*	*14.58*	*25.00*	*60.90*	*887.8*	*CONC*	*1050*	*1067*	*0.57*	*85.0*	*2151.9*	*2.41*	*0.59*
Richmond Road	*27253*	*27254*			*0.910*	*2.02*	*16.60*	*25.00*	*71.22*	*1182.5*	*CONC*	*1050*	*1067*	*0.93*	*93.0*	*2748.7*	*3.07*	*0.50*
Patricia Avenue	*27254*	*EXIST*			*0.000*	*0.00*	*25.60*	*25.50*	*60.10*	*2192.5*	*CONC*	*900*	*914*	*1.24*	*110.0*	*2100.6*	*3.20*	*0.57*
Island Park Drive (Sized for future conditions)	4	5	4.540		0.080	5.23	5.23	24.00	73.15	382.3	CONC	525	533	0.90	35.0	424.8	1.90	0.31
Island Park Drive	6	5			0.220	0.49	0.49	10.00	122.14	59.8	DR 35	300	299	0.50	34.0	68.0	0.97	0.59
Richmond Road	5	7			0.690	1.53	7.25	24.31	72.55	526.0	CONC	675	685	0.45	94.0	586.4	1.59	0.98
Picadilly Avenue	8	7	2.390			2.66	2.66	16.50	79.00	210.0	DR 35	450	448	0.60	11.0	218.1	1.38	0.13
Richmond Road	7	9				0.00	9.91	25.29	70.68	700.3	CONC	750	762	0.60	5.0	899.6	1.97	0.04
	9	10			0.190	0.42	10.33	25.33	70.61	729.4	CONC	750	762	0.60	28.0	899.6	1.97	0.24
	10	11			0.230	0.51	10.84	25.57	70.17	760.8	CONC	750	762	0.60	34.0	899.6	1.97	0.29
	11	12			0.200	0.44	11.29	25.86	69.66	786.2	CONC	750	762	0.60	27.0	899.6	1.97	0.23
Mayfair Avenue	*EXIST*	13	*2.220*			*2.47*	*2.47*	*16.50*	*79.00*	*195.0*	*DR 35*	*450*	*448*	*1.60*	*53.0*	*356.1*	*2.26*	*0.39*
Mayfair Avenue	13	12				0.00	0.00	16.50	79.00	0.0	DR 35	450	448	1.60	10.0	356.1	2.26	0.07
Richmond Road	12	EXIST			0.32	0.71	12.00	26.09	69.25	830.9	CONC	900	914	0.60	40.0	1461.2	2.23	0.30
Western Avenue	*EXIST*	*EXIST*			*0.000*	*0.00*	*12.00*	26.38	*58.77*	*705.2*	*CONC*	*900*	*914*	*0.50*	*16.0*	*1333.9*	*2.03*	*0.13*

Q = 2.78*A*I*R
Intensity / Duration Curve = 10 years
Inlet Time = 10 min. (Minimum)
Manning's Coefficient = 0.013

Italic Text = Existing

Grey Tone = Under Sized Sewer

NOTE: 10 years storm is used for Richmond Road and 5 year storm for Local Streets

LICENSED PROFESSIONAL ENGINEER
R. S. CEBRYK
May 3/05
PROVINCE OF ONTARIO

Appendix C : STORM SEWER

C.1 STORM SEWER DESIGN SHEET

Stantec

Q-WEST PHASE 2

DATE: 2022-05-04
REVISION: 2
DESIGNED BY: DT
CHECKED BY: MJS

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160400864

DESIGN PARAMETERS

$I = a / (t+b)^c$ (As per City of Ottawa Guidelines, 2012)

	1:2 yr	1:5 yr	1:10 yr	1:100 yr
a =	732.951	998.071	1174.184	1735.688
b =	6.199	6.053	6.014	6.014
c =	0.810	0.814	0.816	0.820

MANNING'S n = 0.013
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min
BEDDING CLASS = B

LOCATION			DRAINAGE AREA																				PIPE SELECTION											
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
A2, EXT1	501	BLDG	0.00	0.30	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.000	0.000	0.188	0.188	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	54.3	6.8	375	375	CIRCULAR	PVC	-	1.00	164.8	**32.92%**	1.56	1.17	0.10
																				10.10																		
A4	500	109	0.00	0.06	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.000	0.000	0.053	0.053	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	15.3	12.7	200	200	CIRCULAR	PVC	-	1.00	33.3	**45.79%**	1.05	0.87	0.24
A1, EXT2	109	107	0.00	0.48	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.000	0.000	0.208	0.260	0.000	0.000	0.000	0.000	10.24	75.88	102.93	120.65	176.37	0.0	0.0	74.4	64.7	375	375	CIRCULAR	PVC	-	1.00	164.8	**45.16%**	1.56	1.30	0.83
																				11.17									3000	1500									
CISTERN, B1, B2, C, D1, D3, D5	2A	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	70.0	70.0	70.0	34.2	375	375	CIRCULAR	PVC	-	1.00	164.8	**42.47%**	1.56	1.27	0.45
ROOF A	2	MAIN	0.00	0.00	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.45	75.13	101.88	119.42	174.56	9.2	79.2	79.2	64.0	375	375	CIRCULAR	PVC	-	0.50	116.6	**67.95%**	1.11	1.03	1.03
																				11.48									600	600									

C.2 MODIFIED RATIONAL METHOD CALCULATIONS

Stormwater Management Calculations

File No: **160400864**
Project: **Q-WEST PHASE 2**
Date: **10-May-22**

SWM Approach:
Post-development to Pre-development flows

Post-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table

Catchment Type	Sub-catchment Area ID / Description		Area (ha) "A"		Runoff Coefficient "C"	"A x C"		Overall Runoff Coefficient
Controlled - Tributary	COURT, B3-6, A2, D2, D4	Hard	0.505		0.9	0.454		
		Soft	0.149		0.2	0.030		
		Subtotal		0.654			0.48396	0.740
Controlled - Tributary	A4	Hard	0.058		0.9	0.052		
		Soft	0.004		0.2	0.001		
		Subtotal		0.062			0.0527	0.850
Controlled - Tributary	A1, A3, EXT2	Hard	0.562		0.9	0.506		
		Soft	0.441		0.2	0.088		
		Subtotal		1.003			0.593776	0.592
Uncontrolled - Non-Tributary	UNC2	Hard	0.035		0.9	0.032		
		Soft	0.021		0.2	0.004		
		Subtotal		0.056			0.03584	0.640
Uncontrolled - Non-Tributary	UNC1	Hard	0.077		0.9	0.069		
		Soft	0.013		0.2	0.003		
		Subtotal		0.09			0.072	0.800
Roof	A	Hard	0.250		0.9	0.225		
		Soft	0.000		0.2	0.000		
		Subtotal		0.25			0.225	0.900
Roof	D5	Hard	0.039		0.9	0.035		
		Soft	0.000		0.2	0.000		
		Subtotal		0.039			0.0351	0.900
Roof	D3	Hard	0.033		0.9	0.030		
		Soft	0.000		0.2	0.000		
		Subtotal		0.033			0.0297	0.900
Roof	D1	Hard	0.133		0.9	0.120		
		Soft	0.000		0.2	0.000		
		Subtotal		0.133			0.1197	0.900
Roof	C	Hard	0.178		0.9	0.160		
		Soft	0.000		0.2	0.000		
		Subtotal		0.178			0.1602	0.900
Roof	B2	Hard	0.056		0.9	0.050		
		Soft	0.000		0.2	0.000		
		Subtotal		0.056			0.0504	0.900
Roof	B1	Hard	0.059		0.9	0.053		
		Soft	0.000		0.2	0.000		
		Subtotal		0.059			0.0531	0.900
Total				**2.613**			**1.911**	
Overall Runoff Coefficient= C:								**0.73**

Total Roof Areas	**0.748 ha**
Total Tributary Surface Areas (Controlled and Uncontrolled)	**1.719 ha**
Total Tributary Area to Outlet	**2.467 ha**
Total Uncontrolled Areas (Non-Tributary)	**0.146 ha**
Total Site	**2.613 ha**

Stormwater Management Calculations

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

5 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	998.071
b =	6.053
c =	0.814

t (min)	I (mm/hr)
5	141.18
10	104.19
15	83.56
20	70.25
25	60.90
30	53.93
35	48.52
40	44.18
45	40.63
50	37.65
55	35.12
60	32.94

5 YEAR Predevelopment Target Release from Portion of Site

Subdrainage Area: Predevelopment Tributary Area to Outlet
Area (ha): 2.6100
C: 0.45

Typical Time of Concentration

tc (min)	I (5 yr) (mm/hr)	Qtarget (L/s)
23.8	62.88	**205**

5 YEAR Modified Rational Method for Entire Site

Subdrainage Area: COURT, B3-6, A2, D2, D4 — Controlled - Tributary
Area (ha): 0.65
C: 0.74

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	140.2	50.0	90.2	**54.1**
20	70.25	94.5	50.0	44.5	53.4
30	53.93	72.6	50.0	22.6	40.6
40	44.18	59.4	50.0	9.4	22.7
50	37.65	50.7	50.0	0.7	2.0
60	32.94	44.3	44.3	0.0	0.0
70	29.37	39.5	39.5	0.0	0.0
80	26.56	35.7	35.7	0.0	0.0
90	24.29	32.7	32.7	0.0	0.0
100	22.41	30.1	30.1	0.0	0.0
110	20.82	28.0	28.0	0.0	0.0
120	19.47	26.2	26.2	0.0	0.0

Storage: Building Cistern

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Level	-	-	50.0	54.1	190.0	OK

Subdrainage Area: A4 — Controlled - Tributary
Area (ha): 0.06
C: 0.85

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	15.3	15.3	0.0	**0.0**
20	70.25	10.3	10.3	0.0	**0.0**
30	53.93	7.9	7.9	0.0	**0.0**
40	44.18	6.5	6.5	0.0	**0.0**
50	37.65	5.5	5.5	0.0	**0.0**
60	32.94	4.8	4.8	0.0	**0.0**
70	29.37	4.3	4.3	0.0	**0.0**
80	26.56	3.9	3.9	0.0	**0.0**
90	24.29	3.6	3.6	0.0	**0.0**
100	22.41	3.3	3.3	0.0	**0.0**
110	20.82	3.1	3.1	0.0	**0.0**
120	19.47	2.9	2.9	0.0	**0.0**

Storage: Surface Storage Above CB

Orifice Equation: $= CdA(2gh)^{0.5}$ Where C = 0.572

Orifice Diameter:	95.00	mm
Invert Elevation	66.59	m
T/G Elevation	67.97	m
Max Ponding Depth	0.00	m
Downstream W/L	65.97	m

CB Storage 0.50

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Level	67.97	1.38	21.1	0.0	0.5	OK

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

100 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	1735.688
b =	6.014
c =	0.820

t (min)	I (mm/hr)
5	242.70
10	178.56
15	142.89
20	119.95
25	103.85
30	91.87
35	82.58
40	75.15
45	69.05
50	63.95
55	59.62
60	55.89

100 YEAR Predevelopment Target Release from Portion of Site

Subdrainage Area: Predevelopment Tributary Area to Outlet
Area (ha): 2.6100
C: 0.45

Estimated Time of Concentration after Development

tc (min)	I (100 yr) (mm/hr)	Q100yr (L/s)
23.8	62.88	**205**

100 YEAR Modified Rational Method for Entire Site

Subdrainage Area: COURT, B3-6, A2, D2, D4 — Controlled - Tributary
Area (ha): 0.65
C: 0.93

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	300.3	50.0	250.3	150.2
20	119.95	201.7	50.0	151.7	182.1
30	91.87	154.5	50.0	104.5	**188.1**
40	75.15	126.4	50.0	76.4	183.3
50	63.95	107.6	50.0	57.6	172.7
60	55.89	94.0	50.0	44.0	158.4
70	49.79	83.7	50.0	33.7	141.7
80	44.99	75.7	50.0	25.7	123.2
90	41.11	69.1	50.0	19.1	103.3
100	37.90	63.7	50.0	13.7	82.5
110	35.20	59.2	50.0	9.2	60.7
120	32.89	55.3	50.0	5.3	38.3

Storage: Building Cistern

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Level	-	-	50.0	188.1	190.0	OK

Subdrainage Area: A4 — Controlled - Tributary
Area (ha): 0.06
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	30.8	19.6	11.2	**6.7**
20	119.95	20.7	19.6	1.1	1.3
30	91.87	15.8	15.8	0.0	0.0
40	75.15	13.0	13.0	0.0	0.0
50	63.95	11.0	11.0	0.0	0.0
60	55.89	9.6	9.6	0.0	0.0
70	49.79	8.6	8.6	0.0	0.0
80	44.99	7.8	7.8	0.0	0.0
90	41.11	7.1	7.1	0.0	0.0
100	37.90	6.5	6.5	0.0	0.0
110	35.20	6.1	6.1	0.0	0.0
120	32.89	5.7	5.7	0.0	0.0

Storage: Surface Storage Above CB

Orifice Equation: $Q = CdA(2gh)^{0.5}$ Where C = 0.572

Orifice Diameter:	95.00	mm
Invert Elevation	66.59	m
T/G Elevation	67.97	m
Max Ponding Depth	0.20	m
Downstream W/L	66.98	m

Surface Storage 6.50
CB Storage 0.50

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Level	68.17	1.19	19.6	6.7	7.0	OK

Stormwater Management Calculations

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

Subdrainage Area: A1, A3, EXT2 — Controlled - Tributary
Area (ha): 1.00 — *Includes peak runoff from Area A4.
C: 0.59

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	187.3	29.1	158.1	94.9
20	70.25	126.3	29.1	97.1	116.5
30	53.93	96.9	29.1	67.8	**122.0**
40	44.18	79.4	29.1	50.3	120.7
50	37.65	67.7	29.1	38.5	115.6
60	32.94	59.2	29.1	30.1	108.3
70	29.37	52.8	29.1	23.7	99.3
80	26.56	47.7	29.1	18.6	89.3
90	24.29	43.7	29.1	14.5	78.4
100	22.41	40.3	29.1	11.1	66.8
110	20.82	37.4	29.1	8.3	54.7
120	19.47	35.0	29.1	5.9	42.1

Storage: Storage Within Subsurface Pipe

Orifice Equation: = CdA(2gh)^0.5 — Where C = 0.61

Orifice Diameter:	130.00	mm	300x1500 Pipe	103.8
Invert Elevation	65.31	m	3x 2440x3810 Manholes	18.4
Max Ponding Depth	0.66	m	375mm Pipe	0.0
Downstream W/L	65.31	m	1200 CBMH	0.0

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Level	65.97	0.66	29.1	122.0	122.2	OK

Subdrainage Area: UNC2 — Uncontrolled - Non-Tributary
Area (ha): 0.06
C: 0.64

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	10.4	10.4		
20	70.25	7.0	7.0		
30	53.93	5.4	5.4		
40	44.18	4.4	4.4		
50	37.65	3.8	3.8		
60	32.94	3.3	3.3		
70	29.37	2.9	2.9		
80	26.56	2.6	2.6		
90	24.29	2.4	2.4		
100	22.41	2.2	2.2		
110	20.82	2.1	2.1		
120	19.47	1.9	1.9		

Subdrainage Area: UNC1 — Uncontrolled - Non-Tributary
Area (ha): 0.09
C: 0.80

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	20.9	20.9		
20	70.25	14.1	14.1		
30	53.93	10.8	10.8		
40	44.18	8.8	8.8		
50	37.65	7.5	7.5		
60	32.94	6.6	6.6		
70	29.37	5.9	5.9		
80	26.56	5.3	5.3		
90	24.29	4.9	4.9		
100	22.41	4.5	4.5		
110	20.82	4.2	4.2		
120	19.47	3.9	3.9		

Subdrainage Area: A — Roof
Area (ha): 0.25 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	65.2	7.2	57.9	34.8	21.4	0.00
20	70.25	43.9	8.8	35.2	42.2	26.0	0.00
30	53.93	33.7	9.2	24.5	44.2	27.2	0.00
40	44.18	27.6	9.2	18.4	**44.2**	27.2	0.00
50	37.65	23.6	9.0	14.5	43.5	26.8	0.00
60	32.94	20.6	8.8	11.8	42.4	26.1	0.00
70	29.37	18.4	8.6	9.8	41.2	25.3	0.00
80	26.56	16.6	8.3	8.3	39.9	24.6	0.00
90	24.29	15.2	8.0	7.2	38.6	23.8	0.00
100	22.41	14.0	7.8	6.2	37.4	23.0	0.00
110	20.82	13.0	7.5	5.5	36.2	22.3	0.00
120	19.47	12.2	7.3	4.9	35.1	21.6	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	27.2	0.03	9.2	44.2	243.8	0.00

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

Subdrainage Area: A1, A3, EXT2 — Controlled - Tributary
Area (ha): 1.00 — *Includes peak runoff from Area A4.
C: 0.74

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	388.0	46.3	341.7	205.0
20	119.95	267.1	46.3	220.7	264.9
30	91.87	205.4	46.3	159.0	286.3
40	75.15	168.0	46.3	121.7	**292.0**
50	63.95	143.0	46.3	96.6	289.9
60	55.89	125.0	46.3	78.6	283.0
70	49.79	111.3	46.3	65.0	272.9
80	44.99	100.6	46.3	54.2	260.4
90	41.11	91.9	46.3	45.6	246.1
100	37.90	84.7	46.3	38.4	230.4
110	35.20	78.7	46.3	32.4	213.6
120	32.89	73.5	46.3	27.2	195.8

Storage: Storage Within Subsurface Pipe

Orifice Equation: Q = CdA(2gh)^0.5 — Where C = 0.61

Orifice Diameter:	130.00	mm	300x1500 Pipe	235.8
Invert Elevation	65.31	m	3x 2440x3810 Manholes	46.6
Max Ponding Depth	1.67	m	375mm Pipe	9.0
Downstream W/L	65.31	m	1200 CBMH	0.8

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Level	66.98	1.67	46.3	292.0	292.2	OK

Subdrainage Area: UNC2 — Uncontrolled - Non-Tributary
Area (ha): 0.06
C: 0.80

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	22.2	22.2		
20	119.95	14.9	14.9		
30	91.87	11.4	11.4		
40	75.15	9.4	9.4		
50	63.95	8.0	8.0		
60	55.89	7.0	7.0		
70	49.79	6.2	6.2		
80	44.99	5.6	5.6		
90	41.11	5.1	5.1		
100	37.90	4.7	4.7		
110	35.20	4.4	4.4		
120	32.89	4.1	4.1		

Subdrainage Area: UNC1 — Uncontrolled - Non-Tributary
Area (ha): 0.09
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	44.7	44.7		
20	119.95	30.0	30.0		
30	91.87	23.0	23.0		
40	75.15	18.8	18.8		
50	63.95	16.0	16.0		
60	55.89	14.0	14.0		
70	49.79	12.5	12.5		
80	44.99	11.3	11.3		
90	41.11	10.3	10.3		
100	37.90	9.5	9.5		
110	35.20	8.8	8.8		
120	32.89	8.2	8.2		

Subdrainage Area: A — Roof
Area (ha): 0.25 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	124.1	13.8	110.3	66.2	40.7	0.00
20	119.95	83.4	16.6	66.7	80.1	49.3	0.00
30	91.87	63.8	17.4	46.5	**83.6**	51.5	0.00
40	75.15	52.2	17.4	34.8	83.6	51.5	0.00
50	63.95	44.4	17.1	27.4	82.1	50.5	0.00
60	55.89	38.8	16.6	22.2	80.0	49.2	0.00
70	49.79	34.6	16.1	18.5	77.6	47.7	0.00
80	44.99	31.3	15.6	15.6	75.1	46.2	0.00
90	41.11	28.6	15.1	13.5	72.7	44.7	0.00
100	37.90	26.3	14.6	11.7	70.3	43.3	0.00
110	35.20	24.5	14.2	10.3	68.1	41.9	0.00
120	32.89	22.9	13.7	9.2	65.9	40.6	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	51.5	0.05	17.4	83.6	243.8	0.00

Stormwater Management Calculations

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

Subdrainage Area: D5 — Roof
Area (ha): 0.04 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	10.2	1.6	8.6	5.1	103.0	0.00
20	70.25	6.9	1.6	5.2	6.3	109.3	0.00
30	53.93	5.3	1.6	3.6	**6.5**	110.7	0.00
40	44.18	4.3	1.6	2.7	6.4	110.1	0.00
50	37.65	3.7	1.6	2.0	6.1	108.5	0.00
60	32.94	3.2	1.6	1.6	5.7	106.4	0.00
70	29.37	2.9	1.6	1.3	5.3	103.9	0.00
80	26.56	2.6	1.6	1.0	4.8	101.2	0.00
90	24.29	2.4	1.6	0.8	4.4	97.6	0.00
100	22.41	2.2	1.5	0.7	3.9	93.3	0.00
110	20.82	2.0	1.5	0.5	3.5	89.1	0.00
120	19.47	1.9	1.5	0.4	3.0	84.9	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	110.7	0.11	1.6	6.5	15.6	0.0

Subdrainage Area: D3 — Roof
Area (ha): 0.03 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	8.6	1.6	7.0	4.2	102.0	0.00
20	70.25	5.8	1.6	4.2	5.0	107.4	0.00
30	53.93	4.5	1.6	2.8	**5.1**	107.9	0.00
40	44.18	3.6	1.6	2.0	4.9	106.4	0.00
50	37.65	3.1	1.6	1.5	4.5	104.1	0.00
60	32.94	2.7	1.6	1.1	4.1	101.2	0.00
70	29.37	2.4	1.6	0.9	3.6	97.0	0.00
80	26.56	2.2	1.5	0.7	3.2	92.1	0.00
90	24.29	2.0	1.5	0.5	2.7	87.2	0.00
100	22.41	1.9	1.5	0.4	2.3	82.3	0.00
110	20.82	1.7	1.4	0.3	1.9	77.5	0.00
120	19.47	1.6	1.4	0.2	1.5	71.8	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	107.9	0.11	1.6	5.1	13.2	0.0

Subdrainage Area: D1 — Roof
Area (ha): 0.13 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	34.7	4.8	29.8	17.9	103.6	0.00
20	70.25	23.4	5.1	18.3	22.0	110.3	0.00
30	53.93	17.9	5.1	12.8	**23.1**	112.2	0.00
40	44.18	14.7	5.1	9.6	23.0	112.1	0.00
50	37.65	12.5	5.1	7.5	22.4	111.0	0.00
60	32.94	11.0	5.0	5.9	21.4	109.3	0.00
70	29.37	9.8	5.0	4.8	20.2	107.4	0.00
80	26.56	8.8	4.9	3.9	18.9	105.3	0.00
90	24.29	8.1	4.8	3.3	17.6	103.0	0.00
100	22.41	7.5	4.8	2.7	16.2	100.7	0.00
110	20.82	6.9	4.7	2.3	15.0	97.8	0.00
120	19.47	6.5	4.6	1.9	13.8	94.6	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	112.2	0.11	5.1	23.1	53.2	0.0

Subdrainage Area: C — Roof
Area (ha): 0.18 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	46.4	6.8	39.6	23.8	103.3	0.00
20	70.25	31.3	7.1	24.2	29.1	109.9	0.00
30	53.93	24.0	7.1	16.9	**30.4**	111.6	0.00
40	44.18	19.7	7.1	12.6	30.1	111.2	0.00
50	37.65	16.8	7.1	9.7	29.1	110.0	0.00
60	32.94	14.7	7.0	7.7	27.7	108.2	0.00
70	29.37	13.1	6.9	6.2	26.0	106.1	0.00
80	26.56	11.8	6.8	5.0	24.2	103.8	0.00
90	24.29	10.8	6.7	4.1	22.3	101.5	0.00
100	22.41	10.0	6.6	3.4	20.5	98.7	0.00
110	20.82	9.3	6.4	2.9	18.8	95.4	0.00
120	19.47	8.7	6.3	2.4	17.2	92.1	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	111.6	0.11	7.1	30.4	71.2	0.0

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

Subdrainage Area: D5 — Roof
Area (ha): 0.04 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	19.4	1.8	17.6	10.6	130.8	0.00
20	119.95	13.0	1.8	11.2	13.4	141.6	0.00
30	91.87	10.0	1.9	8.1	14.6	146.1	0.00
40	75.15	8.1	1.9	6.3	15.0	147.9	0.00
50	63.95	6.9	1.9	5.1	**15.2**	148.3	0.00
60	55.89	6.1	1.9	4.2	15.1	147.9	0.00
70	49.79	5.4	1.9	3.5	14.8	147.0	0.00
80	44.99	4.9	1.9	3.0	14.5	145.7	0.00
90	41.11	4.5	1.9	2.6	14.0	144.1	0.00
100	37.90	4.1	1.8	2.3	13.6	142.4	0.00
110	35.20	3.8	1.8	2.0	13.1	140.5	0.00
120	32.89	3.6	1.8	1.7	12.6	138.5	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	148.3	0.15	1.9	15.2	15.6	0.0

Subdrainage Area: D3 — Roof
Area (ha): 0.03 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	16.4	1.8	14.6	8.8	130.1	0.00
20	119.95	11.0	1.8	9.2	11.0	140.1	0.00
30	91.87	8.4	1.9	6.6	11.8	143.9	0.00
40	75.15	6.9	1.9	5.0	**12.1**	145.0	0.00
50	63.95	5.9	1.9	4.0	12.0	144.7	0.00
60	55.89	5.1	1.9	3.3	11.8	143.7	0.00
70	49.79	4.6	1.8	2.7	11.4	142.1	0.00
80	44.99	4.1	1.8	2.3	11.0	140.2	0.00
90	41.11	3.8	1.8	2.0	10.6	138.1	0.00
100	37.90	3.5	1.8	1.7	10.0	135.8	0.00
110	35.20	3.2	1.8	1.4	9.5	133.4	0.00
120	32.89	3.0	1.8	1.2	9.0	131.0	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	145.0	0.14	1.9	12.1	13.2	0.0

Subdrainage Area: D1 — Roof
Area (ha): 0.13 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	66.0	5.7	60.3	36.2	131.0	0.00
20	119.95	44.4	6.1	38.3	46.0	141.9	0.00
30	91.87	34.0	6.2	27.8	50.0	146.4	0.00
40	75.15	27.8	6.3	21.5	51.7	148.3	0.00
50	63.95	23.6	6.3	17.4	**52.1**	148.8	0.00
60	55.89	20.7	6.3	14.4	51.9	148.5	0.00
70	49.79	18.4	6.2	12.2	51.1	147.7	0.00
80	44.99	16.6	6.2	10.4	50.1	146.5	0.00
90	41.11	15.2	6.2	9.0	48.8	145.1	0.00
100	37.90	14.0	6.1	7.9	47.4	143.6	0.00
110	35.20	13.0	6.1	7.0	45.9	141.9	0.00
120	32.89	12.2	6.0	6.2	44.4	140.2	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	148.8	0.15	6.3	52.1	53.2	0.0

Subdrainage Area: C — Roof
Area (ha): 0.18 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	88.4	8.0	80.4	48.2	130.8	0.00
20	119.95	59.4	8.5	50.9	61.1	141.6	0.00
30	91.87	45.5	8.7	36.8	66.3	145.9	0.00
40	75.15	37.2	8.7	28.5	68.3	147.6	0.00
50	63.95	31.6	8.7	22.9	**68.7**	147.9	0.00
60	55.89	27.7	8.7	18.9	68.2	147.5	0.00
70	49.79	24.6	8.7	16.0	67.0	146.5	0.00
80	44.99	22.3	8.6	13.6	65.5	145.2	0.00
90	41.11	20.3	8.6	11.8	63.7	143.7	0.00
100	37.90	18.8	8.5	10.3	61.6	142.0	0.00
110	35.20	17.4	8.4	9.0	59.5	140.3	0.00
120	32.89	16.3	8.3	8.0	57.3	138.4	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	147.9	0.15	8.7	68.7	71.2	0.0

Stormwater Management Calculations

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

Subdrainage Area: B2 — Roof
Area (ha): 0.06 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	14.6	1.9	12.7	7.6	103.8	0.00
20	70.25	9.8	2.0	7.8	9.4	110.8	0.00
30	53.93	7.6	2.1	5.5	9.9	112.9	0.00
40	44.18	6.2	2.1	4.1	**9.9**	113.0	0.00
50	37.65	5.3	2.0	3.2	9.7	112.1	0.00
60	32.94	4.6	2.0	2.6	9.3	110.6	0.00
70	29.37	4.1	2.0	2.1	8.9	108.8	0.00
80	26.56	3.7	2.0	1.7	8.4	106.8	0.00
90	24.29	3.4	2.0	1.5	7.8	104.7	0.00
100	22.41	3.1	1.9	1.2	7.3	102.6	0.00
110	20.82	2.9	1.9	1.0	6.7	100.4	0.00
120	19.47	2.7	1.9	0.9	6.2	97.4	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	113.0	0.11	2.1	9.9	22.4	0.0

Subdrainage Area: B1 — Roof
Area (ha): 0.06 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	15.4	2.4	13.0	7.8	103.0	0.00
20	70.25	10.4	2.5	7.9	9.5	109.4	0.00
30	53.93	8.0	2.5	5.5	**9.9**	110.8	0.00
40	44.18	6.5	2.5	4.1	9.7	110.3	0.00
50	37.65	5.6	2.4	3.1	9.3	108.8	0.00
60	32.94	4.9	2.4	2.4	8.8	106.6	0.00
70	29.37	4.3	2.4	1.9	8.1	104.2	0.00
80	26.56	3.9	2.4	1.5	7.4	101.5	0.00
90	24.29	3.6	2.3	1.2	6.7	98.1	0.00
100	22.41	3.3	2.3	1.0	6.0	93.9	0.00
110	20.82	3.1	2.3	0.8	5.3	89.6	0.00
120	19.47	2.9	2.2	0.6	4.6	85.5	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	110.8	0.11	2.5	9.9	23.6	0.0

SUMMARY TO OUTLET

		Vrequired	Vavailable*	
Tributary Area	2.467 ha			
Total 5yr Flow to Sewer	152 L/s	0	0 m^3	Ok
Non-Tributary Area	0.146 ha			
Total 5yr Flow Uncontrolled	31 L/s			
Total Area	2.613 ha			
Total 5yr Flow	183 L/s			
Target	205 L/s			

Project #160400864, Q-WEST PHASE 2
Modified Rational Method Calculatons for Storage

Subdrainage Area: B2 — Roof
Area (ha): 0.06 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	27.8	2.3	25.5	15.3	131.2	0.00
20	119.95	18.7	2.4	16.2	19.5	142.3	0.00
30	91.87	14.3	2.5	11.8	21.3	147.0	0.00
40	75.15	11.7	2.5	9.2	22.0	149.1	0.00
50	63.95	10.0	2.5	7.4	**22.3**	149.8	0.00
60	55.89	8.7	2.5	6.2	22.3	149.6	0.00
70	49.79	7.8	2.5	5.2	22.0	149.0	0.00
80	44.99	7.0	2.5	4.5	21.6	148.0	0.00
90	41.11	6.4	2.5	3.9	21.2	146.7	0.00
100	37.90	5.9	2.5	3.4	20.6	145.3	0.00
110	35.20	5.5	2.4	3.0	20.0	143.7	0.00
120	32.89	5.1	2.4	2.7	19.4	142.1	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	149.8	0.15	2.5	22.3	22.4	0.0

Subdrainage Area: B1 — Roof
Area (ha): 0.06 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	29.3	2.7	26.6	16.0	130.8	0.00
20	119.95	19.7	2.8	16.9	20.3	141.7	0.00
30	91.87	15.1	2.8	12.3	22.1	146.2	0.00
40	75.15	12.3	2.8	9.5	22.8	148.0	0.00
50	63.95	10.5	2.8	7.7	**23.0**	148.5	0.00
60	55.89	9.2	2.8	6.3	22.8	148.1	0.00
70	49.79	8.2	2.8	5.4	22.5	147.2	0.00
80	44.99	7.4	2.8	4.6	22.0	145.9	0.00
90	41.11	6.7	2.8	4.0	21.4	144.4	0.00
100	37.90	6.2	2.8	3.4	20.7	142.7	0.00
110	35.20	5.8	2.8	3.0	19.9	140.8	0.00
120	32.89	5.4	2.7	2.7	19.2	138.8	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	148.5	0.15	2.8	23.0	23.6	0.0

SUMMARY TO OUTLET

		Vrequired	Vavailable*	
Tributary Area	2.467 ha			
Total 100yr Flow to Sewer	138 L/s	0	0 m^3	Ok
Non-Tributary Area	0.146 ha			
Total 100yr Flow Uncontrolled	67 L/s			
Total Area	2.613 ha			
Total 100yr Flow	205 L/s			
Target	205 L/s			

Project #160400864, Q-WEST PHASE 2
Roof Drain Design Sheet, Area A
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0004	0.0084	41	0.025	1625	41	41	0.025
0.050	0.0008	0.0169	81	0.050	1625	41	81	0.050
0.075	0.0012	0.0253	122	0.075	1625	41	122	0.075
0.100	0.0015	0.0338	163	0.100	1625	41	163	0.100
0.125	0.0019	0.0422	203	0.125	1625	41	203	0.125
0.150	0.0023	0.0507	244	0.150	1625	41	244	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
40.6	2404.4	40.6	0.66789
81.3	1602.9	40.6	1.11316
121.9	1202.2	40.6	1.4471
162.5	961.8	40.6	1.71426
203.1	801.5	40.6	1.93689

Rooftop Storage Summary

Total Building Area (sq.m)		2500
Assume Available Roof Area (sq.	65%	1625
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		22
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		244
Estimated 100 Year Drawdown Time (h)		1.1

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Zurn Drain Catalogue

Head (m)	L/min	L/s	Notch Rating
0.051	45.5	0.00076	232

Calculation Results	5yr	100yr	Available
Qresult (cu.m/s)	0.009	0.017	-
Depth (m)	0.027	0.051	0.150
Volume (cu.m)	44.2	83.6	243.8
Draintime (hrs)	0.7	1.1	

Project #160400864, Q-WEST PHASE 2
Roof Drain Design Sheet, Area B1
Standard Watts Accuflow Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0009	0	0.025	13	0	0	0.025
0.050	0.0006	0.0019	1	0.050	52	1	1	0.050
0.075	0.0007	0.0021	3	0.075	118	2	3	0.075
0.100	0.0008	0.0024	7	0.100	210	4	7	0.100
0.125	0.0009	0.0026	14	0.125	328	7	14	0.125
0.150	0.0009	0.0028	24	0.150	472	10	24	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
0.8	404.1	0.8	0.11225
2.8	974.9	2.1	0.38306
6.9	1708.7	4.0	0.8577
13.5	2561.0	6.7	1.56908
23.5	3502.1	9.9	2.54188

Rooftop Storage Summary

Total Building Area (sq.m)		590
Assume Available Roof Area (sq.	80%	472
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		3
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		24
Estimated 100 Year Drawdown Time (h)		2.5

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Watts Drain Catalogue

Head (m)	L/s Open	0.75	0.5	**0.25**	Closed
0.025	0.3155	0.3155	0.3155	**0.3155**	0.3155
0.05	0.6309	0.6309	0.6309	**0.6309**	0.3155
0.075	0.9464	0.8675	0.7886	**0.7098**	0.3155
0.1	1.2618	1.1041	0.9464	**0.7886**	0.3155
0.125	1.5773	1.3407	1.1041	**0.8675**	0.3155
0.15	1.8927	1.5773	1.2618	**0.9464**	0.3155

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.002	0.003	-
Depth (m)	0.111	0.148	0.150
Volume (cu.m)	9.9	23.0	23.6
Draintime (hrs)	1.2	2.5	

Project #160400864, Q-WEST PHASE 2
Roof Drain Design Sheet, Area B2
Standard Watts Accuflow Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0006	0	0.025	12	0	0	0.025
0.050	0.0006	0.0013	1	0.050	50	1	1	0.050
0.075	0.0008	0.0016	3	0.075	112	2	3	0.075
0.100	0.0009	0.0019	7	0.100	199	4	7	0.100
0.125	0.0011	0.0022	13	0.125	311	6	13	0.125
0.150	0.0013	0.0025	22	0.150	448	9	22	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
0.7	575.3	0.7	0.15981
2.7	1249.2	2.0	0.50682
6.5	2027.3	3.8	1.06995
12.9	2864.8	6.3	1.86573
22.3	3739.5	9.4	2.90448

Rooftop Storage Summary

Total Building Area (sq.m)		560
Assume Available Roof Area (sq.	80%	448
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		2
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		22
Estimated 100 Year Drawdown Time (h)		2.9

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Watts Drain Catalogue

Head (m)	L/s					
	Open	0.75	**0.5**	0.25	Closed	
0.025	0.3155	0.3155	**0.3155**	0.3155	0.3155	
0.05	0.6309	0.6309	**0.6309**	0.6309	0.3155	
0.075	0.9464	0.8675	**0.7886**	0.7098	0.3155	
0.1	1.2618	1.1041	**0.9464**	0.7886	0.3155	
0.125	1.5773	1.3407	**1.1041**	0.8675	0.3155	
0.15	1.8927	1.5773	**1.2618**	0.9464	0.3155	

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.002	0.003	-
Depth (m)	0.113	0.150	0.150
Volume (cu.m)	9.9	22.3	22.4
Draintime (hrs)	1.5	2.9	

Project #160400864, Q-WEST PHASE 2
Roof Drain Design Sheet, Area C
Standard Watts Accuflow Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0022	0	0.025	40	0	0	0.025
0.050	0.0006	0.0044	3	0.050	158	2	3	0.050
0.075	0.0008	0.0055	9	0.075	356	6	9	0.075
0.100	0.0009	0.0066	21	0.100	633	12	21	0.100
0.125	0.0011	0.0077	41	0.125	989	20	41	0.125
0.150	0.0013	0.0088	71	0.150	1424	30	71	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
2.3	522.5	2.3	0.14513
8.6	1134.5	6.3	0.46027
20.8	1841.1	12.2	0.97169
40.9	2601.7	20.1	1.69439
70.9	3396.1	30.0	2.63774

Rooftop Storage Summary

Total Building Area (sq.m)		1780
Assume Available Roof Area (sq.	80%	1424
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		7
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		71
Estimated 100 Year Drawdown Time (h)		2.6

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

From Watts Drain Catalogue

Head (m)	L/s Open	0.75	**0.5**	0.25	Closed
0.025	0.3155	0.3155	**0.3155**	0.3155	0.3155
0.05	0.6309	0.6309	**0.6309**	0.6309	0.3155
0.075	0.9464	0.8675	**0.7886**	0.7098	0.3155
0.1	1.2618	1.1041	**0.9464**	0.7886	0.3155
0.125	1.5773	1.3407	**1.1041**	0.8675	0.3155
0.15	1.8927	1.5773	**1.2618**	0.9464	0.3155

* Note: Number of drains can be reduced if multiple-notch drain used.

Calculation Results	5yr	100yr	Available
Qresult (cu.m/s)	0.007	0.009	-
Depth (m)	0.112	0.148	0.150
Volume (cu.m)	30.4	68.7	71.2
Draintime (hrs)	1.3	2.6	

Project #160400864, Q-WEST PHASE 2
Roof Drain Design Sheet, Area D1
Standard Watts Accuflow Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0016	0	0.025	30	0	0	0.025
0.050	0.0006	0.0032	2	0.050	118	2	2	0.050
0.075	0.0008	0.0039	7	0.075	266	5	7	0.075
0.100	0.0009	0.0047	16	0.100	473	9	16	0.100
0.125	0.0011	0.0055	31	0.125	739	15	31	0.125
0.150	0.0013	0.0063	53	0.150	1064	22	53	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
1.7	546.5	1.7	0.15182
6.4	1186.8	4.7	0.48148
15.5	1925.9	9.1	1.01645
30.5	2721.6	15.0	1.77244
53.0	3552.5	22.4	2.75926

Rooftop Storage Summary

Total Building Area (sq.m)		1330
Assume Available Roof Area (sq.	80%	1064
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		5
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		53
Estimated 100 Year Drawdown Time (h)		2.7

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Watts Drain Catalogue

Head (m)	L/s				
	Open	0.75	**0.5**	0.25	Closed
0.025	0.3155	0.3155	**0.3155**	0.3155	0.3155
0.05	0.6309	0.6309	**0.6309**	0.6309	0.3155
0.075	0.9464	0.8675	**0.7886**	0.7098	0.3155
0.1	1.2618	1.1041	**0.9464**	0.7886	0.3155
0.125	1.5773	1.3407	**1.1041**	0.8675	0.3155
0.15	1.8927	1.5773	**1.2618**	0.9464	0.3155

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.005	0.006	-
Depth (m)	0.112	0.149	0.150
Volume (cu.m)	23.1	52.1	53.2
Draintime (hrs)	1.4	2.7	

Project #160400864, Q-WEST PHASE 2
Roof Drain Design Sheet, Area D3
Standard Watts Accuflow Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0006	0	0.025	7	0	0	0.025
0.050	0.0006	0.0013	0	0.050	29	0	0	0.050
0.075	0.0007	0.0014	2	0.075	66	1	2	0.075
0.100	0.0008	0.0016	4	0.100	117	2	4	0.100
0.125	0.0009	0.0017	8	0.125	183	4	8	0.125
0.150	0.0009	0.0019	13	0.150	264	6	13	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
0.4	339.0	0.4	0.09417
1.6	818.0	1.2	0.32138
3.9	1433.6	2.3	0.7196
7.6	2148.6	3.7	1.31643
13.1	2938.2	5.6	2.13259

Rooftop Storage Summary

Total Building Area (sq.m)		330
Assume Available Roof Area (sq.	80%	264
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		2
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		13
Estimated 100 Year Drawdown Time (h)		2.0

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Watts Drain Catalogue

Head (m)	L/s				
	Open	0.75	0.5	**0.25**	Closed
0.025	0.3155	0.3155	0.3155	**0.3155**	0.3155
0.05	0.6309	0.6309	0.6309	**0.6309**	0.3155
0.075	0.9464	0.8675	0.7886	**0.7098**	0.3155
0.1	1.2618	1.1041	0.9464	**0.7886**	0.3155
0.125	1.5773	1.3407	1.1041	**0.8675**	0.3155
0.15	1.8927	1.5773	1.2618	**0.9464**	0.3155

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.002	0.002	-
Depth (m)	0.108	0.145	0.150
Volume (cu.m)	5.1	12.1	13.2
Draintime (hrs)	0.9	2.0	

Project #160400864, Q-WEST PHASE 2
Roof Drain Design Sheet, Area D5
Standard Watts Accuflow Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0006	0	0.025	9	0	0	0.025
0.050	0.0006	0.0013	1	0.050	35	1	1	0.050
0.075	0.0007	0.0014	2	0.075	78	1	2	0.075
0.100	0.0008	0.0016	5	0.100	139	3	5	0.100
0.125	0.0009	0.0017	9	0.125	217	4	9	0.125
0.150	0.0009	0.0019	16	0.150	312	7	16	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
0.5	400.7	0.5	0.11129
1.9	966.7	1.4	0.37982
4.6	1694.2	2.7	0.85043
9.0	2539.3	4.4	1.55578
15.5	3472.4	6.6	2.52034

Rooftop Storage Summary

Total Building Area (sq.m)		390
Assume Available Roof Area (sq.	80%	312
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		2
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		16
Estimated 100 Year Drawdown Time (h)		2.5

* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).

* Note: Number of drains can be reduced if multiple-notch drain used.

From Watts Drain Catalogue

Head (m)	L/s Open	0.75	0.5	**0.25**	Closed
0.025	0.3155	0.3155	0.3155	**0.3155**	0.3155
0.05	0.6309	0.6309	0.6309	**0.6309**	0.3155
0.075	0.9464	0.8675	0.7886	**0.7098**	0.3155
0.1	1.2618	1.1041	0.9464	**0.7886**	0.3155
0.125	1.5773	1.3407	1.1041	**0.8675**	0.3155
0.15	1.8927	1.5773	1.2618	**0.9464**	0.3155

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.002	0.002	-
Depth (m)	0.111	0.148	0.150
Volume (cu.m)	6.5	15.2	15.6
Draintime (hrs)	1.2	2.5	

C.3 BACKGROUND REPORT EXCERPTS (STORM SEWER)

5.0 Stormwater Management and Servicing

The stormwater management (SWM) criteria for 114 Richmond Road were established in a report titled "Assessment of Adequacy of Public Services Report" prepared by Trow Associates Inc. and dated March 12, 2010. This report indicated a 5-year predevelopment release rate of 194.3L/s based on a site area of 2.21ha and a pre-development runoff coefficient of 0.45. (see **Appendix C** for Excerpts from Trow's report). As per the City of Ottawa's request in an email received September 6, 2011, the allowable release rate has been revised to reflect a calculated time of concentration of 23.8 minutes, based on existing site conditions. Note that the proposed site also receives external drainage from neighbouring properties. These external flows will be captured and conveyed by the proposed system. The target rate for the site is therefore **205 L/s** when external drainage areas are included.

This SWM analysis will demonstrate that the proposed development meets the above criteria, as well as the following:

- Maximum permitted hydraulic grade line (HGL) to be a minimum of 0.30 m below building foundation will be addressed through installation of pumps.
- Size storm sewers to convey 5 year storm event under free-flow conditions using 2004 City of Ottawa I-D-F parameters *(City of Ottawa).* Due to servicing restrictions on the west side of the site, the sewers connecting to Richmond Road are sized to convey the 100 year restricted release rate from roof tops and the underground storm reservoir.
- All flows in excess of the allowable release rate, up to and including the 100-year storm, are to be detained onsite.
- Where possible, maximum ponding depth of 0.30 m (*City of Ottawa*). Note that due to grading restrictions a depression exists within the treed area that is to be preserved and cannot be regraded. No overland flow route is available from this area and as such maximum ponding depths of 0.3m cannot be achieved.
- Standing water depths at parking lot sags not to cause surface flooding on any building or structure *(City of Ottawa)*
- Subdrains required in swales where longitudinal gradient is less than 1.5% *(City of Ottawa)*
- Where possible, major flow from the site is to be safely conveyed by surface routing towards Leighton Terrace and Richmond Road. A depression exists currently within the treed area that is to be preserved and cannot be regraded. Due to elevation changes across the site no overland flow route can be provided at this location. Flows in this area will be captured in a catchbasin and conveyed through the proposed storm sewers but no overland flow route can be provided.

Appendix D : CITY CORRESPONDENCE & CHECKLIST

Servicing study guidelines for development applications

4. Development Servicing Study Checklist

The following section describes the checklist of the required content of servicing studies. It is expected that the proponent will address each one of the following items for the study to be deemed complete and ready for review by City of Ottawa Infrastructure Approvals staff.

The level of required detail in the Servicing Study will increase depending on the type of application. For example, for Official Plan amendments and re-zoning applications, the main issues will be to determine the capacity requirements for the proposed change in land use and confirm this against the existing capacity constraint, and to define the solutions, phasing of works and the financing of works to address the capacity constraint. For subdivisions and site plans, the above will be required with additional detailed information supporting the servicing within the development boundary.

4.1 General Content

- NA ☐ Executive Summary (for larger reports only).
- ☒ Date and revision number of the report.
- ☒ Location map and plan showing municipal address, boundary, and layout of proposed development.
- ☒ Plan showing the site and location of all existing services.
- ☒ Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.
- ☒ Summary of Pre-consultation Meetings with City and other approval agencies.
- ☒ Reference and confirm conformance to higher level studies and reports (Master Servicing Studies, Environmental Assessments, Community Design Plans), or in the case where it is not in conformance, the proponent must provide justification and develop a defendable design criteria.
- ☒ Statement of objectives and servicing criteria.
- ☒ Identification of existing and proposed infrastructure available in the immediate area.
- NA ☒ Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).
- NA ☒ Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.
- NA ☒ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.
- ☒ Proposed phasing of the development, if applicable.

- ☒ Reference to geotechnical studies and recommendations concerning servicing.

- ☒ All preliminary and formal site plan submissions should have the following information:
  - Metric scale
  - North arrow (including construction North)
  - Key plan
  - Name and contact information of applicant and property owner
  - Property limits including bearings and dimensions
  - Existing and proposed structures and parking areas
  - Easements, road widening and rights-of-way
  - Adjacent street names

4.2 Development Servicing Report: Water

- ☒ Confirm consistency with Master Servicing Study, if available
- ☒ Availability of public infrastructure to service proposed development
- ☒ Identification of system constraints
- ☒ Identify boundary conditions
- ☒ Confirmation of adequate domestic supply and pressure
- ☒ Confirmation of adequate fire flow protection and confirmation that fire flow is calculated as per the Fire Underwriter's Survey. Output should show available fire flow at locations throughout the development.
- ☒ Provide a check of high pressures. If pressure is found to be high, an assessment is required to confirm the application of pressure reducing valves.
- ☒ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design
- ☒ Address reliability requirements such as appropriate location of shut-off valves
- ☒ Check on the necessity of a pressure zone boundary modification.
- ☒ Reference to water supply analysis to show that major infrastructure is capable of delivering sufficient water for the proposed land use. This includes data that shows that the expected demands under average day, peak hour and fire flow conditions provide water within the required pressure range

- ☒ Description of the proposed water distribution network, including locations of proposed connections to the existing system, provisions for necessary looping, and appurtenances (valves, pressure reducing valves, valve chambers, and fire hydrants) including special metering provisions.
- ☒ Description of off-site required feedermains, booster pumping stations, and other water infrastructure that will be ultimately required to service proposed development, including financing, interim facilities, and timing of implementation.
- ☒ Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.
- ☒ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

4.3 Development Servicing Report: Wastewater

- ☒ Summary of proposed design criteria (Note: Wet-weather flow criteria should not deviate from the City of Ottawa Sewer Design Guidelines. Monitored flow data from relatively new infrastructure cannot be used to justify capacity requirements for proposed infrastructure).
- ☒ Confirm consistency with Master Servicing Study and/or justifications for deviations.
- ☒ Consideration of local conditions that may contribute to extraneous flows that are higher than the recommended flows in the guidelines. This includes groundwater and soil conditions, and age and condition of sewers.
- ☒ Description of existing sanitary sewer available for discharge of wastewater from proposed development.
- ☒ Verify available capacity in downstream sanitary sewer and/or identification of upgrades necessary to service the proposed development. (Reference can be made to previously completed Master Servicing Study if applicable)
- ☒ Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix ‘C’) format.
- ☒ Description of proposed sewer network including sewers, pumping stations, and forcemains.
- NA ☒ Discussion of previously identified environmental constraints and impact on servicing (environmental constraints are related to limitations imposed on the development in order to preserve the physical condition of watercourses, vegetation, soil cover, as well as protecting against water quantity and quality).
- ☒ Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.
- NA ☒ Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.
- NA ☒ Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.
- ☒ Special considerations such as contamination, corrosive environment etc.

4.4 Development Servicing Report: Stormwater Checklist

- ☒ Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)
- ☒ Analysis of available capacity in existing public infrastructure.
- ☒ A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.
- ☒ Water quantity control objective (e.g. controlling post-development peak flows to pre-development level for storm events ranging from the 2 or 5 year event (dependent on the receiving sewer design) to 100 year return period); if other objectives are being applied, a rationale must be included with reference to hydrologic analyses of the potentially affected subwatersheds, taking into account long-term cumulative effects.
- ☒ Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.
- ☒ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.
- NA ☒ Set-back from private sewage disposal systems.
- NA ☒ Watercourse and hazard lands setbacks.
- ☒ Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.
- ☒ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.
- ☒ Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).
- NA ☒ Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.
- ☒ Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.
- ☒ Any proposed diversion of drainage catchment areas from one outlet to another.
- ☒ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.
- ☒ If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100 year return period storm event.
- NA ☒ Identification of potential impacts to receiving watercourses
- NA ☒ Identification of municipal drains and related approval requirements.
- ☒ Descriptions of how the conveyance and storage capacity will be achieved for the development.
- ☒ 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.

- ☒ Inclusion of hydraulic analysis including hydraulic grade line elevations.
- ☒ Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.
- NA ☒ Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.
- NA ☒ Identification of fill constraints related to floodplain and geotechnical investigation.

4.5 Approval and Permit Requirements: Checklist

The Servicing Study shall provide a list of applicable permits and regulatory approvals necessary for the proposed development as well as the relevant issues affecting each approval. The approval and permitting shall include but not be limited to the following:

- ☒ Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.
- NA ☒ Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.
- NA ☒ Changes to Municipal Drains.
- ☒ Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

4.6 Conclusion Checklist

- ☒ Clearly stated conclusions and recommendations
- ☒ Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.
- ☒ All ~~draft and~~ final reports shall be signed and stamped by a professional Engineer registered in Ontario

Stantec Consulting Ltd.
400 - 1331 Clyde Avenue, Ottawa ON K2C 3G4

April 23, 2020
File: 160400864

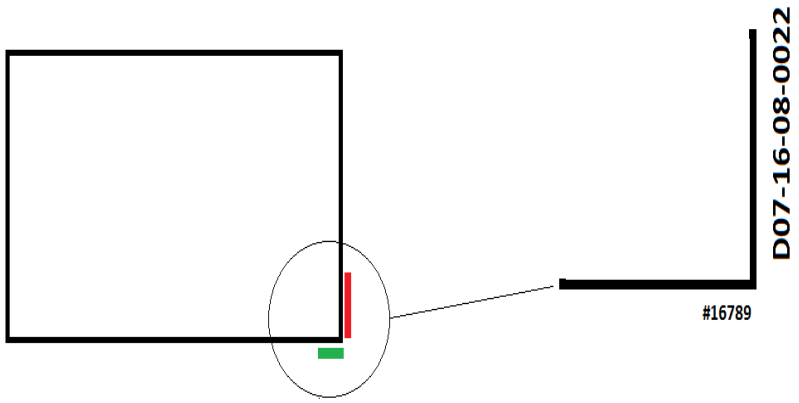
Attention: Shawn Wessel, Project Manager
City of Ottawa
Development Review

Dear Shawn,

Reference: 114 Richmond Road City Comments – D07-12-18-0080

General:

1. Place City of Ottawa project # D07 # on all plans using **BOLD BLACK TEXT** as per this sample where the D07 # is shown as **D07-16-08-0022**.



For the purpose of this application, this file number is D07-12-18-0080. In addition, the Plan number (for GIS & Data Mgmt) will be **# 18016** for this project.

R/ Text added to drawings as indicated.

2. Please refer to City of Ottawa website portal **for "Guide to preparing Studies and Plans"** at https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans.

R/ Noted

3. Please ensure you are using the current guidelines, bylaws and standards including materials of construction, disinfection and all relevant reference to OPSS/D and AWWA guidelines - all current and as amended, such as:

Reference: **114 Richmond Road City Comments – D07-12-18-0080**

City of Ottawa Sewer Design Guidelines (**CoOSDG**) complete with ISTDB 2012-01, 2014-01, 2016-01, 2018-01 & 2019-02 technical bulletin updates as well as current Sewer , Landscape, Road Standard Detail Drawings as well as Sewer Material Specifications (MS Docs).
Sewer Connection (2003-513) & Sewer Use (2003-514) By-Laws.

City of Ottawa Water Distribution Design Guidelines (**CoOWDDG**) complete with ISTDB 2010-02, 2014-02 & 2018-02 technical bulletin updates as well as current Watermain/ Services Material Specifications (MS Docs) as well as Water and Road Standard Detail Drawings.
Water (2018-167) By-Law

Ensure to include version date and add "(as amended)" when referencing all standards, detail drwaings, by-Laws and guidelines.

R/ Noted

4. All plans or reports stamped or noted with "NOT FOR CONSTRUCTION" to be removed prior to review, if applicable. Suggested that "Preliminary Drawings" and/or "Subject to Approval" or similar wording is used in its place.

   R/ Noted

5. A gas pressure release station is required now for buildings that exceed 12 units. Be sure to include this on the Grading, Site Servicing, SWM and Landscape plans.

   Gas Blow Off Station.pdf

   R/ Pressure release station to be included on composite utility plan drawings.

6. Water services greater than 19 mm require a Water Data Card. Please complete card and submit when completed, *once design has been finalized* and in preparation for Commence Work Notification and Water Permit Application.

   2019 Water Data Card.xls

   R/ Noted & will be submitted after approval.

Site Servicing & Stormwater Management Report, prepared by Stantec Consulting Ltd., dated April 1, 2019:

1. Revise the report and plans in the report based upon your changes to the plans as mentioned below. Review and revise accordingly.
   R/ Revised as per below.
2. Please see the attached city guidelines and add a completed checklist with the report.

Reference: 114 Richmond Road City Comments – D07-12-18-0080

R/ Checklist added to report appendices.

3. Please speak to pumping sanitary to 375 mm Ø sanitary sewer pipe extension from building as per the corresponding **Site Servicing Plan,** Dwg SSP-1, prepared by Stantec Consulting Ltd., revision 1 dated April 1, 2019
   R/ Note added to report section 4.3.

4. Re: Water and FUS
   - why the demands in Appendix A don't match the ones in section 3.2 of the report?
     R/ Demands shown in the appendices were confirmed to match section 3.2
   - confirm if redundancy (looped watermain, service separated by valve, ..) will be provided considering that number of units at each connection exceeds 50?
     R/ Further clarification highlighting second connection added to report. Internal watermain looping previously identified in section 3.1 of the report.
   - Are hydrants being proposed on this site? If not, what's the distance from the furthest proposed building to the nearest existing hydrant?
     R/ On-site fire hydrants serviced by building internal plumbing added to plan and have been placed to be within 45m of building fire department connections.
   - This report speaks to provided fire flow results at nodes J3, J8 and J6 (as per Fig 1-5 in Appendix A). Please confirmed what the resulting pressure would be at the furthest building? Why hasn't the model been extended to the furthest buildings?
     R/ The model was originally prepared considering separate connections to serve Phases 1 and 2 without interconnection between the two phases, with dead-end junction J3 corresponding to the point of entry to the building at Phase 1, and junctions J8 and J6 corresponding to the property line at Byron in Phase 2. With internal looping of the development, head losses across the development are effectively minimized, with potential to provide the required fire flows at any location along the proposed site.

5. Report references Geotechnical Investigation Report. Please ensure the most recent report is sited.
   R/ Reference revised.
6. Please demonstrate that you have taken into account redudancy for this proposed connection due to the base flow of the building being greater than 50 m³/d (0.58 l/s) as per Ottawa Design Guidelines – Water Distribution 2010 (as ammended), Section 4.3.1.
   We understand that the existing water service from Phase I (off Richmond Road) is to feed Phase II-A development.
   R/ See response to Comment 4 above.
7. Please clearly show where outlet is for Cistern that is proposed to be pumped.
   R/ Cistern outlet clearly identified within note on Drawing SSP-1.
8. The Geotechnical Investigation Report dated March 20, 2019
   Indicates that a subfloor drainage system, consisting of lines of perforted drainage pipe subdrains connected to a positive outlet should be provided. Reference this in your report.
   R/ As stated in the geotechnical report section 6.1, "The perimeter drainage pipe should direct water to the sump pit(s) within the lower basement area". These sump pits are expected to be pumped as the basement is well below existing sewer depth. As noted on the servicing plan, a storm stub has been identified as the outlet location for the pumped footing drain. Refer to mecahnical drawings for internal plumbing details.
9. This report did not discuss the quality control measures for stormwater runoff, which is a requirement for a SWM report. Please add a quality control section and add information regarding local RVCA concerns on this issue for this site.

Reference: **114 Richmond Road City Comments – D07-12-18-0080**

R/ No quality controls were identified at Phase 1 of the development, with ultimate buildout of Phase 2 clearly indicated at time of approval. Sign-off will be obtained from the RVCA to confirm assumptions made during Phase 1.

10. Provide Flow Control Roof Drainage Declaration as per Ontario Building Code (OBC) Section 7.4.10.4. Alternatively, provide a stamped and sealed memo that confirms the new roof will be designed with flow control drains to meet the Stormwater Management objectives with roof spill scuppers and in accordance with the requirements of clause 7.4.10.4 of the latest edition of the Ontario Building code, as ammended.

Flow_Control_Declaration.pdf

R/ A roof flow control declaration is to be provided by the building mechanical engineer for the current submission and under separate cover.

11. It is recommended that a pressurized drainpipe type material be used for the roof drain leader pipe in the event of surcharge in the system.
R. Consideration of pressure pipe highlighted to building mechanical consultant.
12. Neither the report, nor the plans, speak to the footing drains and how they will be integrated into the site service design. Footing drains are to be independently connected unless utilizing a pumping system with electrical and pump backup with an integrated ICD. Revise report and drawings as necessary.
R/ Footing drains assumed to be pumped, and to discharge into storm sewer upstream of ex MH2 and downstream of the proposed cistern to remain uncontrolled. Details of the connection to occur within building footprint per building mechanical consultant design.
13. In the body of the report - provide HWL for the site in regard to the required storage that was determined.
R/ Water elevation added to table 4 of the report. Cistern water elevation dependent on design of cistern by others.
14. Underground storage is mentioned and taking into account for the SWM for this site in this report. Provide information on type of underground storage system including product name and model, number of chambers, chamber configuration, confirm invert of chamber system, top of chamber system, required cover over system and details, interior bottom slope (for self cleansing), chart of storage values, length, width and height, capacity etc.
R/ Building cistern is to be pumped, with maximum release rate and minimum volume as specified on Drawing SD-1, and elsewhere within the report/drawings. Remaining design elements are under purview of building mechanical consultant – please refer to mechanical design for details.
15. Above and below ground storage is permitted although uses ½ Peak Flow Rate or is modeled. Please confirm that this has been accounted for and/or revise.
R/ The rationale provided within this comment is applicable in consideration of a gravity controlled ICD or otherwise where peak outflow rate varies by head in the storage tank. As the cistern is expected to be pumped out at a constant rate to the peak value specified in the report, the average release rate equates directly to the peak release rate. No further increase in required volume is justfified.

Rationale:
The Modified Rational Method for storage computation in the Sewer Design Guidelines was originally intended to be used for above ground storage (i.e. parking lot) where the change in head over the orifice varied from 1.5 m to 1.2 m (assuming a 1.2 m deep CB and a max ponding depth of 0.3 m). This change

in head was small and hence the release rate fluctuated little, therefore there was no need to use an average release rate.

When underground storage is used, the release rate fluctuates from a maximum peak flow based on maximum head down to a release rate of zero. This difference is large and has a significant impact on storage requirements. We therefore require that an average release rate be used to estimate the required volume. Alternatively, the consultant may choose to use a submersible pump in the design to ensure a constant release rate.

In the event that there is differing opinion from the designer's perspective regarding the required storage, The City will require that the designer demonstrate their rationale utilizing dynamic modelling, that will then be reviewed by City modellers in the Water Resources Group.

Note that the above, including roof areas (all SWM Storage) will added to upcoming revised Sewer Design Guidelines to account for underground/surface storage, which is now widely used.

16. What will be the actual underground storage provided during the major (100 year) and minor (2 year) storm events?
    R/ Please see V(required) columns of previously provided Tables 4 and 5 within the report for storage within the 5 and 100 year event.
17. Provide a cross section of underground chamber system showing invert and obvert/top, major and minor HWLs, top of ground, system volume provided during major and minor events. Provide manufacturer specifications if applicable.
    R/ Please see response to comment 14 above.
18. Report should reference roof drainage area and approiate plan showing drainage area and roof drain locations.
    R/ Assumed number of roof drains and attributed drainage area previously noted in calculations within appendix C and storm drainage area plan SD-1. Location of roof drains and individual drainage areas subject to roof design by others to overall peak release rates noted within the schedule of roof release rates on drawing SD-1. Please see response to above comment 10.

Plan Specific Comments:

Grading Plan, Dwg GP-1, prepared by Stantec Consulting Ltd., revision 1 dated April 1, 2019:

1. Provide a Note: Contractor is responsible to keep the roads free and clean from mud or debris.
   R/ Note added to drawing.
2. Please provide top and bottom retaining wall elevations on Phase I part of property (West property line). Is this part of the retaining wall already built? If so, please use a different layer or appropriate identify the existing vs proposed wall area.
   R/ Additional elevations shown, with linetype adjusted to demonstrate previously constructed wall.
3. No water ponding against building or on public lands. Finish grade at foundation wall of proposed 6-storey building (N/W corner) has same grade as top of curb in roadway. Please ensure this does not occur at any other location on site.
   R/ Grade adjusted to ensure emergency overland flow path progresses away from building edge.

4. Indicate if you will have ponding at the proposed CB and CBMH's. You should show the ponding on the plans. Revise if applicable.
   R/ No surface ponding is proposed with the exception of area A4 (CB 500). Ponding area shown on drawing GP-1.

Site Servicing Plan, Dwg SSP-1, prepared by Stantec Consulting Ltd., revision 1 dated April 1, 2019:

1. See notes above regarding SWM report.
   R/ See responses above regarding SWM report.
2. Revise all that is required and ensure these revisions are captured in the Servicing and Stormwater Management Report.
   R/ Revised as noted.
3. Back flow valves for service lateral connections are to be shown on the plans.
   R/ Backflow valves are internal to proposed building, and will form part of building permit application package to meet building code requirements.

Storm Drainage Area Plan. Dwg SD-1, prepared by Stantec Consulting Ltd., revision 1 dated April 1, 2019:

1. See notes above regarding SWM report.
   R/ See responses above regarding SWM report.
2. Revise all that is required and ensure these revisions are captured in the Servicing and Stormwater Management Report.
   R/ Revised as noted.
3. Show all ponding area (particularly at CBs and CBMHs) relative to 5 and 100-year storm event(s) if applicable. Ensure this information is in the Servicing and Stormwater Management Report.
   R/ Ponding area note revised for CB 500.
4. Provide information on type of underground storage system including product name and model, number of chambers, chamber configuration, confirm invert of chamber system, top of chamber system, required cover over system and details, etc., interior bottom slope (for self cleansing), chart of storage values, width and height, capacity etc.
   R/ See responses above relating to subsurface storage cistern. Subsurface storage pipe for drainage areas A1, A3, EXT2, A4 is existing, and detailed on previously approved Phase 1 drawings.

Erosion & Sediment Control Plan, Dwg EC/DS-1, prepared by Stantec Consulting Ltd., revision 1 dated April 1, 2019:

1. Provide a Note: Contractor is responsible to keep the roads free and clean from mud or debris.
   R/ Additional note added to plan.
2. Insert the following opening paragraph in Notes*, "The contractor shall implement best management practices, to provide for protection of the area drainage system and the receiving watercourse, during construction activities. The contractor acknowledges that failure to implement appropriate erosion and sediment control measures may be subject to penalties imposed by any applicable regulatory agency."*
   R/ Additional note added to plan.
3. Provide North Arrow on plan.
   R/ Revised as noted.
4. Silt fence should be extended along property line to northern development limits at east side of property.
   R/ Revised as noted.

Reference: **114 Richmond Road City Comments – D07-12-18-0080**

Roof Drainage Plan:

1. Not provided. Please submit a plan of proposed roof drainage or revise SWM or Site Plan accordingly.
   R/ Not provided – please see responses to servicing and stormwater management report above.
2. Provide roof drain type with specified opening setting and/or controlled Q.
   R/ Assumed roof drain type and release rates previously provided within section 5.3.2.1, and calculations within Appendix C
3. Provide 2, 5 and 100 year storm event flood plain area on roof.
   R/ Assumed ponding areas noted on previously provided calculations within Appendix C. Note that assumed ponding regions are subject to roof design by others to be designed to meet SWM objectives based on flow control roof drainage declaration – see responses to servicing report comments above.
4. Provide scupper locations with outlet elevation.
   R / Scupper locations to be designed by others at time of building permit application to meet building code requirements & those identified within the flow control roof drainage declaration.

Regards,

Stantec Consulting Ltd.

Kris Kilborn
Associate, Community Development
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Fax: 613 722 2799
kris.kilborn@stantec.com

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