david schaeffer engineering ltd

120 Iber Road, Suite 103
Ottawa, Ontario K2S 1E9
Tel. (613) 836-0856
Fax (613) 836-7183
www.DSEL.ca

SITE SERVICING AND STORMWATER MANAGEMENT REPORT

FOR

RIOCAN HOLDINGS INC.
2525 CARLING AVENUE – PHASE 1

CITY OF OTTAWA

PROJECT NO.: 17-997
CITY APPLICATION NO.: D07-12-XX-XXXX

DECEMBER 2018 – REV. 1

SITE SERVICING AND STORMWATER MANAGEMENT REPORT
FOR 2525 CARLING AVENUE – PHASE 1

RIOCAN HOLDINGS INC.

DECEMBER 2018- REV. 1

TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

SITE SERVICING AND STORMWATER MANAGEMENT REPORT
FOR
2525 CARLING AVENUE – PHASE 1

RIOCAN HOLDINGS INC.

DECEMBER 2018 – REV. 1

CITY OF OTTAWA
PROJECT NO.: 17-997

1.0 INTRODUCTION

David Schaeffer Engineering Limited (DSEL) has been retained by RioCan Holdings Inc. to prepare a Site Servicing and Stormwater Management report in support of the application for Site Plan Control (SPC) for the redevelopment of the Lincoln Fields Shopping Centre, located at 2525 Carling Avenue.

The subject property is located within the City of Ottawa urban boundary, in the Bay Ward. As illustrated in ***Figure 1,*** below, the subject property is bounded by Carling Avenue to the south; Richmond Road to the north; Croydon Avenue to the west and the Sir John A. Macdonald Parkway to the west. The subject property measures approximately ***6.55 ha***. The proposed SPC application is for Phase 1 of the development which encompasses ***4.69 Ha*** of the south portion of the property.

Figure 1: Site Location

The proposed SPC application would allow for the development of a new 2 storey retail store central to the site and a new 2 storey office/retail building fronting Carling Avenue.

The objective of this report is to provide sufficient detail to demonstrate the proposed development is supported by existing services.

1.1 Existing Conditions

The existing site includes a commercial mall, external restaurant buildings and associated surface parking. The elevations range between 75.25 m at the south-west corner of the site to 71.00 m internal to the site.

Sewer and watermain mapping, along with as-built information collected from the City of Ottawa indicate the following existing infrastructure within the adjacent right-of-ways:

Carling Avenue:

- 1067 mm diameter concrete pressure pipe CL C301;
- 152 mm diameter watermain;
- 600 mm diameter watermain;
- 900 mm storm sewer; and
- 300 mm sanitary sewer.

Croydon Avenue:

- 150 mm diameter watermain;
- 225 mm diameter sanitary sewer; and
- 300 mm diameter storm sewer.

Richmond Road:

- 300 mm diameter watermain;
- 300 mm diameter sanitary sewer; and
- 600 mm diameter storm sewer.

Sir John A Macdonald Parkway:

- 450 mm diameter sanitary sewer, within an easement of 1330 Richmond Road;
- 600 mm diameter storm sewer, within an easement of 1330 Richmond Road; and
- 1524 mm diameter concrete pressure pipe.

1.2 Required Permits / Approvals

The proposed development is subject to the site plan control approval process. The City of Ottawa must approve the engineering design drawings and reports prior to the issuance of site plan control.

The proposed stormwater management system will continue to service one lot or parcel of land, therefore, the system qualifies for an exemption from an Environmental Compliance Application under Section 53 of the Ontario Water Resources Act.

1.3 Pre-consultation

Pre-consultation correspondence, along with the servicing guidelines checklist, is located in ***Appendix A***.

2.0 GUIDELINES, PREVIOUS STUDIES, AND REPORTS

2.1 Existing Studies, Guidelines, and Reports

The following studies were utilized in the preparation of this report:

- **Ottawa Sewer Design Guidelines**,
  City of Ottawa, *SDG002,* October 2012.
  (City Standards)

  - **Technical Bulletin ISTB-2018-01**
    City of Ottawa, March 21, 2018.
    (ISTB-2018-01)

  - **Technical Bulletin ISTB-2018-04**
    City of Ottawa, June 27, 2018.
    (*ISTB-2018-04)*

- **Ottawa Design Guidelines – Water Distribution**
  City of Ottawa, July 2010.
  (Water Supply Guidelines)

  - **Technical Bulletin ISD-2010-2**
    City of Ottawa, December 15, 2010.
    (*ISD-2010-2*)

  - **Technical Bulletin ISDTB-2014-02**
    City of Ottawa, May 27, 2014.
    (ISDTB-2014-02)

  - **Technical Bulletin ISDTB-2018-02**
    City of Ottawa, March 21, 2018.
    (ISDTB-2018-02)

- **Design Guidelines for Sewage Works,**
  Ministry of the Environment, 2008.
  (MOE* Design Guidelines*)

- **Stormwater Planning and Design Manual,**
  Ministry of the Environment, March 2003.
  (SWMP Design Manual)

- **Ontario Building Code Compendium**
  Ministry of Municipal Affairs and Housing Building Development Branch,
  January 1, 2010 Update.
  (OBC)

- **City of Ottawa Infrastructure Master Plan**
  City of Ottawa
  November 2013
  (City of Ottawa IMP)

- **Stormwater Management Guidelines for the Pinecrest Creek/Westboro Area**
  JF Sabourin & Associates Inc.
  June 2012
  (Pinecrest Creek SWM)

3.0 WATER SUPPLY SERVICING

3.1 Existing Water Supply Services

The subject property lies within the City of Ottawa 1W pressure zone, as shown by the Pressure Zone map, located in ***Appendix B***. The site is currently serviced by the existing 152 mm diameter watermain within the Carling Avenue right-of-way, as well as, the 305 mm diameter watermain within the Richmond Road right-of-way.

The existing development is currently serviced by a looped 254 mm diameter watermain, with one connection to the 305 mm diameter watermain within the Richmond Road right-of-way and one connection to the 152 mm diameter watermain within the Carling Avenue right-of-way. The existing shopping complex on site is serviced through a 102 mm diameter connection to the 152 mm diameter watermain within the Carling Avenue right-of-way. Refer to ***Table 1,*** below, for estimated existing water demand.

Table 1
Summary of Existing Water Demand

Design Parameter	Existing Demand[1] (L/min)
Average Daily Demand	44.8
Max Day	67.1
Peak Hour	120.8

1) Water demand calculation per ***Water Supply Guidelines***. See ***Appendix B*** for detailed calculations.

Refer to drawing ***EX-1,*** accompanying this report, for the existing site servicing layout.

3.2 Water Supply Servicing Design

It is proposed that a portion of the existing 250 mm diameter looped watermain network be reused and connect to a new proposed 250 mm diameter internal watermain. The new connection will replace the existing looped connection to the 152 mm diameter watermain within Carling Avenue. Refer to drawing ***SSP-1***, accompanying this report, for the proposed watermain layout.

Table 2, below, summarizes the ***Water Supply Guidelines*** employed in the preparation of the preliminary water demand estimate.

Table 2
Water Supply Design Criteria

Design Parameter	Value
Office	75 L/9.3m^2/d
Restaurant	125 L/seat/d
Commercial Retail	2.5 L/m^2/d
Commercial Maximum Daily Demand	1.5 x avg. day
Commercial Maximum Hour Demand	1.8 x max. day
Minimum Watermain Size	150 mm diameter
Minimum Depth of Cover	2.4 m from top of watermain to finished grade
During normal operating conditions desired operating pressure is within	350 kPa and 480 kPa
During normal operating conditions pressure must not drop below	275 kPa
During normal operating conditions pressure must not exceed	552 kPa
During fire flow operating pressure must not drop below	140 kPa
Daily Average based on Appendix 4-A from **Water Supply Guidelines* *** Residential Max. Daily and Max. Hourly peaking factors per MOE Guidelines for Drinking-Water Systems Table 3-3 for 0 to 500 persons.* *-Table updated to reflect ISD-2010-2 and ISTB-2018-02.*	

Table 3, below, summarizes the anticipated water demand for the proposed development, which was calculated using the ***Water Supply Guidelines.*** Refer to ***Appendix B*** for associated calculations.

Table 3
Summary of Estimated Water Demand

Design Parameter	Proposed Demand[1] (L/min)
Average Daily Demand	13.3
Max Day + Fire Flow	20.0 + 5,000
Peak Hour	36.0
2) Water demand calculation per ***Water Supply Guidelines***. See ***Appendix B*** for detailed calculations.	

The City of Ottawa was contacted to obtain boundary conditions associated with the estimated water demand as indicated in ***Table 3***. No response was received at the time of publication. Correspondence with the City has been included in ***Appendix A***.

The required fire flow (RFF) was estimated in accordance with **ISTB-2018-02**; the resulting flows for each building were sent to the City of Ottawa for boundary conditions. The following parameters, below, were provided by the Architect, see ***Appendix A*** for collaborating correspondence:

- Type of construction – Non-Combustible Construction;
- Occupancy type – Limited Combustibility; and

- Sprinkler Protection – Supervised Sprinkler System.

Table 4, below, summarizes the fire flow for each building, per the above assumptions and the available fire flow based on existing hydrants within 150 m per ***Table 18.5.4.3*** of the ***ISTB-2018-02***.

Table 4
Anticipated Fire Flow Demand

Building Type	Anticipated Fire Demand (L/min)	Available Fire Flow per Table 18.5.4.3 of ISTB-2018-02 (L/min)
Building A	5,000	11,356
Building B	3,000	17,034

In advance of boundary conditions from the City of Ottawa, an estimate of pressure during the average day was established based on the ***City of Ottawa IMP***. The proposed development is located within the 1W pressure zone and a nominal pressure of 115 m, per ***Table 5.3*** of the ***City of Ottawa IMP,*** was assumed for calculations. Based on the existing ground elevation at the proposed connection on Carling Avenue, an average day pressure of ***407 kPa*** is estimated. The estimated pressure falls within the desired pressure summarized in ***Table 2***. Pressure during fire flow scenarios to be confirmed once boundary conditions are received from the City of Ottawa.

3.3 Water Supply Conclusion

It is proposed to service the development through a looped internal watermain network using the existing connection to the 305 mm diameter watermain within Richmond Road and replacing the existing connection to the 152 mm diameter watermain with a new connection at the same connection point.

Estimated water demand under proposed conditions was submitted to the City of Ottawa for establishing boundary conditions. Boundary conditions have not yet been received at the time of this submission.

It is proposed that the development will be serviced by existing fire hydrants located on both Richmond Road and Carling Avenue. Based on ***Table 18.5.4.3*** of **ISTB-2018-02,** the fire flow demands of the proposed buildings can be supplied through the existing hydrants. Pressure during fire flow scenarios to be confirmed once boundary conditions are received from the City of Ottawa.

It is estimated that the available pressure at the site will be approximately ***407 kPa***, which is within the desired pressure range, as specified by the ***Water Supply Guidelines***. The design of the water distribution system conforms to all relevant City Guidelines and Policies.

4.0 WASTEWATER SERVICING

4.1 Existing Wastewater Services

The subject site lies within the Pinecrest Collector Sewer catchment area, as shown by the City sewer mapping included in ***Appendix C***. The existing site consists of a commercial mall, currently contributing wastewater to the existing 450 mm diameter sanitary sewer crossing the Sir John A. Macdonald Parkway.

Table 5, below, summarizes the existing wastewater flow being discharged from the site.

Table 5
Summary of Existing Wastewater Flows

Design Parameter	Existing Sanitary Flow[1] (L/s)
Average Dry Weather Flow Rate	2.57
Peak Dry Weather Flow Rate	3.85
Peak Wet Weather Flow Rate	5.53

4.2 Wastewater Design

The proposed development will be serviced through two sanitary connections, one directed to the existing 225 mm diameter sanitary sewer within the Carling Avenue right-of-way and the one directed to the existing sanitary service conveying flow to the 450 mm diameter sanitary sewer within the Sir John A. Macdonald Parkway right-of-way.

Table 6, below***,*** summarizes the ***City Standards*** employed in the design of the proposed wastewater sewer system.

Table 6
Wastewater Design Criteria

Design Parameter	Value
Office Floor Space	75 L/9.3m^2/d
Restaurant Space	125 L/seat/d
Commercial Floor Space	5 L/m^2/d
Commercial Peaking Factor	1.5 x Average ICI Flow
Residential Daily Demand	280 L/person/day
Peaking Factor	Harmon's Peaking Factor. Max 3.8
Infiltration and Inflow Allowance	0.33 L/s/ha
Sanitary sewers are to be sized employing the Manning's Equation	$Q = \frac{1}{n} AR^{2/3} S^{1/2}$
Minimum Sanitary Sewer Lateral	135 mm diameter
Minimum Manning's 'n'	0.013
Minimum Depth of Cover	2.5 m from crown of sewer to grade
Minimum Full Flowing Velocity	0.6 m/s
Maximum Full Flowing Velocity	3.0 m/s
Extracted from Sections 4 and 6 of the City of Ottawa Sewer Design Guidelines, October 2012 and City of Ottawa ISTB-2018-01.	

Table 7, below, demonstrates the estimated peak flow discharging to the existing 450 mm diameter sanitary sewer within the Sir John A. Macdonald Parkway right-of-way. See ***Appendix C*** for associated calculations.

Table 7
Summary of Estimated Peak Wastewater Flow – Building A

Design Parameter	Anticipated Sanitary Flow[1] (L/s)
Average Dry Weather Flow Rate	1.11
Peak Dry Weather Flow Rate	1.67
Peak Wet Weather Flow Rate	2.94
*1) Based on criteria shown in **Table 3***	

The peak flow to the existing sanitary sewer within Sir John A. Macdonald Parkway is equal to ***2.94 L/s***, which is a ***2.59 L/s*** decrease compared to the existing condition. Due to the decrease to the existing sanitary flow, it is anticipated that the sanitary sewer within Sir John A. Macdonald Parkway has sufficient capacity to convey the flow from Building A of the proposed development.

Table 8, below, demonstrates the estimated peak flow discharging to the existing 225 mm diameter sanitary sewer within the Carling Avenue right-of-way. See ***Appendix C*** for associated calculations.

Table 8
Summary of Estimated Peak Wastewater Flow – Building B

Design Parameter	Anticipated Sanitary Flow[1] (L/s)
Average Dry Weather Flow Rate	0.76
Peak Dry Weather Flow Rate	1.13
Peak Wet Weather Flow Rate	1.29
*2) Based on criteria shown in **Table 3***	

An external sanitary analysis was completed for the existing sanitary sewer within Carling Avenue up to the Pincrest Collector Sewer. The available capacity of the most restrictive length of pipe of the existing sewer is ***56.8 L/s***, sufficient to convey the proposed increase of ***1.29 L/s.*** Refer to ***Appendix C*** for existing sanitary analysis of Carling Avenue.

4.3 Wastewater Servicing Conclusions

The site is tributary to the Pinecrest Collector sewer. It is proposed to discharge wastewater from the site through two connections, one to the existing 450 mm diameter sanitary sewer within the Sir John A. Macdonald Parkway right-of-way and another to the existing 225 mm diameter sewer within the Carling Avenue right-of-way.

A sanitary analysis was completed for the Carling Avenue sanitary sewer to ensure adequate capacity in both outlets exists to service the subject property. The proposed development results in a decrease in sanitary flow from current conditions to the Sir John A. Macdonald Parkway sanitary sewer, thus it is concluded that this sewer has adequate capacity to service the proposed development.

The proposed wastewater design conforms to all relevant ***City Standards***.

5.0 STORMWATER MANAGEMENT

5.1 Existing Stormwater Services

Stormwater runoff from the subject property is tributary to the City of Ottawa sewer system and is located within the Ottawa River West sub-watershed. As such, approvals for proposed development within this area are under the approval authority of the City of Ottawa.

Flows that influence the watershed in which the subject property is located are further reviewed by the principal authority. The subject property is located within the Pinecrest Creek watershed and is therefore subject to review by the Rideau Valley Conservation Authority (RVCA).

The existing shopping complex is serviced through a network on internal sewers with the majority of flow discharging to the existing 600 mm diameter sewer crossing the Sir John A. Macdonald Parkway. The storm sewer crosses the Parkway discharging to a 2400mm storm sewer and the Ottawa River Parkway Pipe (ORP) described in the ***Pinecrest Creek SWM.***

A portion of the subject property discharges to storm sewers within Richmond Road and Croydon Avenue and are proposed to be retained in the proposed condition. Refer to ***EX-1*** for existing internal sewer layout.

5.2 Post-development Stormwater Management Target – Phase I

Stormwater management quantity and quality control requirements for the proposed development are extracted from the ***Pinecrest Creek SWM*** included in ***Appendix D***:

- The more stringent of the following criteria will govern:
  - i) 100-year storm event discharge is not to exceed ***33.5 L/s/ha***; based on a controlled site area of ***4.355 Ha***, allowable release rate is equal to ***145.9 L/s***
  - ii) requirements of City's Sewer Design Guideline. Based on a 2-year storm event, 0.5 RC and 19.5 minute TC, a 2-year flow rate of ***320 L/s*** was calculated.
- Total suspended solids (TSS) removal of 80%
- Retain the first ***10mm*** of runoff to be infiltrated. Based on a controlled site area of ***4.355 Ha***, required retention is equal to ***435.5m^3***.

Based on the above criteria, the allowable release rate for the site must be attenuated to ***145.9 L/s***.

5.3 Proposed Stormwater Management System

To meet the stormwater objectives the proposed development will utilize a combination of rooftop, surface and subsurface storage.

The private stormwater sewer system has been sized to convey an uncontrolled 5-year storm runoff rate and been sized to support stormwater runoff from the future phases (shown as ***U2*** on drawing ***SWM-1***). Detailed layout and sizing are illustrated by ***SSP-1*** and the storm sewer calculation sheet included in ***Appendix D***.

It is proposed that existing drainage areas that will not be modified by the proposed Phase 1 works will be accommodated in the storm sewer design, however, will not require flow attenuation in accordance with ***Section 5.2***. This includes existing drainage to Richmond Road Storm Sewer (***EX-2*** on ***SWM-1)***; existing drainage from the north-west corner of the site to directed to the proposed storm sewer (***EX-3*** on ***SWM-1***); existing drainage to Croydon Avenue storm sewer (***EX-1*** on ***SWM-1***) and drainage from the south of the site to the proposed storm sewer ***(EX-4*** on ***SWM-1***).

The remaining ***4.355 Ha*** of drainage area is proposed to be controlled by inlet control devices (ICD) located at various catch basins and manholes. ***Table 9*** below summarizes inlet control details, flow rates and storages for each control area.

Table 9
Stormwater Flow Rate Summary

Drainage Area ID	Drainage Area (Ha)	Inlet Control Device	5-Year Release Rate	5-Year Storage	100-Year Release Rate	100-Year Required Storage	100-Year Available Storage
			(L/s)	(m^3)	(L/s)	(m^3)	(m^3)
Unattenuated Areas (U1)	0.028		2.0	0.0	4.4	0.0	0.0
Roof Controls (BLDG-A)	0.407		24.2	56.7	32.0	129.4	322.2
Attenutated Areas (A118+A119)	0.602	75	19.1	113.8	19.4	268.4	336.4
Attenutated Areas (A120+BLDG-B)	0.482	TEMPEST LMF 90	4.5	174.2	10.9	241.4	284.1
Attenutated Areas (A100+A101)	0.514	TEMPEST LMF 65	2.3	161.4	6.1	291.3	305.9
Attenutated Areas (A109)	0.618	TEMPEST LMF 80	2.9	192.9	9.2	338.3	343.1
Attenutated Areas (A122)	1.221	75	17.0	307.6	17.8	683.5	690.5
Attenutated Areas (A103-A)	0.032	TEMPEST LMF 55	3.4	3.0	3.5	8.6	9.7
Attenutated Areas (A103-B)	0.043	TEMPEST LMF 75	6.3	2.9	6.5	9.5	10.6
Attenutated Areas (A103-C)	0.131	TEMPEST LMF 95	10.6	15.1	11.0	40.4	41.3
Attenutated Areas (A106)	0.275	95	15.7	0.1	24.5	5.8	8.4
Total	**4.355**		**108.1**	**1027.8**	**145.2**	**2016.7**	**2352.2**

It is calculated that ***2016.7 m³*** of storage will be required on site to attenuate flow to the established release rate of ***145.2 L/s***; Detailed storage calculations are included in ***Appendix D***.

It is proposed to lower the bottom of the tank below the invert of the ICD to meet the required ***435.5m³*** of retention on-site. A total of ***443m³*** of storage is proposed below the invert of the inlet control devices, resulting in excess of ***10mm*** stormwater retention across the site. Refer to the manufacturer details in ***Appendix D*** and drawing ***SSP-1*** for details.

Quality control to achieve an 80% TSS removal is proposed to be provided by an Oil-Grit Separator (OGS) located at the outlet to the existing storm sewer on Sir John A. Macdonald, refer to ***Appendix D*** for a copy of the OGS sizing report.

5.4 Stormwater Servicing Conclusions

Post development stormwater runoff will be required to be restricted to the allowable target release rate for storm events up to and including the 100-year storm in accordance with the ***Pincrest Creek SWM***. It is calculated that ***2016.7 m³*** of storage will be required on site to attenuate flow to a release rate of ***145.2 L/s.***

Underground storage tanks are proposed to be lowered below the invert of the ICD to allow for the first ***10mm*** or a total of ***435.5m³*** to be retained on-site.

An Oil-Grit Separator is proposed to achieve a quality control target of 80% TSS removal.

The proposed stormwater design conforms to all relevant ***City Standards*** and Policies for approval.

6.0 UTILITIES

Gas and Hydro services currently exist within the Caring Avenue and Merivale Road right-of-ways. Utility servicing will be coordinated with the individual utility companies prior to site development.

Special considerations will need to be taken with development within the Hydro corridor. The proposed development will be coordinated and approved by the utility company having jurisdiction.

7.0 EROSION AND SEDIMENT CONTROL

Soil erosion occurs naturally and is a function of soil type, climate and topography. During construction the extent of erosion losses is exaggerated due to the removal of vegetation and the top layer of soil becoming agitated.

Prior to topsoil stripping, earthworks or underground construction, erosion and sediment controls will be implemented and will be maintained throughout construction.

Silt fence will be installed around the perimeter of the site and will be cleaned and maintained throughout construction. Silt fence will remain in place until the working areas have been stabilized and re-vegetated.

Catch basins will have SILTSACKs or an approved equivalent installed under the grate during construction to protect from silt entering the storm sewer system.

A mud mat will be installed at the construction access in order to prevent mud tracking onto adjacent roads.

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

- Limit extent of exposed soils at any given time;
- Re-vegetate exposed areas as soon as possible;
- Minimize the area to be cleared and grubbed;
- Protect exposed slopes with plastic or synthetic mulches;
- Install silt fence to prevent sediment from entering existing ditches;
- No refueling or cleaning of equipment near existing watercourses;
- Provide sediment traps and basins during dewatering;
- Install filter cloth between catch basins and frames;
- Plan construction at proper time to avoid flooding; and
- Establish material stockpiles away from watercourses, so that barriers and filters may be installed.

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

- Verification that water is not flowing under silt barriers; and
- Clean and change filter cloth at catch basins.

8.0 CONCLUSION AND RECOMMENDATIONS

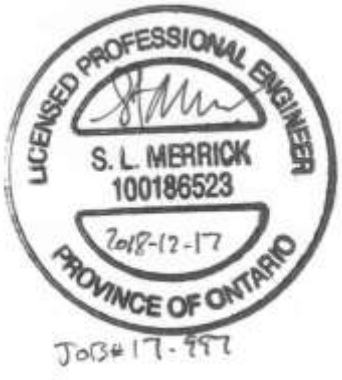
David Schaeffer Engineering Ltd. (DSEL) has been retained by RioCan Holdings Inc. to prepare a Site Servicing and Stormwater Management Report in support of the Site Plan Control (SPC) application for the Phase I development at 2525 Carling Avenue. The preceding report outlines the following:

- Boundary conditions have not been received at the time of publication, however, a review of pressure zone information in the ***City of Ottawa IMP*** allowed for an average day pressure estimate of ***407 kPa***;
- The FUS method for estimating fire flow indicated ***5,000 L/min*** is required for the Phase I development. Based on ***Table 18.5.4.3*** of **ISTB-2018-02,** the fire flow demands of the proposed buildings can be supplied through the existing hydrants. Pressure during fire flow scenarios to be confirmed once boundary conditions are received from the City of Ottawa;
- Existing sanitary sewers within Sir John A. Macdonald Parkway and Carling Avenue have sufficient capacity to convey peak wastewater flow of ***2.94 L/s*** and ***1.29 L/s*** from Building A and B, respectively;
- Allowable release rate, quality control requirements and required ***10mm*** runoff retention per ***Pincrest Creek SWM***;
- Stormwater objectives will be met through retention via rooftop, surface and subsurface storage. It is calculated that ***2016.7 m³*** of storage will be required on site to attenuate flow to the established release rate.

Prepared by,
David Schaeffer Engineering Ltd.

Per: Brandon Chow

Reviewed by,
David Schaeffer Engineering Ltd.



Per: Steven L. Merrick, P. Eng.

z:\projects\17-997_riocan_lincoln-fields\b_design\b3_reports\b3-2_servicing (dsel)\2018-12_fsr-sub1\ssr-2018-12-17_997_kef.docx

APPENDIX A

Pre-Consultation

DEVELOPMENT SERVICING STUDY CHECKLIST

17-997 17/12/2018

4.1 General Content		
☐	Executive Summary (for larger reports only).	N/A
☒	Date and revision number of the report.	Report Cover Sheet
☒	Location map and plan showing municipal address, boundary, and layout of proposed development.	Drawings/Figures, EX-1
☒	Plan showing the site and location of all existing services.	Figure 1, EX-1
☒	Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	Section 1.0, Section 5.0
☒	Summary of Pre-consultation Meetings with City and other approval agencies.	Section 1.3, Appendix A
☒	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.	Section 2.1
☒	Statement of objectives and servicing criteria.	Section 1.0
☒	Identification of existing and proposed infrastructure available in the immediate area.	Sections 3.1, 4.1, 5.1, EX-1
☐	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).	N/A
☒	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.	GP-1
☐	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.	N/A
☐	Proposed phasing of the development, if applicable.	N/A
☒	Reference to geotechnical studies and recommendations concerning servicing.	Section 2.1
☒	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	Drawings/Figures

4.2 Development Servicing Report: Water		
☐	Confirm consistency with Master Servicing Study, if available	N/A
☒	Availability of public infrastructure to service proposed development	Section 3.1
☒	Identification of system constraints	Section 3.1
☐	Identify boundary conditions	Not available at time of report
☒	Confirmation of adequate domestic supply and pressure	Section 3.2, 3.2.1, 3.3

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

☒	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.	Section 3.2, Appendix B
☐	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.	N/A
☐	Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design	N/A
☐	Address reliability requirements such as appropriate location of shut-off valves	N/A
☐	Check on the necessity of a pressure zone boundary modification	N/A
☒	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	Section 3.2, 3.2.1, 3.3
☒	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.	Section 3.2, SSP-1
☐	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.	N/A
☒	Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.	Section 3.2, Appendix B
☒	Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	Section 3.2.1, Appendix B

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).	Section 4.2
☐	Confirm consistency with Master Servicing Study and/or justifications for deviations.	N/A
☐	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.	N/A
☒	Description of existing sanitary sewer available for discharge of wastewater from proposed development.	Section 4.1, EX-1
☒	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)	Section 4.2, Appendix C
☒	Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	Section 4.2, Appendix C
☒	Description of proposed sewer network including sewers, pumping stations, and forcemains.	Section 4.2, SSP-1
☐	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).	N/A

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

☐	Pumping stations: impacts of proposed development on existing pumping stations or requirements for new pumping station to service development.	N/A
☐	Forcemain capacity in terms of operational redundancy, surge pressure and maximum flow velocity.	N/A
☐	Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.	N/A
☐	Special considerations such as contamination, corrosive environment etc.	N/A

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)	Section 5.1
☒	Analysis of available capacity in existing public infrastructure.	Section 5.1, Appendix D
☒	A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Drawings/Figures
☒	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.	Section 5.2
☒	Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	Section 5.2
☒	Description of the stormwater management concept with facility locations and descriptions with references and supporting information	Section 5.3
☐	Set-back from private sewage disposal systems.	N/A
☐	Watercourse and hazard lands setbacks.	N/A
☒	Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.	Appendix A
☐	Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.	N/A
☒	Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).	Section 5.3
☐	Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	N/A
☒	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.	Section 5.1, 5.3, Appendix D
☐	Any proposed diversion of drainage catchment areas from one outlet to another.	N/A
☐	Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	Section 5.3
☐	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.	N/A
☐	Identification of potential impacts to receiving watercourses	N/A
☐	Identification of municipal drains and related approval requirements.	N/A

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

☒	Descriptions of how the conveyance and storage capacity will be achieved for the development.	Section 5.3
☐	100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	N/A
☐	Inclusion of hydraulic analysis including hydraulic grade line elevations.	Section 5.4
☒	Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Section 7.0
☐	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.	N/A
☐	Identification of fill constraints related to floodplain and geotechnical investigation.	N/A

4.5 Approval and Permit Requirements: Checklist

☐	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 ct. 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.	Section 1.2
☐	Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.	N/A
☐	Changes to Municipal Drains.	N/A
☐	Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)	N/A

4.6 Conclusion Checklist

☒	Clearly stated conclusions and recommendations	Section 8.0
☐	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	

*Extracted from the City of Ottawa-Servicing Study Guidelines for Development Applications

Genavieve Melatti

From: Genavieve Melatti
Sent: Friday, December 14, 2018 3:08 PM
To: 'gabrielle.schaeffer@ottawa.ca'
Cc: Steve Merrick; Brandon Chow
Subject: 2525 Carling Avenue - Boundary Conditions Request
Attachments: wtr-2018-12-14_997_ggg.pdf; 1803 Lincoln Field Dec 14.pdf

Good afternoon Gabrielle,

Would we be able to request boundary conditions for the proposed development at 2525 Carling Avenue:

1. Location of Service / Street Number: 2525 Carling Avenue

2. Type of development and the fire flow required for the proposed development:

- The proposed development is commercial, consisting of two building; one two-storey retail food store with 2620m^2 of floor area and a two storey retail/office building with 1517.6m^2 of floor area .
- We are proposing to connect to the existing 150mm diameter service already accessing the subject site at the location shown in the figure below.
- The maximum fire flow demand for the proposed development is 5,000L/min for the retail food store located at the north-north end of the property and 3,000L/min for the proposed commercial/retail/office building at the south-eastern end of the site. The calculations and parameters used in these calculations are in the attached FUS calculation sheet.
- We are looking for the boundary conditions at the proposed connection point shown below.

3.

	L/min	L/s
Avg. Daily	13.3	0.22
Max Day	20.0	0.33
Peak Hour	36.0	0.60

It you have any questions please feel free to contact me.

Thank you,

Genavieve Melatti
Project Coordinator/ Junior Designer

DSEL
david schaeffer engineering ltd.

120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext. 569
email: gmelatti@DSEL.ca

Genavieve Melatti

From: Robert Verch <rverch@rlaarchitecture.ca>
Sent: Friday, December 14, 2018 2:48 PM
To: Genavieve Melatti
Cc: Steve Merrick; Brandon Chow
Subject: 1803 RioCan Lincoln Fields - FUS Calculations

See below.

From: Genavieve Melatti <GMelatti@dsel.ca>
Sent: December-14-18 1:24 PM
To: Robert Verch <rverch@rlaarchitecture.ca>
Cc: Steve Merrick <SMerrick@dsel.ca>; Brandon Chow <BChow@dsel.ca>
Subject: RioCAN Lincoln Fields - FUS Calculations

Good afternoon Rob,

I was wondering if you would be able to provide some information for us today that is required in order to complete the FUS calculations for this project.

- Would you be able to please confirm the sprinkler systems for the buildings? **Yes**
- We are assuming that both storeys of the metro will be retail space (2620m^2 total) and that "Building 2" will be 746.6 m^2 of commercial space and 771.0 m^2 of office space. Would you be able to confirm this? **Second floor of the Metro is a mezzanine, it is there offices. Yes to the areas and use of the Rexall / Office building.**
- I have included the ISO Guide in which sections 1, 2 and 3 on pages 3 to 10 provides definitions to clarify as well as the section from the City's technical bulletin. Note that ISO refers only to fire-resistive for fire ratings not less than 1-hour. Would you be able to provide the ISO class for each building. **Class 3 (non-combustible)**

A. *Determine the type of construction.*

- Coefficient *C* in the FUS method is equivalent to coefficient *F* in the ISO method:

Correspondence between FUS and ISO construction coefficients

FUS type of construction	ISO class of construction	Coefficient *C*
Fire-resistive construction	Class 6 (fire resistive)	0.6
	Class 5 (modified fire resistive)	0.6
Non-combustible construction	Class 4 (masonry non-combustible)	0.8
	Class 3 (non-combustible)	0.8
Ordinary construction	Class 2 (joisted masonry)	1.0
Wood frame construction	Class 1 (frame)	1.5

However, the FUS definition of fire-resistive construction is more restrictive than those of ISO construction classes 5 and 6 (modified fire resistive and fire resistive). FUS requires structural members and floors in buildings of fire-resistive construction to have a fire-resistance rating of 3 hours or longer.

- With the exception of fire-resistive construction that is defined differently by FUS and ISO, practitioners can refer to the definitions of the ISO construction classes (and the supporting definitions of the types of materials and assemblies that make up the ISO construction classes) found in the current ISO guide [4] (see Annex i) to help select coefficient *C*.
- To identify the most appropriate type of construction for buildings of mixed construction, the rules included in the current ISO guide [4] can be followed (see Annex i). For a building to be assigned a given classification, the rules require ⅔ (67%) or more of the total wall area and ⅔ (67%) or more of the total floor and roof area of the building to be constructed according to the given construction class or a higher class.
- New residential developments (less than 4 storeys) are predominantly of wood frame construction ($C = 1.5$) or ordinary construction ($C = 1.0$) if exterior walls are of brick or masonry. Residential buildings with exterior walls of brick or masonry veneer and those with less than ⅔ (67%) of their exterior walls made of brick or masonry are considered wood frame construction ($C = 1.5$).

If you have any questions at all please feel free to contact me.

Thank you,

Genavieve Melatti
Project Coordinator/ Junior Designer

DSEL
david schaeffer engineering ltd.

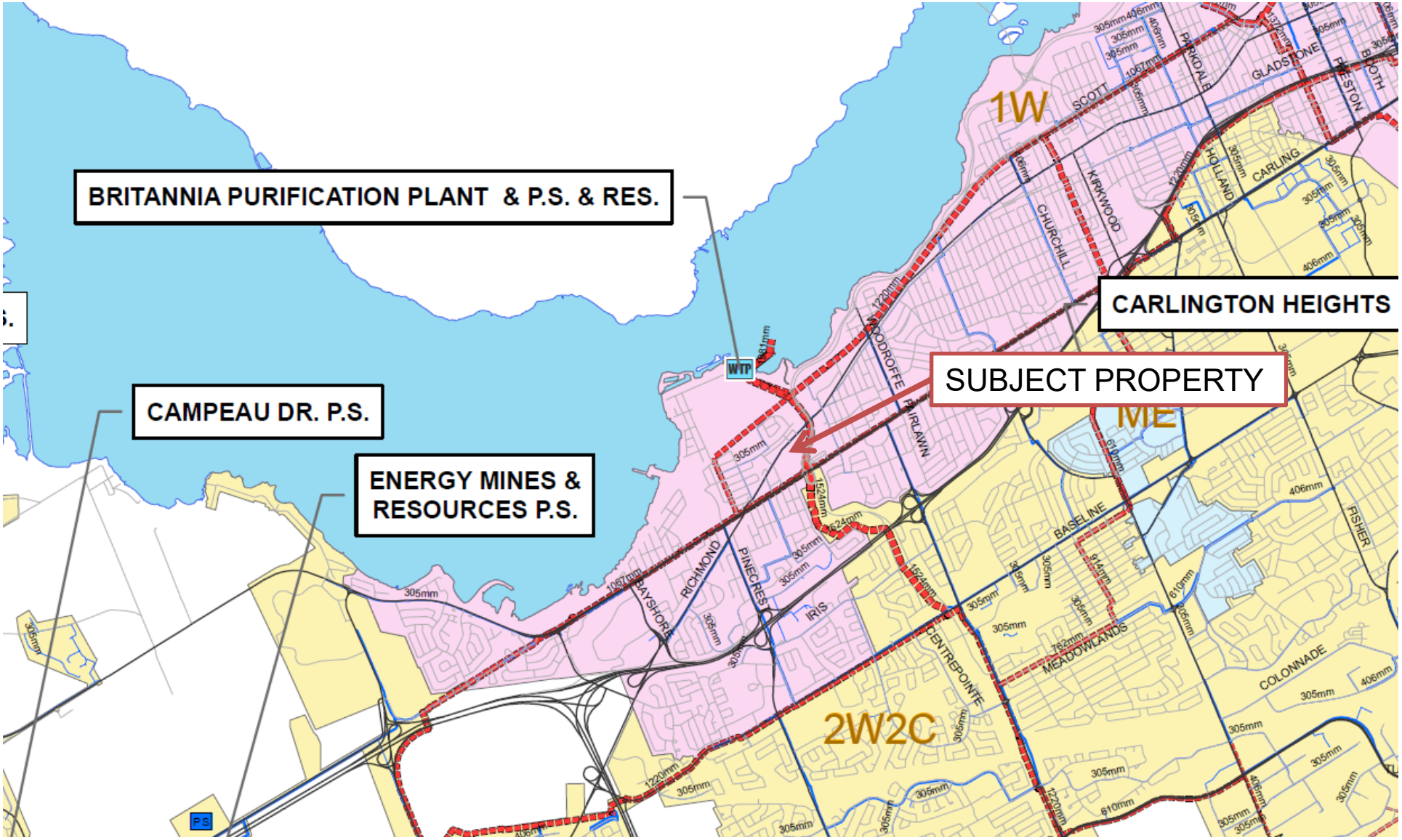
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

phone: (613) 836-0856 ext. 569
email: gmelatti@DSEL.ca

APPENDIX B

Water Supply

Pressure Zone Map



2525 CARLING AVENUE - PHASE 1
Existing Site Conditions

Water Demand Design Flows per Unit Count
City of Ottawa - Water Distribution Guidelines, July 2010

Domestic Demand

Type of Housing	Per / Unit	Units	Pop
Single Family	3.4	-	0
Semi-detached	2.7	-	0
Townhouse	2.7	-	0
Apartment			0
Bachelor	1.4	-	0
1 Bedroom	1.4	-	0
2 Bedroom	2.1	-	0
3 Bedroom	3.1	-	0
Average	1.8	-	0

	Pop	Avg. Daily		Max Day		Peak Hour	
		m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Total Domestic Demand	0	0.0	0.0	0.0	0.0	0.0	0.0

Institutional / Commercial / Industrial Demand

			Avg. Daily		Max Day		Peak Hour	
Property Type	**Unit Rate**	**Units**	m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Commercial floor space	2.5 $L/m^2/d$		0.00	0.0	0.0	0.0	0.0	0.0
Office	75 $L/9.3m^2/d$	-	0.00	0.0	0.0	0.0	0.0	0.0
Restaurant*	125 L/seat/d	71	8.94	6.2	13.4	9.3	24.1	16.8
Shopping Centres	2.5 $L/m^2/d$	22,204	55.51	38.5	83.3	57.8	149.9	104.1
Industrial - Heavy	55,000 L/gross ha/d	-	0.00	0.0	0.0	0.0	0.0	0.0
Total I/CI Demand			64.4	44.8	96.7	67.1	174.0	120.8
Total Demand			**64.4**	**44.8**	**96.7**	**67.1**	**174.0**	**120.8**

* Estimated number of seats at 1seat per $9.3m^2$

2525 CARLING AVENUE - PHASE 1
Proposed Site Conditions

Water Demand Design Flows per Unit Count
City of Ottawa - Water Distribution Guidelines, July 2010

Domestic Demand

Type of Housing	Per / Unit	Units	Pop
Single Family	3.4	-	0
Semi-detached	2.7	-	0
Townhouse	2.7	-	0
Apartment			0
Bachelor	1.4	-	0
1 Bedroom	1.4	-	0
2 Bedroom	2.1	-	0
3 Bedroom	3.1	-	0
Average	1.8	-	0

	Pop	Avg. Daily		Max Day		Peak Hour	
		m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Total Domestic Demand	0	0.0	0.0	0.0	0.0	0.0	0.0

Institutional / Commercial / Industrial Demand

			Avg. Daily		Max Day		Peak Hour	
Property Type	**Unit Rate**	**Units**	m^3/d	L/min	m^3/d	L/min	m^3/d	L/min
Commercial floor space	2.5 $L/m^2/d$	3,367	8.42	5.8	12.6	8.8	22.7	15.8
Office	75 $L/9.3m^2/d$	771	6.22	4.3	9.3	6.5	16.8	11.7
Restaurant*	125 L/seat/d	37	4.57	3.2	6.8	4.8	12.3	8.6
Shopping Centres	2.5 $L/m^2/d$		0.00	0.0	0.0	0.0	0.0	0.0
Industrial - Heavy	55,000 L/gross ha/d	-	0.00	0.0	0.0	0.0	0.0	0.0
Total I/CI Demand			19.2	13.3	28.8	20.0	51.8	36.0
Total Demand			**19.2**	**13.3**	**28.8**	**20.0**	**51.8**	**36.0**

* Estimated number of seats at 1 seat per $9.3m^2$

Fire Flow Estimation per Fire Underwriters Survey

Water Supply For Public Fire Protection - 1999

Fire Flow Required

1. Base Requirement

$$F = 220C\sqrt{A}$$ L/min *Where **F** is the fire flow, **C** is the Type of construction and **A** is the Total flo*

Type of Construction: Non-Combustible Construction

C	0.8		*Type of Construction Coefficient per FUS Part II, Section 1*
A	2620.0	m^2	*Total floor area based on FUS Part II section 1*

Fire Flow	9008.7 L/min	
	9000.0 L/min	*rounded to the nearest 1,000 L/min*

Adjustments

2. Reduction for Occupancy Type

Limited Combustible -15%

Fire Flow	**7650.0 L/min**

3. Reduction for Sprinkler Protection

Sprinklered - Supervised -50%

Reduction	**-3825 L/min**

4. Increase for Separation Distance

	Cons. of Exposed Wall	S.D	Lw	Ha	LH	EC	
N	Non-Combustible	>45m	97	1	97	0%	
S	Non-Combustible	>45m	72	2	144	0%	
E	Non-Combustible	20.1m-30m	56	2	112	10%	
W	Non-Combustible	>45m	56	1	56	0%	
		% Increase				**10%**	*value not to exceed 75%*

Increase	**765.0 L/min**

Lw = Length of the Exposed Wall
Ha = number of storeys of the adjacent structure. Max 5 stories
LH = Length-height factor of exposed wall. Value rounded up.
EC = Exposure Charge

Total Fire Flow

Fire Flow	4590.0 L/min	*fire flow not to exceed 45,000 L/min nor be less than 2,000 L/min per*
	5000.0 L/min	*rounded to the nearest 1,000 L/min*

Notes:
-Type of construction, Occupancy Type and Sprinkler Protection information provided by Roderick Lahey Architect Inc.
-Calculations based on Fire Underwriters Survey - Part II

Fire Flow Estimation per Fire Underwriters Survey

Water Supply For Public Fire Protection - 1999

Fire Flow Required

1. Base Requirement

$$F = 220C\sqrt{A}$$ L/min *Where **F** is the fire flow, **C** is the Type of construction and **A** is the Total flo*

Type of Construction: Non-Combustible Construction

C	0.8		*Type of Construction Coefficient per FUS Part II, Section 1*
A	1517.6	m^2	*Total floor area based on FUS Part II section 1*

Fire Flow	6856.3 L/min	
	7000.0 L/min	*rounded to the nearest 1,000 L/min*

Adjustments

2. Reduction for Occupancy Type

Limited Combustible -15%

Fire Flow	**5950.0 L/min**

3. Reduction for Sprinkler Protection

Sprinklered - Supervised -50%

Reduction	**-2975 L/min**

4. Increase for Separation Distance

	Cons. of Exposed Wall	S.D	Lw	Ha	LH	EC	
N	Non-Combustible	>45m	31	2	62		0%
S	Non-Combustible	>45m	31	2	62		0%
E	Non-Combustible	>45m	31	1	31		0%
W	Non-Combustible	>45m	31	2	62		0%
		% Increase					**0%** *value not to exceed 75%*

Increase	**0.0 L/min**

Lw = Length of the Exposed Wall
Ha = number of storeys of the adjacent structure. Max 5 stories
LH = Length-height factor of exposed wall. Value rounded up.
EC = Exposure Charge

Total Fire Flow

Fire Flow	2975.0 L/min	*fire flow not to exceed 45,000 L/min nor be less than 2,000 L/min per*
	3000.0 L/min	*rounded to the nearest 1,000 L/min*

Notes:
-Type of construction, Occupancy Type and Sprinkler Protection information provided by Roderick Lahey Architect Inc.
-Calculations based on Fire Underwriters Survey - Part II

through pressure control at the PSs. The key characteristics of each pump station in the system are provided in *Table 5.3*.

Table 5.3: Existing Water Pump Station Characteristics

Pump Station	Pressure Zone	Zone Type	Nominal Discharge HGL (m)	Total Capacity (MLD)[1]	Firm Capacity (MLD)[2]
Carlington 2W	2W	Open	131	68.0	34.0
Barrhaven Reservoir	BARR	Open	155	7.5	0.0
Ottawa South	3C	Closed	151	39.7	26.2
Billings Bridge	2C	Open	134	177.5	127.0
Britannia 2W	2W	Open	134	302.0	208.0
Glen Cairn	3W	Open	160	87.5	49.5
Forest Ridge	2E	Open	134	91.5	47.0
Lemieux	1W	Open	115	456.0	308.0
Fleet	1W	Open	115	279.0	189.0
Britannia 1W	1W	Open	115	328.0	213.0
Carlington ME	ME	Closed	154	13.5	5.5
Campeau	3W	Open	160	100.0	58.0
Hurdman	1E	Open	115	286.0	204.0
Barrhaven	BARR	Open	155	104.5	57.0
Orléans	2E	Open	134	93.4	64.5
Leitrim	4C	Closed	165	33.3	19.0
Montreal	MONT	Closed	148	39.4	21.9
Brittany	MONT	Closed	148	8.1	2.6
Morgan's Grant	MG	Closed	145	17.7	12.3

Source: Pressure Zone Operation Manuals
HGL = Hydraulic Grade Line (a number that reflects both the elevation of the pump station, and the station discharge pressure)
MLD = Million Litres per Day
BARR = Barrhaven
MONT = Montreal
ME = Meadowlands
MG = Morgan's Grant

1. The nominal capacity of the station with all pumps in operation.
2. Total capacity of the station less the capacity of the largest pump. Typically, pump stations are designed to provide a firm capacity that is at least equal to the expected water system demand at the planning horizon.

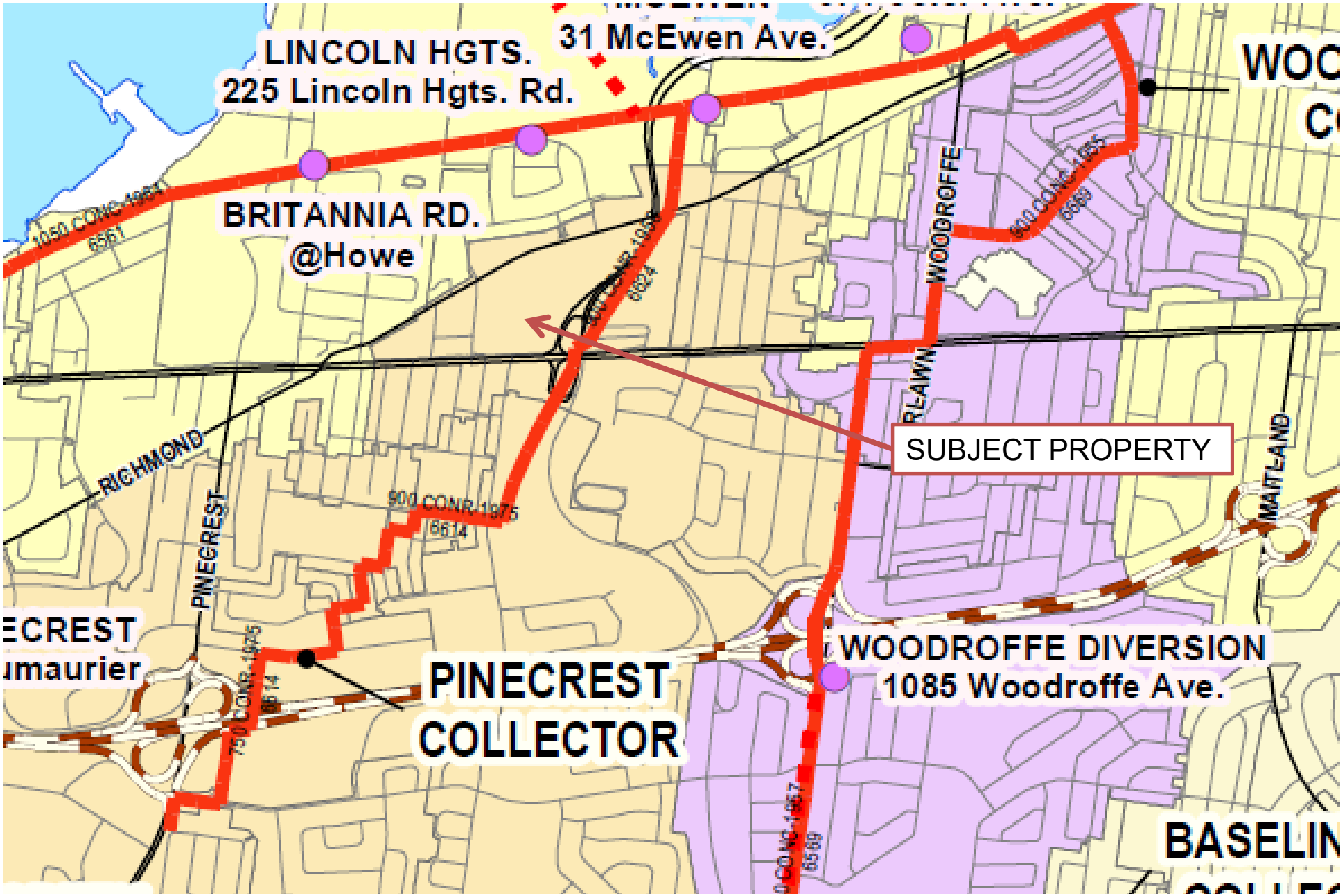
5.2.1.3 Water Storage Facilities

Water storage facilities are strategically located throughout the distribution system to augment supply during high water demand periods and fire flow conditions, and to increase the reliability of water supply during system outages. During average water demand conditions, pumps are operated to allow frequent turnover of water within each facility to keep the water fresh. The key characteristics of each of the storage facilities are provided in *Table 5.4*.

APPENDIX C

Wastewater Collection

Sanitary Trunk Sewer and Collection Area Map



RIOCAN HOLDINGS INC.
2525 CARLING AVENUE - PHASE 1
Existing Site Conditions

Wastewater Design Flows per Unit Count
City of Ottawa Sewer Design Guidelines, 2012

Site Area 5.080 **ha**

Extraneous Flow Allowances

Infiltration / Inflow **1.68 L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	Pop
Single Family	3.4		0
Semi-detached and duplex	2.7		0
Townhouse	2.7		0
Stacked Townhouse	2.3		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1		0
3 Bedroom	3.1		0
Average	1.8		0

Total Pop **0**

Average Domestic Flow **0.00 L/s**

Peaking Factor **3.80**

Peak Domestic Flow **0.00 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	Unit Rate		No. of Units	Avg Wastewater (L/s)
Commercial floor space*	5	$L/m^2/d$	22,204	2.57
Office	75	$L/9.3m^2/d$		0.00
Restaurant***	125	L/seat/d		0.00
Ex. Industrial - Light**	35,000	L/gross ha/d		0.00
Industrial - Light**	35,000	L/gross ha/d		0.00
Industrial - Heavy**	55,000	L/gross ha/d		0.00

Average I/C/I Flow **2.57**

Peak Institutional / Commercial Flow 3.85
Peak Industrial Flow** 0.00
Peak I/C/I Flow **3.85**

** assuming a 12 hour commercial operation*

*** peak industrial flow per City of Ottawa Sewer Design Guidelines Appendix 4B*

*** Estimated number of seats at 1seat per $9.3m^2$

Total Estimated Average Dry Weather Flow Rate	**2.57 L/s**
Total Estimated Peak Dry Weather Flow Rate	**3.85 L/s**
Total Estimated Peak Wet Weather Flow Rate	**5.53 L/s**

2525 CARLING AVENUE - PHASE 1
Proposed Site Conditions - Building A

Wastewater Design Flows per Unit Count
City of Ottawa Sewer Design Guidelines, 2004

Site Area 4.530 **ha**

Extraneous Flow Allowances

Infiltration / Inflow **1.27 L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	Pop
Single Family	3.4		0
Semi-detached and duplex	2.7		0
Townhouse	2.7		0
Stacked Townhouse	2.3		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1		0
3 Bedroom	3.1		0
Average	1.8		0

Total Pop **0**

Average Domestic Flow **0.00 L/s**

Peaking Factor **3.80**

Peak Domestic Flow **0.00 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	Unit Rate	No. of Units	Avg Wastewater (L/s)
Commercial floor space*	5 $L/m^2/d$	3,367	0.39
Office	75 $L/9.3m^2/d$	771	0.67
Restaurant***	125 L/seat/d	37	0.05
Ex. Industrial - Light**	35,000 L/gross ha/d		0.00
Industrial - Light**	35,000 L/gross ha/d		0.00
Industrial - Heavy**	55,000 L/gross ha/d		0.00

Average I/C/I Flow **1.11**

Peak Institutional / Commercial Flow 1.67
Peak Industrial Flow** 0.00
Peak I/C/I Flow **1.67**

** assuming a 12 hour commercial operation*
*** peak industrial flow per City of Ottawa Sewer Design Guidelines Appendix 4B*

Total Estimated Average Dry Weather Flow Rate	**1.11 L/s**
Total Estimated Peak Dry Weather Flow Rate	**1.67 L/s**
Total Estimated Peak Wet Weather Flow Rate	**2.94 L/s**

2525 CARLING AVENUE - PHASE 1
Proposed Site Conditions - Building B

Wastewater Design Flows per Unit Count
City of Ottawa Sewer Design Guidelines, 2004

Site Area 0.550 **ha**

Extraneous Flow Allowances

Infiltration / Inflow **0.15 L/s**

Domestic Contributions

Unit Type	Unit Rate	Units	Pop
Single Family	3.4		0
Semi-detached and duplex	2.7		0
Townhouse	2.7		0
Stacked Townhouse	2.3		0
Apartment			
Bachelor	1.4		0
1 Bedroom	1.4		0
2 Bedroom	2.1		0
3 Bedroom	3.1		0
Average	1.8		0

Total Pop **0**

Average Domestic Flow **0.00 L/s**

Peaking Factor **3.80**

Peak Domestic Flow **0.00 L/s**

Institutional / Commercial / Industrial Contributions

Property Type	Unit Rate	No. of Units	Avg Wastewater (L/s)
Commercial floor space*	5 $L/m^2/d$	747	0.09
Office	75 $L/9.3m^2/d$	771	0.67
Restaurant***	125 L/seat/d		0.00
Ex. Industrial - Light**	35,000 L/gross ha/d		0.00
Industrial - Light**	35,000 L/gross ha/d		0.00
Industrial - Heavy**	55,000 L/gross ha/d		0.00

Average I/C/I Flow **0.76**

Peak Institutional / Commercial Flow 1.13
Peak Industrial Flow** 0.00
Peak I/C/I Flow **1.13**

** assuming a 12 hour commercial operation*
*** peak industrial flow per City of Ottawa Sewer Design Guidelines Appendix 4B*

Total Estimated Average Dry Weather Flow Rate	**0.76 L/s**
Total Estimated Peak Dry Weather Flow Rate	**1.13 L/s**
Total Estimated Peak Wet Weather Flow Rate	**1.29 L/s**

EXTERNALSANITARY SEWER CALCULATION SHEET

CLIENT: **RIOCAN HOLDINGS INC.**
LOCATION: **2525 Carling Avenue**
FILE REF: **18-997**
DATE: **17-Dec-18**

DESIGN PARAMETERS

Avg. Daily Flow Res.	280	L/p/d	Peak Fact Res. Per Harmons: Min = 2.0, Max =3.8		Infiltration / Inflow	0.33	L/s/ha
Avg. Daily Flow Comm	28,000	L/ha/d	Peak Fact. Comm. If (Q_I/Q_{TOTAL}>20%)	1.5 Peak Fact. Comm. 1	Min. Pipe Velocity	0.60	m/s full flowing
Avg. Daily Flow Instit.	28,000	L/ha/d	Peak Fact. Instit. If (Q_I/Q_{TOTAL}>20%)	1.5 Peak Fact. Instit. 1	Max. Pipe Velocity	3.00	m/s full flowing
Avg. Daily Flow Indust.	35,000	L/ha/d	Peak Fact. Indust. per MOE graph		Mannings N	0.013	
			Correction Factor K	0.8			

Location			Residential Area and Population									Commercial		Institutional		Industrial		Infiltration				Pipe Data								
Area ID	Up	Down	Area	Number of Units by type				Pop.	Cumulative		Peak. Fact.	Q_{res}	Area	Accu. Area	Area	Accu. Area	Area	Accu. Area	Q_{C+I+I}	Total Area	Accu. Area	Infiltration Flow	Total Flow	DIA	Slope	Length	$A_{hydraulic}$	R	Velocity	Q_{cap}	Q / Q full
			(ha)	Singles	Semi's	Town's	Apt's**		Area (ha)	Pop.	(-)	(L/s)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(mm)	(%)	(m)	(m^2)	(m)	(m/s)	(L/s)	(-)
	EX.SAN MH1	EX.SAN MH2	0.000					0.0	0.000	0.0	3.80	0.00		0.00		0.00		0.00		0.000	0.000	0.000	0.00	225	1.80	18.7	0.040	0.056	1.52	60.2	0.00
	EX.SAN MH2	EX.SAN MH3	11.640	85	64	74	18	694.0	11.6	694.0	3.32	7.46	0.27	0.27		0.00		0.00	0.1	11.910	11.910	3.930	11.52	225	1.60	130.3	0.040	0.056	1.43	56.8	0.20
	EX.SAN MH3	EX.SAN MH4	0.000					0.0	11.640	694.0	3.32	7.46		0.27		0.00		0.00	0.8	0.000	11.910	3.930	12.16	225	7.60	63.4	0.040	0.056	3.11	123.8	0.10

SANITARY SEWER CALCULATION SHEET

CLIENT: **RIOCAN HOLDINGS INC.**
LOCATION: **2525 Carling Avenue**
FILE REF: **18-997**
DATE: **14-Dec-18**

DESIGN PARAMETERS

Avg. Daily Flow Res.	280	L/p/d	Peak Fact Res. Per Harmons: Min = 2.0, Max =3.8			Infiltration / Inflow	0.33 L/s/ha
Avg. Daily Flow Comm	28,000	L/ha/d	Peak Fact. Comm. If (Q_i/Q_{TOTAL}>20%)	1.5	Peak Fact. Comm. 1	Min. Pipe Velocity	0.60 m/s full flowing
Avg. Daily Flow Instit.	28,000	L/ha/d	Peak Fact. Instit. If (Q_i/Q_{TOTAL}>20%)	1.5	Peak Fact. Instit. 1	Max. Pipe Velocity	3.00 m/s full flowing
Avg. Daily Flow Indust.	35,000	L/ha/d	Peak Fact. Indust. per MOE graph			Mannings N	0.013
			Correction Factor K	0.8			

Location			Residential Area and Population									Commercial		Institutional		Industrial		Infiltration				Pipe Data								
Area ID	Up	Down	Area	Number of Units by type				Pop.	Cumulative		Peak. Fact.	Q_{res}	Area	Accu. Area	Area	Accu. Area	Area	Accu. Area	Q_{C+I+I}	Total Area	Accu. Area	Infiltration Flow	Total Flow	DIA	Slope	Length	$A_{hydraulic}$	R	Velocity	Q_{cap}	Q / Q full
			(ha)	Singles	Semi's	Town's	Apt's**		Area (ha)	Pop.	(-)	(L/s)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(L/s)	(ha)	(ha)	(L/s)	(L/s)	(mm)	(%)	(m)	(m^2)	(m)	(m/s)	(L/s)	(-)
	RECON STUB	MH101A	0.000					0.0	0.0	0.0	3.80	0.00		0.00		0.00		0.00	0.0	0.000	0.000	0.000	0.00	200	1.00	38.6	0.031	0.050	1.04	32.8	0.00
BLDGA	MH101A	MH102A	0.000					0.0	0.000	0.0	3.80	0.00	0.26	0.26		0.00		0.00	0.1	0.262	0.262	0.086	0.21	250	0.50	112.2	0.049	0.063	0.86	42.0	0.01
	MH102A	MH103A	0.000					0.0	0.000	0.0	3.80	0.00		0.26		0.00		0.00	0.8	0.000	0.262	0.086	0.86	250	0.50	28.4	0.049	0.063	0.86	42.0	0.02
BLDGB	BLDGB	MH201A	0.000					0.0	0.000	0.0	3.80	0.00	0.08	0.08		0.00		0.00	0.8	0.080	0.080	0.026	0.80	200	1.00	25.4	0.031	0.050	1.04	32.8	0.02
	MH201A	EX.SAN MH	0.000					0.0	0.000	0.0	3.80	0.00		0.08		0.00		0.00	0.8	0.000	0.080	0.026	0.80	250	0.50	15.6	0.049	0.063	0.86	42.0	0.02

Sanitary Drainage Area

APPENDIX D

Stormwater Management

Table 3.1: SWM Guidelines for the Pinecrest Creek / Westboro Study Area

	Development Type	Runoff Volume Reduction	Water Quality	Water Quantity	
			TSS Removal	Flood Flow Management	Erosion Control
Commercial/Institutional and Industrial Developments - discharging directly to Ottawa River Parkway (ORP) pipe *					
5	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amerded soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	On-site removal of 80% of TSS.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
Residential Development Requiring Site Plan Control Approval - discharging upstream of Ottawa River Parkway (ORP) pipe inlet					
6	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the 10 mm and detention of the 25 mm design storms.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amerded soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal due to on-site retention in landscaped areas and detention of the 25 mm design storm.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Control (detain) the runoff from the 25 mm design storm such that the peak outflow from the site does not exceed 5.8 L/s/ha.
Residential Development Requiring Site Plan Control Approval - discharging directly to Ottawa River Parkway (ORP) pipe					
7	a) sites with soil infiltration rates ≥ 1 mm/hour	Minimum on-site retention of the 10 mm design storm.	Inherent TSS removal due to on-site retention of the 10 mm design storm.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable
	b) site's soil infiltration rates < 1 mm/hour	If the entire property is underlain by native soils with infiltration rates less than 1 mm/hr, no infiltrating SWM measures may be used. A minimum depth of 300 mm of amerded soil shall be provided below all front yard landscaped areas. A green roof and/or rain harvesting measures could be implemented to provide further runoff volume reduction.	Inherent TSS removal from on-site retention in landscaped areas.	The more stringent of the following criteria will govern: i) 1:100 year discharge from site not to exceed 33.5 L/s/ha); or ii) Requirements of City's Sewer Design Guideline (Section 8.3.7.3, revised Sept. 2008).	Not applicable

*Infiltration measures should not be used on sites or source areas where the land use or activity could generate higher concentrations of hydrocarbons, trace metals or toxicants than are found in typical stormwater runoff (e.g., vehicle refueling, handling areas for hazardous materials, etc.). This would include retail gasoline outlet sites due to the potential for spills. In addition, these measures should be sited so that they will not receive runoff from high traffic areas where large amounts of de-icing salts are used. The design of these systems shall be in accordance with the guidance in the Stormwater Management Planning and Design Manual (MOE, 2003) and the Low Impact Development Stormwater Management Planning and Design Guide (CVC & TRCA, 2010).

Note: For a mixed use property, if surface parking has been provided the site will be considered commercial. If surface parking has not been provided, the site will be considered residential for the purposes of applying the SWM criteria in this table.

Detailed Stormceptor Sizing Report – 2525 Carling Ave. (Split 2)

Project Information & Location			
Project Name	2525 Carling Ave.	**Project Number**	-
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	12/16/2018
Designer Information		**EOR Information (optional)**	
Name	Brandon O'Leary	**Name**	Brandon Chow
Company	Forterra	**Company**	David Schaeffer Engineering Ltd.
Phone #	905-630-0359	**Phone #**	
Email	brandon.oleary@forterrabp.com	**Email**	

Stormwater Treatment Recommendation

The recommended Stormceptor Model(s) which achieve or exceed the user defined water quality objective for each site within the project are listed in the below Sizing Summary table.

Site Name	2525 Carling Ave. (Split 2)
Recommended Stormceptor Model	EFO12
TSS Removal (%) Provided	83
Particle Size Distribution (PSD)	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

The recommended Stormceptor model achieves the water quality objectives based on the selected inputs, historical rainfall records and selected particle size distribution.

EFO Sizing Summary			
EFO Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**	**Standard EFO Hydrocarbon Storage Capacity**
EFO4	51	51	265 L (70 gal)
EFO6	65	73	610 L (160 gal)
EFO8	72	84	1070 L (280 gal)
EFO10	79	91	1670 L (440 gal)
EFO12	83	94	2475 L (655 gal)
Parallel Units / MAX	Custom	Custom	Custom

For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

OVERVIEW

Stormceptor ® EF is a continuation and evolution of the most globally recognized oil-grit separator (OGS) stormwater treatment technology - **Stormceptor ®.** Also known as a hydrodynamic separator, the enhanced flow Stormceptor EF is a high performing oil-grit separator that effectively removes a wide variety of pollutants from stormwater and snowmelt runoff at higher flow rates as compared to the original Stormceptor. Stormceptor EF captures and retains sediment (TSS), free oils, gross pollutants and other pollutants that attach to particles, such as nutrients and metals. Stormceptor EF's patent-pending treatment and scour prevention technology and internal bypass ensures sediment is retained during all rainfall events.

Design Methodology

Stormceptor is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology using local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective. The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. The Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing:

- Site parameters
- Continuous historical rainfall data, including duration, distribution, peaks & inter-event dry periods
- Particle size distribution, and associated settling velocities (Stokes Law, corrected for drag)
- TSS load
- Detention time of the system

Hydrology Analysis
PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of Stormceptor are based on the average annual removal of TSS for the selected site parameters. The Stormceptor is engineered to capture sediment particles by treating the required average annual runoff volume, ensuring positive removal efficiency is maintained during each rainfall event, and preventing negative removal efficiency (scour). Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station			
State/Province	Ontario	**Total Number of Rainfall Events**	4093
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	1990.7
Elevation (ft)	370	**Total Infiltration (mm)**	1449.7
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	17537.7

Notes
• Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor, which uses the EPA Rainfall and Runoff modules. • Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal defined by the selected PSD, and based on stable site conditions only, after construction is completed. • For submerged applications or sites specific to spill control, please contact your local Stormceptor representative for further design assistance.

ONLINE APPLICATION

Stormceptor EF's internal bypass and patent-pending scour prevention technology has demonstrated very effective retention of pollutants in third-party testing and verification following the Canadian ETV's **Procedure for Laboratory Testing of Oil-Grit Separators.** Sediment scour prevention demonstrated an effluent concentration of less than 10 mg/L for sediment particles ranging from 1 to 1,000 microns, even during peak influent flow rates associated with infrequent high intensity storm events. While Stormceptor EF will capture oil, only the Stormceptor EFO configuration has been third-party tested and verified to retain greater than 99% of captured oil. Based on these verified performance attributes, the most efficient and widely accepted application of Stormceptor EF is an online configuration, which allows all upstream conveyance flows to enter and exit the unit. The online application eliminates the need for costly additional bypass structures, piping and installation expense.

FLOW ENTRANCE OPTIONS

Single Inlet Pipe – A common design which includes one inlet pipe and one outlet pipe. A 90-degree (maximum) bend is also accepted with this configuration.

Inlet Grate – Allows surface runoff to enter the unit from grade. The inlet grate option can also be used in conjunction with one inlet pipe or multiple inlet pipes. A removable flow deflector is added in the Stormceptor EF4/EFO4.

Maximum Pipe Diameter		
Model	Inlet (in/mm)	Outlet (in/mm)
EF4 / EFO4	24 / 610	24 / 610
EF6 / EFO6	36 / 915	36 / 915
EF8 / EFO8	48 / 1220	48 / 1220
EF10 / EFO10	72 / 1828	72 / 1828
EF12 / EFO12	72 / 1828	72 / 1828

Multiple Inlet Pipe – Allows for multiple inlet pipes of various diameters to enter the unit.

Maximum Pipe Diameter		
Model	Inlet (in/mm)	Outlet (in/mm)
EF4 / EFO4	18 / 457	24 / 610
EF6 / EFO6	30 / 762	36 / 915
EF8 / EFO8	42 / 1067	48 / 1220
EF10 / EFO10	60 / 1524	72 / 1828
EF12 / EFO12	60 / 1524	72 / 1828

Drainage Area	
Total Area (ha)	3.08
Imperviousness %	93

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000

Up Stream Flow Diversion	
Max. Flow to Stormceptor (cms)	

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	
Pipe Material	
Multiple Inlets (Y/N)	No
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

Removing the smallest fraction of particulates from runoff ensures the majority of pollutants, such as metals, hydrocarbons and nutrients are captured. The table below identifies the Particle Size Distribution (PSD) that was selected to define TSS removal for the Stormceptor design.

Fine Distribution		
Particle Diameter (microns)	Distribution %	Specific Gravity
20.0	20.0	1.30
60.0	20.0	1.80
150.0	20.0	2.20
400.0	20.0	2.65
2000.0	20.0	2.65

Site Name	2525 Carling Ave. (Split 2)

Site Details

Drainage Area

Total Area (ha)	3.08
Imperviousness %	93
Oil Spill Capture Volume (L)	

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Surface Characteristics

Width (m)	351.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (L/s)	0

Maintenance Frequency

Maintenance Frequency (months) >	12

Winter Months

Winter Infiltration	0

TSS Loading Parameters

TSS Loading Function	Build Up/ Wash-off

Buildup/Wash-off Parameters

Target Event Mean Conc. (EMC) mg/L	125
Exponential Buildup Power	0.40
Exponential Washoff Exponent	0.20

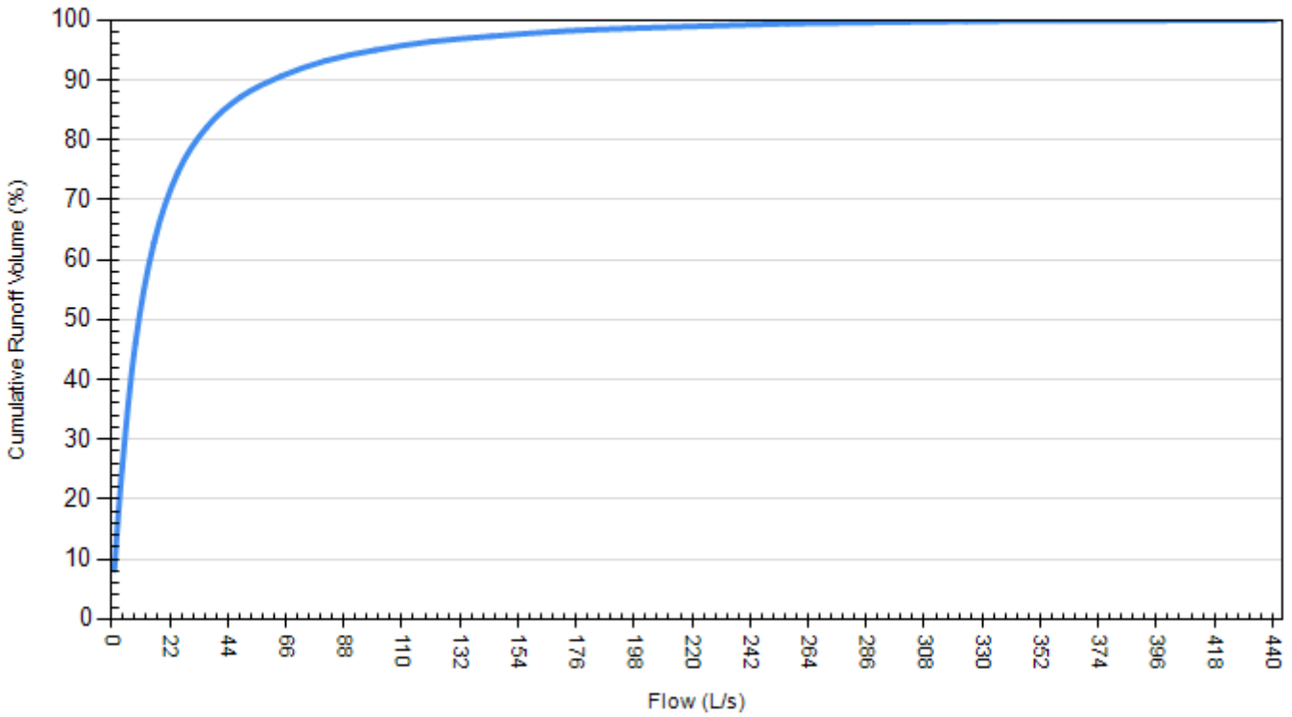
TSS Availability Parameters

Availability Constant A	0.057
Availability Factor B	0.04
Availability Exponent C	1.10
Min. Particle Size Affected by Availability (micron)	400

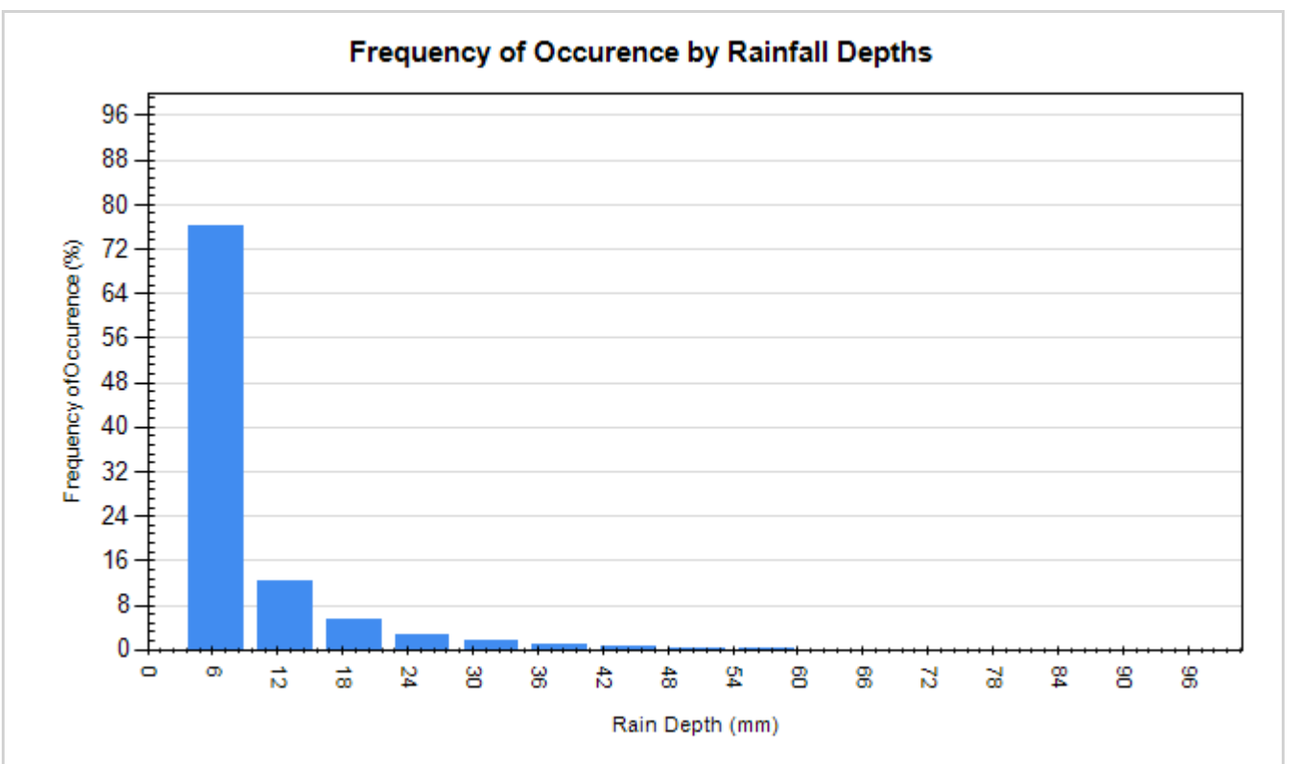
Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	**Runoff Volume (m³)**	**Volume Over (m³)**	**Cumulative Runoff Volume (%)**
1	44522	498290	8.2
4	137511	405294	25.3
9	250280	292669	46.1
16	340882	201916	62.8
25	404197	138567	74.5
36	445888	96967	82.1
49	473208	69578	87.2
64	492025	50777	90.6
81	505815	36979	93.2
100	515905	26904	95.0
121	523071	19728	96.4
144	528397	14405	97.3
169	532409	10393	98.1
196	535394	7410	98.6
225	537645	5157	99.0
256	539442	3362	99.4
289	540784	2019	99.6
324	541660	1144	99.8
361	542122	682	99.9
400	542388	416	99.9
441	542590	214	100.0

Cumulative Runoff Volume by Runoff Rate

For area: 3.08(ha), imperviousness: 93.0%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A



Rainfall Event Analysis				
Rainfall Depth (mm)	**No. of Events**	**Percentage of Total Events (%)**	**Total Volume (mm)**	**Percentage of Annual Volume (%)**
6.35	3113	76.1	5230	24.9
12.70	501	12.2	4497	21.4
19.05	225	5.5	3469	16.5
25.40	105	2.6	2317	11.0
31.75	62	1.5	1765	8.4
38.10	35	0.9	1206	5.8
44.45	28	0.7	1163	5.5
50.80	12	0.3	557	2.7
57.15	7	0.2	378	1.8
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0



STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Manning 0.013

	LOCATION		AREA (Ha)				FLOW			SEWER DATA								
			5 YEAR				Time of	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	Conc.	5 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	LOW (min	Q/Q full
A109	109	110	0.62	0.90	1.55	1.55	10.00	104.19	161	450	450	CONC	0.75	47.2	246.9	1.55	0.51	0.65
	110	112			0.00	1.55	10.51	101.59	157	450	450	CONC	3.23	25.1	512.4	3.22	0.13	0.31
EX-3	112	113	0.73	0.90	1.84	3.38	10.64	100.95	341	525	525	CONC	1.80	8.2	577.0	2.67	0.05	0.59
					0.00	3.38												
	113	123	0.00	0.90	0.00	3.38	10.69	100.70	341	750	750	CONC	0.20	69.3	497.9	1.13	1.02	0.68
To STM 123						3.38	11.71											
A122	122	123	1.22	0.90	3.05	3.05	10.00	104.19	318	750	750	CONC	0.30	15.1	609.8	1.38	0.18	0.52
To STM 123						3.05	10.18											
BLDG-A*	123	114			0.00	6.44	11.71	95.95	650	900	900	CONC	0.20	58.1	809.6	1.27	0.76	0.80
	114	115			0.00	6.44	12.47	92.73	629	1050	1050	CONC	0.12	29.3	946.0	1.09	0.45	0.66
To STM 115						6.44	12.92											
A118	118	119	0.31	0.90	0.77	0.77	10.00	104.19	80	375	375	PVC	0.34	34.8	102.2	0.93	0.63	0.78
A119	119	107	0.30	0.90	0.74	1.51	10.63	101.00	152	450	450	CONC	0.46	19.3	193.4	1.22	0.26	0.79
To STM107						1.51	10.89											
BLDG B*									13									
A120	120	121	0.39	0.90	0.98	0.98	10.00	104.19	115	450	450	CONC	0.41	47.5	182.6	1.15	0.69	0.63
	121	105			0.00	0.98	10.69	100.69	112	450	450	CONC	0.29	17.5	153.5	0.97	0.30	0.73
To STM105						0.98	10.99											
EX-4			0.51	0.90	1.29	1.29												
A103	103	104	0.21	0.90	0.52	1.80	10.00	104.19	188	450	450	CONC	0.71	66.5	240.2	1.51	0.73	0.78
To STM 104						1.80	10.73											
A100	100	101	0.44	0.90	1.10	1.10	10.00	104.19	114	375	375	PVC	0.81	46.4	157.8	1.43	0.54	0.72
A101	101	104	0.08	0.90	0.19	1.29	10.54	101.42	131	450	450	CONC	0.34	24.9	166.2	1.05	0.40	0.79
To STM104						1.29	10.94											
	102	104			0.00	0.00	10.00	104.19	0	300	300	PVC	0.94	15.0	93.8	1.33	0.19	0.00
From STM101						1.29	10.94											
From STM103						1.80	10.73											
	104	105			0.00	3.09	10.94	99.49	307	600	600	CONC	0.28	54.4	324.9	1.15	0.79	0.95
From STM121						0.98	10.99											
	105	106			0.00	4.07	11.73	95.88	403	675	675	CONC	0.35	30.8	497.3	1.39	0.37	0.81
	106	107	0.28	0.90	0.70	4.77	12.10	94.29	463	750	750	CONC	0.27	29.9	578.5	1.3	0.4	0.80
From STM107						1.51	10.89											
	107	108			0.00	6.28	12.48	92.71	627	825	825	CONC	0.30	31.7	786.2	1.5	0.4	0.80
	108	115			0.00	6.28	12.83	91.28	618	825	825	CONC	1.06	45.8	1477.9	2.8	0.3	0.42
To STM 115						6.28	13.11											
From 108						6.28	13.11											
From 114						6.44	12.92											
	115	117			0.00	12.72	13.11	90.21	1192	1050	1050	CONC	0.44	8.6	1811.4	2.1	0.1	0.66

*** Building Flow Equal to the 100-Year Controlled Release Rate**

Definitions:
Q = 2.78 AIR, where
Q = Peak Flow in Litres per second (L/s)
A = Areas in hectares (ha)
I = Rainfall Intensity (mm/h)
R = Runoff Coefficient

Notes:
1) Ottawa Rainfall-Intensity Curve
2) Min. Vel

Designed: B.N.C.
Checked: S.L.M.
Dwg. Reference: SWM-1

PROJECT: Lincoln Fields Shopping Centre
LOCATION: 2525 Carling Avenue **City of Ottawa**
File Ref:
Date: 13 Dec 2018
Sheet No. SHEET 1 OF 1

Stormwater - Proposed Development
City of Ottawa Sewer Design Guidelines, 2012

Target Flow Rate

Area 4.355 ha
Q* 145.9 L/s
*Allowable release rate calculated at 33.5 L/s/ha per SWM Guidelines for Pinecrest Creek / Westboro Study Area

Note:
10mm of rainwater volume to be detained on-site as per Pinecrest Creek SWM Criteria.
Req. Vol. 435.5 m³

Estimated Post Development Peak Flow from Unattenuated Areas

Area ID U1
Total Area 0.03 ha
C 0.25 Rational Method runoff coefficient

	5-year					100-year				
t_c (min)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)	i (mm/hr)	Q_{actual}* (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)
10.0	104.2	2.0	2.0	0.0	0.0	178.6	4.4	4.4	0.0	0.0

Note:
C value for the 100-year storm is increased by 25%, to a maximum of 1.0 per Ottawa Sewer Design Guidelines (5.4.5.2.1)

Estimated Post Development Peak Flow from Attenuated Areas

Building ID BLDG-A
Roof Area 0.407 ha
Avail Storage Area 0.387
C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*
t_c 10 min, tc at outlet without restriction

Estimated Number of Roof Drains
Building Length 68
Building Width 55
Number of Drains 21
m^2 / Drain 184.1 max 232.25m^2/notch as recommended by Zurn for Ottawa

Roof Top Rating Curve per Zurn Model Z-105-5

d (m)	A (m^2)	V_{acc} (m^3)	V_{avail} (m^3)	Q_{notch} (L/s)	Q_{roof} (L/s)	$V_{drawdown}$ (hr)
0.000	0	0.0	0.0	0.00	0.00	0.00
0.025	241.7	2.0	2.0	0.38	7.98	0.07
0.050	966.6	14.1	16.1	0.77	16.17	0.31
0.075	2174.9	38.3	54.4	1.14	23.94	0.76
0.100	3866.5	74.5	128.9	1.52	31.92	1.40
0.125	3866.5	96.7	225.5	1.90	39.90	2.08
0.150	3866.5	96.7	322.2	2.28	47.88	2.64

* Assumes one notch opening per drain, assumes maximum slope of 10cm

	5-year					100-year				
t_c (min)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)	i (mm/hr)	Q_{actual} (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)
10	104.2	106.0	24.2	81.8	49.1	178.6	201.9	32.0	169.9	101.9
15	83.6	85.0	24.2	60.8	54.7	142.9	161.5	32.0	129.6	116.6
20	70.3	71.5	24.2	47.3	56.7	120.0	135.6	32.0	103.6	124.4
25	60.9	62.0	24.2	37.8	56.7	103.8	117.4	32.0	85.4	128.2
30	53.9	54.9	24.2	30.7	55.2	91.9	103.9	32.0	71.9	129.4
35	48.5	49.4	24.2	25.2	52.9	82.6	93.4	32.0	61.4	128.9
40	44.2	45.0	24.2	20.8	49.8	75.1	85.0	32.0	53.0	127.2
45	40.6	41.3	24.2	17.1	46.3	69.1	78.1	32.0	46.1	124.5
50	37.7	38.3	24.2	14.1	42.4	64.0	72.3	32.0	40.3	121.0
55	35.1	35.7	24.2	11.5	38.1	59.6	67.4	32.0	35.4	117.0
60	32.9	33.5	24.2	9.3	33.6	55.9	63.2	32.0	31.2	112.4
65	31.0	31.6	24.2	7.4	28.8	52.6	59.5	32.0	27.6	107.5
70	29.4	29.9	24.2	5.7	23.9	49.8	56.3	32.0	24.3	102.2
75	27.9	28.4	24.2	4.2	18.8	47.3	53.4	32.0	21.5	96.6
80	26.6	27.0	24.2	2.8	13.6	45.0	50.9	32.0	18.9	90.7
85	25.4	25.8	24.2	1.6	8.3	43.0	48.6	32.0	16.6	84.7
90	24.3	24.7	24.2	0.5	2.8	41.1	46.5	32.0	14.5	78.4
95	23.3	23.7	23.7	0.0	0.0	39.4	44.6	32.0	12.6	71.9
100	22.4	22.8	22.8	0.0	0.0	37.9	42.9	32.0	10.9	65.3
105	21.6	22.0	22.0	0.0	0.0	36.5	41.3	32.0	9.3	58.6
110	20.8	21.2	21.2	0.0	0.0	35.2	39.8	32.0	7.8	51.7

5-year Q_{roof}	**24.19 L/s**	**100-year Q_{roof}**	**31.96 L/s**
5-year Max. Storage Required	**56.7 m^3**	**100-year Max. Storage Required**	**129.4 m^3**
5-year Storage Depth	**0.076 m**	**100-year Storage Depth**	**0.100 m**
5-year Estimated Drawdown Time	**0.78 hr**	**00-year Estimated Drawdown Time**	**1.41 hr**

Building ID	BLDG-B	
Roof Area	0.090	ha
Avail Storage Area	0.086	
C	0.90	Rational Method runoff coefficient
t_c	10	min, tc at outlet without restriction

Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations

Estimated Number of Roof Drains

Building Length	31	
Building Width	31	
Number of Drains	10	
m^2 / Drain	85.5	max 232.25m^2/notch as recommended by Zurn for Ottawa

Roof Top Rating Curve per Zurn Model Z-105-5

d	A	V_{acc}	V_{avail}	Q_{notch}	Q_{roof}	$V_{drawdown}$
(m)	(m^2)	(m^3)	(m^3)	(L/s)	(L/s)	(hr)
0.000	0	0.0	0.0	0.00	0.00	0.00
0.025	53.4	0.4	0.4	0.38	3.80	0.03
0.050	213.8	3.1	3.6	0.77	7.70	0.15
0.075	480.9	8.5	12.0	1.14	11.40	0.35
0.100	855.0	16.5	28.5	1.52	15.20	0.65
0.125	855.0	21.4	49.9	1.90	19.00	0.96
0.150	855.0	21.4	71.3	2.28	22.80	1.23

* Assumes one notch opening per drain, assumes maximum slope of 10cm

	5-year					100-year				
t_c	i	Q_{actual}	$Q_{release}$	Q_{stored}	V_{stored}	i	Q_{actual}	$Q_{release}$	Q_{stored}	V_{stored}
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
10	104.2	23.4	9.9	13.6	8.1	178.6	44.6	13.3	31.4	18.8
15	83.6	18.8	9.9	8.9	8.0	142.9	35.7	13.3	22.4	20.2
20	70.3	15.8	9.9	5.9	7.1	120.0	30.0	13.3	16.7	20.0
25	60.9	13.7	9.9	3.8	5.7	103.8	26.0	13.3	12.7	19.0
30	53.9	12.1	9.9	2.2	4.0	91.9	23.0	13.3	9.7	17.4
35	48.5	10.9	9.9	1.0	2.2	82.6	20.6	13.3	7.4	15.5
40	44.2	9.9	9.9	0.0	0.1	75.1	18.8	13.3	5.5	13.2
45	40.6	9.1	9.1	0.0	0.0	69.1	17.3	13.3	4.0	10.7
50	37.7	8.5	8.5	0.0	0.0	64.0	16.0	13.3	2.7	8.1
55	35.1	7.9	7.9	0.0	0.0	59.6	14.9	13.3	1.6	5.4
60	32.9	7.4	7.4	0.0	0.0	55.9	14.0	13.3	0.7	2.5
65	31.0	7.0	7.0	0.0	0.0	52.6	13.2	13.2	0.0	0.0
70	29.4	6.6	6.6	0.0	0.0	49.8	12.4	12.4	0.0	0.0
75	27.9	6.3	6.3	0.0	0.0	47.3	11.8	11.8	0.0	0.0
80	26.6	6.0	6.0	0.0	0.0	45.0	11.2	11.2	0.0	0.0
85	25.4	5.7	5.7	0.0	0.0	43.0	10.7	10.7	0.0	0.0
90	24.3	5.5	5.5	0.0	0.0	41.1	10.3	10.3	0.0	0.0
95	23.3	5.2	5.2	0.0	0.0	39.4	9.9	9.9	0.0	0.0
100	22.4	5.0	5.0	0.0	0.0	37.9	9.5	9.5	0.0	0.0
105	21.6	4.9	4.9	0.0	0.0	36.5	9.1	9.1	0.0	0.0
110	20.8	4.7	4.7	0.0	0.0	35.2	8.8	8.8	0.0	0.0

5-year Q_{roof}	**9.70 L/s**	**100-year Q_{roof}**	**13.28 L/s**
5-year Max. Storage Required	**8.1 m^3**	**100-year Max. Storage Required**	**20.2 m^3**
5-year Storage Depth	**0.063 m**	**100-year Storage Depth**	**0.087 m**
5-year Estimated Drawdown Time	**0.26 hr**	**00-year Estimated Drawdown Time**	**0.50 hr**

* Building B Flow added to Drainage Area A120

Estimated Post Development Peak Flow from Attenuated Areas

Area ID A118, A119
Available Sub-surface Storage
Maintenance Structures

ID	CBMH 118	CBMH 119	CB 118A	CB 119A
Structure Dia./Area (mm/mm^2)	1200	1200	360	360
T/L*	73.85	73.85	73.85	73.85
INV	71.68	71.48	72.35	72.35
Depth	2.17	2.37	1.50	1.50
$V_{structure}$ (m^3)	2.5	2.7	0.2	0.2

Sewers

ID	250mm	375mm		U/G STORG.
Storage Pipe Dia (mm)	250	375		
L (m)	39.5	34.8		
V_{sewer} (m^3)	1.9	3.8		0.0

*Top of lid or max ponding elevation 74.15

Total Subsurface Storage (m^3) 11.3

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	Ponding	h_o	delta d	V*	V_{acc}**	$Q_{release}$†	$V_{drawdown}$
	(m)	(m^2)	(m)	(m)	(m^3)	(m^3)	(L/s)	(hr)
Orifice INV	71.48		0.00			0.0	0.0	0.00
	72.60		1.12	1.12	5.8	5.8	12.6	0.13
T/L	73.85	1	2.37	1.25	5.5	11.3	18.4	0.17
0.15m Ponding	74.00	948	2.52	0.15	49.3	60.6	18.9	0.89
0.30m Ponding	74.15	2907.0	2.67	0.15	275.8	336.4	19.5	4.79

* V=Incremental storage volume
**V_{acc}=Total surface and sub-surface
† $Q_{release}$ = Release rate calculated from orifice equation

Orifice Location **CBMH 119** **Dia** 75
Total Area 0.60 ha
C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c	i	Q_{actual}‡	$Q_{release}$	Q_{stored}	V_{stored}	i	Q_{actual}‡	$Q_{release}$	Q_{stored}	V_{stored}
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
10	104.2	156.8	19.1	137.8	82.7	178.6	298.6	19.4	279.2	167.5
15	83.6	125.8	19.1	106.7	96.0	142.9	239.0	19.4	219.6	197.6
20	70.3	105.7	19.1	86.7	104.0	120.0	200.6	19.4	181.2	217.4
25	60.9	91.6	19.1	72.6	108.9	103.8	173.7	19.4	154.3	231.4
30	53.9	81.2	19.1	62.1	111.8	91.9	153.6	19.4	134.2	241.6
35	48.5	73.0	19.1	54.0	113.3	82.6	138.1	19.4	118.7	249.3
40	44.2	66.5	19.1	47.4	113.8	75.1	125.7	19.4	106.3	255.1
45	40.6	61.1	19.1	42.1	113.6	69.1	115.5	19.4	96.1	259.4
50	37.7	56.7	19.1	37.6	112.8	64.0	106.9	19.4	87.6	262.7
55	35.1	52.9	19.1	33.8	111.5	59.6	99.7	19.4	80.3	265.1
60	32.9	49.6	19.1	30.5	109.9	55.9	93.5	19.4	74.1	266.7
65	31.0	46.7	19.1	27.7	107.9	52.6	88.0	19.4	68.7	267.8
70	29.4	44.2	19.1	25.1	105.6	49.8	83.3	19.4	63.9	268.3
75	27.9	42.0	19.1	22.9	103.1	47.3	79.0	19.4	59.6	268.4
80	26.6	40.0	19.1	20.9	100.4	45.0	75.2	19.4	55.9	268.1
85	25.4	38.2	19.1	19.1	97.5	43.0	71.8	19.4	52.5	267.5
90	24.3	36.6	19.1	17.5	94.5	41.1	68.7	19.4	49.4	266.6
95	23.3	35.1	19.1	16.0	91.3	39.4	65.9	19.4	46.6	265.4
100	22.4	33.7	19.1	14.7	88.0	37.9	63.4	19.4	44.0	264.0
105	21.6	32.5	19.1	13.4	84.6	36.5	61.0	19.4	41.7	262.4
110	20.8	31.3	19.1	12.3	81.0	35.2	58.9	19.4	39.5	260.6

5-year $Q_{attenuated}$ 19.06 L/s **100-year $Q_{attenuated}$ 19.37 L/s**
5-year Max. Storage Required 113.8 m^3 **100-year Max. Storage Required 268.4 m^3**
Est. 5-year Storage Elevation 74.03 m **Est. 100-year Storage Elevation 74.11 m**

Area ID A120

Available Sub-surface Storage

Maintenance Structures

ID	MH 120	MH 121	CB 120A	CB 120B	CB 121A
Structure Dia./Area (mm/mm^2)	1200	1200	360	360	360
T/L*	73.85	73.85	74.05	74.05	74.05
INV	72.19	71.97	72.55	72.55	72.55
Depth	1.66	1.88	1.50	1.50	1.50
$V_{structure}$ (m^3)	1.9	2.1	0.2	0.2	0.2

Sewers

ID	250mm	450mm		U/G STORG.
Storage Pipe Dia (mm)	250	450		
L (m)	43.7	47.5		
V_{sewer} (m^3)	2.1	7.6		165.0
	*Top of lid or max ponding elevation			74.30

Total Subsurface Storage (m^3) 179.3

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	**Ponding**	**h_o**	**delta d**	**V***	**V_{acc}****	**$Q_{release}$†**	**$V_{drawdown}$**
	(m)	**(m^2)**	**(m)**	**(m)**	**(m^3)**	**(m^3)**	**(L/s)**	**(hr)**
Orifice INV	71.97		0.00			0.0	0.0	0.00
Storage Pipe OBV	72.46		0.49	0.49	174.7	174.7	4.5	10.78
T/L	74.05	1	2.08	1.59	4.6	179.3	10.5	4.74
0.15m Ponding	74.20	440	2.23	0.15	23.1	202.4	10.8	5.21
0.25m Ponding	74.30	1264.0	2.33	0.10	81.7	284.1	11.0	7.17

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **MH 121 TEMPEST LMF 90**

Total Area 0.39 ha

C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c (min)	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**
10	104.2	112.0	10.0	102.0	61.2	178.6	207.7	10.9	196.8	118.1
20	70.3	115.6	10.0	105.6	126.7	120.0	143.9	10.9	133.0	159.6
25	60.9	101.5	10.0	91.5	137.3	103.8	126.4	10.9	115.5	173.2
30	53.9	91.1	10.0	81.1	145.9	91.9	113.3	10.9	102.4	184.3
35	48.5	82.9	10.0	72.9	153.1	82.6	103.2	10.9	92.3	193.8
40	44.2	76.4	10.0	66.4	159.3	75.1	95.1	10.9	84.2	202.1
45	40.6	71.0	10.0	61.0	164.8	69.1	88.5	10.9	77.6	209.4
50	37.7	65.8	10.0	55.8	167.4	64.0	82.9	10.9	72.0	216.1
55	35.1	61.3	10.0	51.3	169.4	59.6	78.2	10.9	67.3	222.1
60	32.9	57.5	10.0	47.5	170.9	55.9	74.1	10.9	63.2	227.7
65	31.0	54.1	10.0	44.1	172.1	52.6	70.6	10.9	59.7	232.9
70	29.4	51.2	10.0	41.2	173.0	49.8	67.4	10.9	56.5	237.2
75	27.9	48.6	10.0	38.6	173.6	47.3	63.9	10.9	53.0	238.5
80	26.6	46.3	10.0	36.3	174.0	45.0	60.8	10.9	49.9	239.5
85	25.4	44.2	10.0	34.2	174.2	43.0	58.0	10.9	47.1	240.3
90	24.3	42.3	10.0	32.3	174.2	41.1	55.5	10.9	44.6	240.8
95	23.3	40.5	10.0	30.5	174.1	39.4	53.2	10.9	42.3	241.2
100	22.4	39.0	10.0	29.0	173.8	37.9	51.1	10.9	40.2	241.4
105	21.6	37.5	10.0	27.5	173.4	36.5	49.2	10.9	38.3	241.4
110	20.8	36.2	10.0	26.2	172.9	35.2	47.5	10.9	36.6	241.2
115	20.1	35.0	10.0	25.0	172.3	34.0	45.8	10.9	34.9	241.0

‡ Includes controlled flow from BLDG-B

5-year $Q_{attenuated}$	**4.49 L/s**	**100-year $Q_{attenuated}$**	**10.90 L/s**
5-year Max. Storage Required	**174.2 m^3**	**100-year Max. Storage Required**	**241.4 m^3**
Est. 5-year Storage Elevation	**72.46 m**	**Est. 100-year Storage Elevation**	**74.25 m**

Area ID A100, A101

Available Sub-surface Storage

Maintenance Structures

ID	MH 100	MH 101	DCB 100A	DCB 100B	CB 101A
Structure Dia./Area (mm/mm^2)	1200	1200	720	720	360
T/L*	74.13	74.05	74.00	74.00	74.00
INV	71.95	71.50	72.50	72.50	72.50
Depth	2.18	2.55	1.50	1.50	1.50
$V_{structure}$ (m^3)	2.5	2.9	0.8	0.8	0.2

Sewers

ID	250mm	375mm		U/G STORG.
Storage Pipe Dia (mm)	250	375		
L (m)	12.3	46.4		
V_{sewer} (m^3)	0.6	5.1		239.0
	*Top of lid or max ponding elevation			74.20

Total Subsurface Storage (m^3) 251.8

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	**Ponding**	**h_o**	**delta d**	**V***	**V_{acc}****	**$Q_{release}$†**	**$V_{drawdown}$**
	(m)	**(m^2)**	**(m)**	**(m)**	**(m^3)**	**(m^3)**	**(L/s)**	**(hr)**
Orifice INV	71.50		0.00			0.0	0.0	0.00
Storage Pipe OBV	72.03		0.53	0.53	244.7	244.7	3.5	19.42
T/L	74.00	2	2.50	1.97	7.1	251.8	5.9	11.86
0.10m Ponding	74.10	208	2.60	0.10	7.6	259.5	6.0	12.01
0.20m Ponding	74.20	782.0	2.70	0.10	46.4	305.9	6.2	13.71

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **MH 101 TEMPEST LMF 65**

Total Area 0.51 ha

C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c (min)	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**
10	104.2	133.9	2.3	131.6	79.0	178.6	255.0	6.1	248.9	149.3
15	83.6	107.4	2.3	105.1	94.6	142.9	204.1	6.1	198.0	178.2
20	70.3	90.3	2.3	88.0	105.6	120.0	171.3	6.1	165.2	198.2
25	60.9	78.3	2.3	76.0	114.0	103.8	148.3	6.1	142.2	213.3
30	53.9	69.3	2.3	67.0	120.6	91.9	131.2	6.1	125.1	225.1
35	48.5	62.4	2.3	60.1	126.1	82.6	117.9	6.1	111.8	234.8
40	44.2	56.8	2.3	54.5	130.8	75.1	107.3	6.1	101.2	242.9
45	40.6	52.2	2.3	49.9	134.8	69.1	98.6	6.1	92.5	249.7
50	37.7	48.4	2.3	46.1	138.3	64.0	91.3	6.1	85.2	255.6
55	35.1	45.2	2.3	42.8	141.4	59.6	85.2	6.1	79.0	260.8
60	32.9	42.3	2.3	40.0	144.1	55.9	79.8	6.1	73.7	265.3
65	31.0	39.9	2.3	37.6	146.6	52.6	75.2	6.1	69.1	269.3
70	29.4	37.8	2.3	35.4	148.9	49.8	71.1	6.1	65.0	272.9
75	27.9	35.9	2.3	33.5	150.9	47.3	67.5	6.1	61.4	276.1
80	26.6	34.1	2.3	31.8	152.8	45.0	64.3	6.1	58.1	279.0
85	25.4	32.6	2.3	30.3	154.5	43.0	61.4	6.1	55.2	281.6
90	24.3	31.2	2.3	28.9	156.1	41.1	58.7	6.1	52.6	283.9
95	23.3	30.0	2.3	27.7	157.6	39.4	56.3	6.1	50.2	286.1
100	22.4	28.8	2.3	26.5	159.0	37.9	54.1	6.1	48.0	288.0
105	21.6	27.7	2.3	25.4	160.2	36.5	52.1	6.1	46.0	289.8
110	20.8	26.8	2.3	24.5	161.4	35.2	50.3	6.1	44.1	291.3

5-year $Q_{attenuated}$ **2.31 L/s** **100-year $Q_{attenuated}$** **6.14 L/s**

5-year Max. Storage Required **161.4 m^3** **100-year Max. Storage Required** **291.3 m^3**

Est. 5-year Storage Elevation **71.85 m** **Est. 100-year Storage Elevation** **74.17 m**

Area ID A109

Available Sub-surface Storage

Maintenance Structures

ID	MH 109	MH 110	CB 109A	CB 109B	CB 109C	CB 109D
Structure Dia./Area (mm/mm^2)	1200	1200	360	360	360	360
T/L*	73.25	73.21	73.05	73.20	73.20	73.20
INV	71.23	70.78	71.55	71.70	71.70	71.70
Depth	2.02	2.43	1.50	1.50	1.50	1.50
$V_{structure}$ (m^3)	2.3	2.7	0.2	0.2	0.2	0.2

Sewers

ID	250mm	375mm		U/G STORG.
Storage Pipe Dia (mm)	250	375		
L (m)	28.5	47.15		
V_{sewer} (m^3)	1.4	5.2		255.0
	*Top of lid or max ponding elevation			73.35

Total Subsurface Storage (m^3) 267.4

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	**Ponding**	**h_o**	**delta d**	**V***	**V_{acc}****	**$Q_{release}$†**	**$V_{drawdown}$**
	(m)	**(m^2)**	**(m)**	**(m)**	**(m^3)**	**(m^3)**	**(L/s)**	**(hr)**
Orifice INV	70.78		0.00			0.0	0.0	0.00
Storage Pipe OBV	71.42		0.64	0.64	261.6	261.6	4.0	18.17
T/L	73.05	0	2.27	1.63	5.8	267.4	8.5	8.74
0.15m Ponding	73.20	142	2.42	0.15	7.5	274.9	8.8	8.68
0.30m Ponding	73.35	870.0	2.57	0.15	68.2	343.1	9.2	10.36

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **MH 110 TEMPEST LMF 80**

Total Area 0.62 ha

C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c (min)	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**
10	104.2	161.0	2.9	158.0	94.8	178.6	306.5	9.2	297.4	178.4
15	83.6	129.1	2.9	126.1	113.5	142.9	245.3	9.2	236.1	212.5
20	70.3	108.5	2.9	105.6	126.7	120.0	205.9	9.2	196.7	236.1
25	60.9	94.1	2.9	91.1	136.7	103.8	178.3	9.2	169.1	253.6
30	53.9	83.3	2.9	80.4	144.7	91.9	157.7	9.2	148.5	267.4
35	48.5	75.0	2.9	72.0	151.2	82.6	141.8	9.2	132.6	278.4
40	44.2	68.3	2.9	65.3	156.8	75.1	129.0	9.2	119.8	287.6
45	40.6	62.8	2.9	59.8	161.5	69.1	118.5	9.2	109.4	295.3
50	37.7	58.2	2.9	55.2	165.7	64.0	109.8	9.2	100.6	301.8
55	35.1	54.3	2.9	51.3	169.3	59.6	102.4	9.2	93.2	307.5
60	32.9	50.9	2.9	47.9	172.6	55.9	96.0	9.2	86.8	312.4
65	31.0	48.0	2.9	45.0	175.6	52.6	90.4	9.2	81.2	316.7
70	29.4	45.4	2.9	42.4	178.2	49.8	85.5	9.2	76.3	320.5
75	27.9	43.1	2.9	40.1	180.6	47.3	81.1	9.2	71.9	323.8
80	26.6	41.0	2.9	38.1	182.8	45.0	77.2	9.2	68.1	326.7
85	25.4	39.2	2.9	36.2	184.9	43.0	73.7	9.2	64.6	329.3
90	24.3	37.5	2.9	34.6	186.7	41.1	70.6	9.2	61.4	331.6
95	23.3	36.0	2.9	33.1	188.4	39.4	67.7	9.2	58.5	333.6
100	22.4	34.6	2.9	31.7	190.0	37.9	65.1	9.2	55.9	335.4
105	21.6	33.3	2.9	30.4	191.5	36.5	62.7	9.2	53.5	336.9
110	20.8	32.2	2.9	29.2	192.9	35.2	60.4	9.2	51.3	338.3

5-year $Q_{attenuated}$ **2.95 L/s** **100-year $Q_{attenuated}$** **9.17 L/s**

5-year Max. Storage Required **192.9 m^3** **100-year Max. Storage Required** **338.3 m^3**

Est. 5-year Storage Elevation **71.25 m** **Est. 100-year Storage Elevation** **73.34 m**

Estimated Post Development Peak Flow from Attenuated Areas

Area ID A122
Available Sub-surface Storage
Maintenance Structures

ID	CBMH 122	DCB 122A	DCB 122B
Structure Dia./Area (mm/mm^2)	1200	720	720
T/L*	71.70	71.70	71.70
INV	69.77	70.20	70.20
Depth	1.93	1.50	1.50
$V_{structure}$ (m^3)	2.2	0.8	0.8

Sewers

ID	250mm			U/G STORG.
Storage Pipe Dia (mm)	250			
L (m)	69.6			
V_{sewer} (m^3)	3.4			250.0
*Top of lid or max ponding elevation				72.00

Total Subsurface Storage (m^3) 257.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	**Ponding**	**h_o**	**delta d**	**V***	**V_{acc}****	**$Q_{release}$†**	**$V_{drawdown}$**
	(m)	**(m^2)**	**(m)**	**(m)**	**(m^3)**	**(m^3)**	**(L/s)**	**(hr)**
Orifice INV	69.77		0.00			0.0	0.0	0.00
Storage Pipe OBV	70.44		0.67	0.67	253.4	253.4	9.8	7.20
T/L	71.70	2	1.93	1.26	3.7	257.2	16.6	4.31
0.15m Ponding	71.85	1,348	2.08	0.15	70.0	327.1	17.2	5.28
0.30m Ponding	72.00	3690	2.23	0.15	363.4	690.5	17.8	10.76

* V=Incremental storage volume
**V_{acc}=Total surface and sub-surface
† $Q_{release}$ = Release rate calculated from orifice equation

Orifice Location **CBMH 122** **Dia** 75
Total Area 1.22 ha
C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c	**i**	**Q_{actual}‡**	**$Q_{release}$**	**Q_{stored}**	**V_{stored}**	**i**	**Q_{actual}‡**	**$Q_{release}$**	**Q_{stored}**	**V_{stored}**
(min)	**(mm/hr)**	**(L/s)**	**(L/s)**	**(L/s)**	**(m^3)**	**(mm/hr)**	**(L/s)**	**(L/s)**	**(L/s)**	**(m^3)**
10	104.2	318.0	17.2	300.9	180.5	178.6	605.6	17.8	587.8	352.7
20	70.3	214.4	17.2	197.3	236.7	120.0	406.8	17.8	389.0	466.8
30	53.9	164.6	17.2	147.4	265.4	91.9	311.6	17.8	293.8	528.8
40	44.2	134.9	17.2	117.7	282.5	75.1	254.9	17.8	237.1	568.9
50	37.7	114.9	17.2	97.8	293.3	64.0	216.9	17.8	199.1	597.3
60	32.9	100.6	17.2	83.4	300.2	55.9	189.6	17.8	171.8	618.3
70	29.4	89.7	17.2	72.5	304.4	49.8	168.9	17.8	151.1	634.4
80	26.6	81.1	17.2	63.9	306.7	45.0	152.6	17.8	134.8	646.9
90	24.3	74.1	17.2	57.0	307.6	41.1	139.4	17.8	121.6	656.7
100	22.4	68.4	17.2	51.2	307.3	37.9	128.6	17.8	110.7	664.4
110	20.8	63.6	17.2	46.4	306.1	35.2	119.4	17.8	101.6	670.4
120	19.5	59.4	17.2	42.2	304.2	32.9	111.6	17.8	93.8	675.0
130	18.3	55.8	17.2	38.7	301.6	30.9	104.8	17.8	87.0	678.4
140	17.3	52.7	17.2	35.5	298.5	29.2	98.9	17.8	81.1	680.9
150	16.4	49.9	17.2	32.8	294.9	27.6	93.6	17.8	75.8	682.5
160	15.6	47.5	17.2	30.3	291.0	26.2	89.0	17.8	71.2	683.3
170	14.8	45.3	17.2	28.1	286.6	25.0	84.8	17.8	67.0	683.5
180	14.2	43.3	17.2	26.1	282.0	23.9	81.1	17.8	63.3	683.1
190	13.6	41.5	17.2	24.3	277.1	22.9	77.7	17.8	59.8	682.2
200	13.0	39.8	17.2	22.7	271.9	22.0	74.6	17.8	56.7	680.9
210	12.6	38.3	17.2	21.2	266.5	21.1	71.7	17.8	53.9	679.1

5-year $Q_{attenuated}$ **17.04 L/s** **100-year $Q_{attenuated}$** **17.81 L/s**
5-year Max. Storage Required **307.6 m^3** **100-year Max. Storage Required** **683.5 m^3**
Est. 5-year Storage Elevation **71.81 m** **Est. 100-year Storage Elevation** **72.00 m**

Area ID A103-A

Available Sub-surface Storage

Maintenance Structures

ID	**CB 103A**				
Structure Dia./Area (mm/mm^2)	360				
T/L*	74.50				
INV	73.00				
Depth	1.50				
$V_{structure}$ (m^3)	0.2				

Sewers

ID				
Storage Pipe Dia (mm)				
L (m)				
V_{sewer} (m^3)				0.0

*Top of lid or max ponding elevation 74.70

Total Subsurface Storage (m^3) 0.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	**Ponding**	**h_o**	**delta d**	**V***	**V_{acc}****	**$Q_{release}$†**	**$V_{drawdown}$**
	(m)	**(m^2)**	**(m)**	**(m)**	**(m^3)**	**(m^3)**	**(L/s)**	**(hr)**
Orifice INV	73.00		0.00			0.0	0.0	0.00
T/L	74.50	0	1.50	1.50	0.2	0.2	3.2	0.02
0.05m Ponding	74.55	10	1.55	0.05	0.2	0.4	3.3	0.03
0.20m Ponding	74.70	139.0	1.70	0.15	9.3	9.7	3.5	0.77

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **CB 103A TEMPEST LMF 55**

Total Area 0.03 ha

C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c (min)	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**
10	104.2	8.3	3.4	5.0	3.0	178.6	15.9	3.5	12.4	7.4
15	83.6	6.7	3.4	3.3	3.0	142.9	12.7	3.5	9.2	8.3
20	70.3	5.6	3.4	2.3	2.7	120.0	10.7	3.5	7.2	8.6
25	60.9	4.9	3.4	1.5	2.3	103.8	9.2	3.5	5.8	8.6
30	53.9	4.3	3.4	1.0	1.7	91.9	8.2	3.5	4.7	8.4
35	48.5	3.9	3.4	0.5	1.1	82.6	7.3	3.5	3.9	8.1
40	44.2	3.5	3.4	0.2	0.4	75.1	6.7	3.5	3.2	7.7
45	40.6	3.3	3.3	0.0	0.0	69.1	6.1	3.5	2.7	7.2
50	37.7	3.0	3.0	0.0	0.0	64.0	5.7	3.5	2.2	6.6
55	35.1	2.8	2.8	0.0	0.0	59.6	5.3	3.5	1.8	6.0
60	32.9	2.6	2.6	0.0	0.0	55.9	5.0	3.5	1.5	5.4
65	31.0	2.5	2.5	0.0	0.0	52.6	4.7	3.5	1.2	4.7
70	29.4	2.3	2.3	0.0	0.0	49.8	4.4	3.5	0.9	4.0
75	27.9	2.2	2.2	0.0	0.0	47.3	4.2	3.5	0.7	3.3
80	26.6	2.1	2.1	0.0	0.0	45.0	4.0	3.5	0.5	2.5
85	25.4	2.0	2.0	0.0	0.0	43.0	3.8	3.5	0.3	1.7
90	24.3	1.9	1.9	0.0	0.0	41.1	3.7	3.5	0.2	1.0
95	23.3	1.9	1.9	0.0	0.0	39.4	3.5	3.5	0.0	0.2
100	22.4	1.8	1.8	0.0	0.0	37.9	3.4	3.5	0.0	0.0
105	21.6	1.7	1.7	0.0	0.0	36.5	3.2	3.5	0.0	0.0
110	20.8	1.7	1.7	0.0	0.0	35.2	3.1	3.5	0.0	0.0

5-year $Q_{attenuated}$ **3.36 L/s** **100-year $Q_{attenuated}$** **3.48 L/s**

5-year Max. Storage Required **3.0 m^3** **100-year Max. Storage Required** **8.6 m^3**

Est. 5-year Storage Elevation **74.59 m** **Est. 100-year Storage Elevation** **74.68 m**

Area ID A103-B

Available Sub-surface Storage

Maintenance Structures

ID	CB 103B				
Structure Dia./Area (mm/mm^2)	360				
T/L*	74.41				
INV	72.91				
Depth	1.50				
$V_{structure}$ (m^3)	0.2				

Sewers

ID				
Storage Pipe Dia (mm)				
L (m)				
V_{sewer} (m^3)				

*Top of lid or max ponding elevation 74.56

Total Subsurface Storage (m^3) 0.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	Ponding	h_o	delta d	V*	V_{acc}**	$Q_{release}$†	$V_{drawdown}$
	(m)	(m^2)	(m)	(m)	(m^3)	(m^3)	(L/s)	(hr)
Orifice INV	72.85		0.00			0.0	0.0	0.00
T/L	74.35	0	1.50	1.50	0.2	0.2	6.0	0.01
0.15m Ponding	74.50	39.0	1.65	0.15	2.2	2.3	6.3	0.10
0.25m Ponding	74.60	136.0	1.75	0.10	8.3	10.6	6.5	0.45

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **CB 103B TEMPEST LMF 75**

Total Area 0.04 ha

C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c (min)	i (mm/hr)	Q_{actual}‡ (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)	i (mm/hr)	Q_{actual}‡ (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)
10	104.2	11.2	6.3	4.9	2.9	178.6	21.3	6.5	14.9	8.9
15	83.6	9.0	6.3	2.7	2.4	142.9	17.1	6.5	10.6	9.5
20	70.3	7.6	6.3	1.2	1.5	120.0	14.3	6.5	7.9	9.4
25	60.9	6.5	6.3	0.2	0.3	103.8	12.4	6.5	5.9	8.9
30	53.9	5.8	5.8	0.0	0.0	91.9	11.0	6.5	4.5	8.1
35	48.5	5.2	5.2	0.0	0.0	82.6	9.9	6.5	3.4	7.1
40	44.2	4.7	4.7	0.0	0.0	75.1	9.0	6.5	2.5	6.0
45	40.6	4.4	4.4	0.0	0.0	69.1	8.2	6.5	1.8	4.8
50	37.7	4.0	4.0	0.0	0.0	64.0	7.6	6.5	1.2	3.5
55	35.1	3.8	3.8	0.0	0.0	59.6	7.1	6.5	0.6	2.1
60	32.9	3.5	3.5	0.0	0.0	55.9	6.7	6.5	0.2	0.7
65	31.0	3.3	3.3	0.0	0.0	52.6	6.3	6.5	0.0	0.0
70	29.4	3.2	3.2	0.0	0.0	49.8	5.9	6.5	0.0	0.0
75	27.9	3.0	3.0	0.0	0.0	47.3	5.6	6.5	0.0	0.0
80	26.6	2.9	2.9	0.0	0.0	45.0	5.4	6.5	0.0	0.0
85	25.4	2.7	2.7	0.0	0.0	43.0	5.1	6.5	0.0	0.0
90	24.3	2.6	2.6	0.0	0.0	41.1	4.9	6.5	0.0	0.0
95	23.3	2.5	2.5	0.0	0.0	39.4	4.7	6.5	0.0	0.0
100	22.4	2.4	2.4	0.0	0.0	37.9	4.5	6.5	0.0	0.0
105	21.6	2.3	2.3	0.0	0.0	36.5	4.4	6.5	0.0	0.0
110	20.8	2.2	2.2	0.0	0.0	35.2	4.2	6.5	0.0	0.0

5-year $Q_{attenuated}$ 6.31 L/s **100-year $Q_{attenuated}$ 6.47 L/s**

5-year Max. Storage Required 2.9 m^3 **100-year Max. Storage Required 9.5 m^3**

Est. 5-year Storage Elevation 74.51 m **Est. 100-year Storage Elevation 74.59 m**

Area ID A103-C

Available Sub-surface Storage

Maintenance Structures

ID	CB 103C				
Structure Dia./Area (mm/mm^2)	360				
T/L*	74.21				
INV	72.71				
Depth	1.50				
$V_{structure}$ (m^3)	0.2				

Sewers

ID				
Storage Pipe Dia (mm)				
L (m)				
V_{sewer} (m^3)				0.0
*Top of lid or max ponding elevation				74.42

Total Subsurface Storage (m^3) 0.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	Ponding	h_o	delta d	V*	V_{acc}**	$Q_{release}$†	$V_{drawdown}$
	(m)	(m^2)	(m)	(m)	(m^3)	(m^3)	(L/s)	(hr)
Orifice INV	72.62		0.00			0.0	0.0	0.00
T/L	74.12	0	1.50	1.50	0.2	0.2	9.8	0.01
0.15m Ponding	74.27	94	1.65	0.15	5.0	5.2	10.5	0.14
0.30m Ponding	74.42	428.0	1.80	0.15	36.1	41.3	11.0	1.04

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **CB 103C TEMPEST LMF 95**

Total Area 0.13 ha

C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c (min)	i (mm/hr)	Q_{actual}‡ (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)	i (mm/hr)	Q_{actual}‡ (L/s)	$Q_{release}$ (L/s)	Q_{stored} (L/s)	V_{stored} (m^3)
10	104.2	34.1	10.6	23.5	14.1	178.6	65.0	11.0	54.0	32.4
15	83.6	27.4	10.6	16.7	15.1	142.9	52.0	11.0	41.0	36.9
20	70.3	23.0	10.6	12.4	14.8	120.0	43.6	11.0	32.7	39.2
25	60.9	19.9	10.6	9.3	14.0	103.8	37.8	11.0	26.8	40.2
30	53.9	17.7	10.6	7.0	12.6	91.9	33.4	11.0	22.4	40.4
35	48.5	15.9	10.6	5.3	11.0	82.6	30.0	11.0	19.1	40.0
40	44.2	14.5	10.6	3.8	9.2	75.1	27.3	11.0	16.4	39.3
45	40.6	13.3	10.6	2.7	7.2	69.1	25.1	11.0	14.1	38.2
50	37.7	12.3	10.6	1.7	5.1	64.0	23.3	11.0	12.3	36.9
55	35.1	11.5	10.6	0.9	2.9	59.6	21.7	11.0	10.7	35.3
60	32.9	10.8	10.6	0.2	0.5	55.9	20.3	11.0	9.4	33.7
65	31.0	10.2	10.2	0.0	0.0	52.6	19.2	11.0	8.2	31.9
70	29.4	9.6	9.6	0.0	0.0	49.8	18.1	11.0	7.1	29.9
75	27.9	9.1	9.1	0.0	0.0	47.3	17.2	11.0	6.2	27.9
80	26.6	8.7	8.7	0.0	0.0	45.0	16.4	11.0	5.4	25.8
85	25.4	8.3	8.3	0.0	0.0	43.0	15.6	11.0	4.6	23.7
90	24.3	8.0	8.0	0.0	0.0	41.1	15.0	11.0	4.0	21.5
95	23.3	7.6	7.6	0.0	0.0	39.4	14.3	11.0	3.4	19.2
100	22.4	7.3	7.3	0.0	0.0	37.9	13.8	11.0	2.8	16.8
105	21.6	7.1	7.1	0.0	0.0	36.5	13.3	11.0	2.3	14.5
110	20.8	6.8	6.8	0.0	0.0	35.2	12.8	11.0	1.8	12.0

5-year $Q_{attenuated}$ 10.64 L/s **100-year $Q_{attenuated}$ 10.99 L/s**

5-year Max. Storage Required 15.1 m^3 **100-year Max. Storage Required 40.4 m^3**

Est. 5-year Storage Elevation 74.31 m **Est. 100-year Storage Elevation 74.42 m**

Area ID A106

Available Sub-surface Storage

Maintenance Structures

ID	**CB 106A**				
Structure Dia./Area (mm/mm^2)	360				
T/L*	73.02				
INV	71.52				
Depth	1.50				
$V_{structure}$ (m^3)	0.2				

Sewers

ID				
Storage Pipe Dia (mm)				
L (m)				
V_{sewer} (m^3)				0.0

*Top of lid or max ponding elevation 73.20

Total Subsurface Storage (m^3) 0.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage	**Ponding**	**h_o**	**delta d**	**V***	**V_{acc}****	**$Q_{release}$†**	**$V_{drawdown}$**
	(m)	**(m^2)**	**(m)**	**(m)**	**(m^3)**	**(m^3)**	**(L/s)**	**(hr)**
Orifice INV	71.52		0.00			0.0	0.0	0.00
T/L	73.02	0	1.50	1.50	0.2	0.2	23.5	0.00
0.15m Ponding	73.07	30	1.55	0.05	0.6	0.8	23.8	0.01
0.30m Ponding	73.20	94.0	1.68	0.13	7.7	8.4	24.8	0.09

* V=Incremental storage volume

**V_{acc}=Total surface and sub-surface

† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **CB 106A** **Dia** 95

Total Area 0.28 ha

C 0.20 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

	5-year					100-year				
t_c (min)	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**	**i (mm/hr)**	**Q_{actual}‡ (L/s)**	**$Q_{release}$ (L/s)**	**Q_{stored} (L/s)**	**V_{stored} (m^3)**
10	104.2	15.9	15.7	0.2	0.1	178.6	34.1	24.5	9.6	5.8
15	83.6	12.8	12.8	0.0	0.0	142.9	27.3	24.5	2.8	2.5
20	70.3	10.7	10.7	0.0	0.0	120.0	22.9	24.5	0.0	0.0
25	60.9	9.3	9.3	0.0	0.0	103.8	19.8	24.5	0.0	0.0
30	53.9	8.2	8.2	0.0	0.0	91.9	17.5	24.5	0.0	0.0
35	48.5	7.4	7.4	0.0	0.0	82.6	15.8	24.5	0.0	0.0
40	44.2	6.8	6.8	0.0	0.0	75.1	14.4	24.5	0.0	0.0
45	40.6	6.2	6.2	0.0	0.0	69.1	13.2	24.5	0.0	0.0
50	37.7	5.8	5.8	0.0	0.0	64.0	12.2	24.5	0.0	0.0
55	35.1	5.4	5.4	0.0	0.0	59.6	11.4	24.5	0.0	0.0
60	32.9	5.0	5.0	0.0	0.0	55.9	10.7	24.5	0.0	0.0
65	31.0	4.7	4.7	0.0	0.0	52.6	10.1	24.5	0.0	0.0
70	29.4	4.5	4.5	0.0	0.0	49.8	9.5	24.5	0.0	0.0
75	27.9	4.3	4.3	0.0	0.0	47.3	9.0	24.5	0.0	0.0
80	26.6	4.1	4.1	0.0	0.0	45.0	8.6	24.5	0.0	0.0
85	25.4	3.9	3.9	0.0	0.0	43.0	8.2	24.5	0.0	0.0
90	24.3	3.7	3.7	0.0	0.0	41.1	7.9	24.5	0.0	0.0
95	23.3	3.6	3.6	0.0	0.0	39.4	7.5	24.5	0.0	0.0
100	22.4	3.4	3.4	0.0	0.0	37.9	7.2	24.5	0.0	0.0
105	21.6	3.3	3.3	0.0	0.0	36.5	7.0	24.5	0.0	0.0
110	20.8	3.2	3.2	0.0	0.0	35.2	6.7	24.5	0.0	0.0

5-year $Q_{attenuated}$ **15.70 L/s** **100-year $Q_{attenuated}$** **24.48 L/s**

5-year Max. Storage Required **0.1 m^3** **100-year Max. Storage Required** **5.8 m^3**

Est. 5-year Storage Elevation **72.52 m** **Est. 100-year Storage Elevation** **73.15 m**

Summary of Release Rates and Storage Volumes

Control Area	Drainage Area (Ha)	Inlet Control Device	5-Year Release Rate (L/s)	5-Year Required Storage (m^3)	100-Year Release Rate (L/s)	100-Year Required Storage (m^3)	100-Year Available Storage (m^3)
Unattenuated Areas (U1)	0.028		2.0	0.0	4.4	0.0	0.0
Roof Controls (BLDG-A)	0.407		24.2	56.7	32.0	129.4	322.2
Attenutated Areas (A118+A119)	0.602	75	19.1	113.8	19.4	268.4	336.4
Attenutated Areas (A120+BLDG-B)	0.482	TEMPEST LMF 90	4.5	174.2	10.9	241.4	284.1
Attenutated Areas (A100+A101)	0.514	TEMPEST LMF 65	2.3	161.4	6.1	291.3	305.9
Attenutated Areas (A109)	0.618	TEMPEST LMF 80	2.9	192.9	9.2	338.3	343.1
Attenutated Areas (A122)	1.221	75	17.0	307.6	17.8	683.5	690.5
Attenutated Areas (A103-A)	0.032	TEMPEST LMF 55	3.4	3.0	3.5	8.6	9.7
Attenutated Areas (A103-B)	0.043	TEMPEST LMF 75	6.3	2.9	6.5	9.5	10.6
Attenutated Areas (A103-C)	0.131	TEMPEST LMF 95	10.6	15.1	11.0	40.4	41.3
Attenutated Areas (A106)	0.275	95	15.7	0.1	24.5	5.8	8.4
Total	**4.355**		**108.1**	**1027.8**	**145.2**	**2016.7**	**2352.2**

STORMTANK® Module Volume Calculator

Inputs

Project Name:	A120		
Engineer:		Date:	
Units:	SI	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	914.4
Stone Storage:	All	Porosity:	40%

Dimensions

Module		
Length:	28	m
Width:	12	m
Excavation		
Length:	28.5	m
Width:	12.5	m
Stone		
Leveling Bed:	0	m
Top Backfill:	0	m
Compacted Fill:	0	m

Results

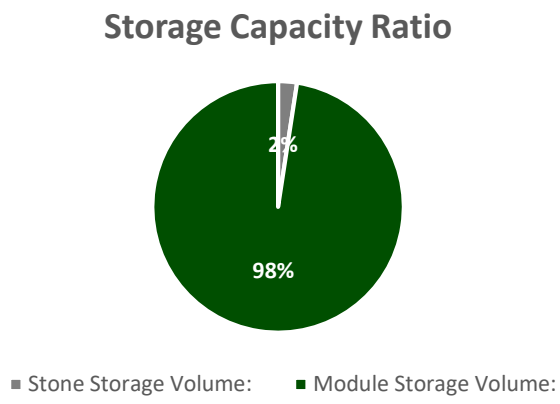
Capacity:

Stone Storage Volume:	7.41	m^3
Module Storage Volume:	298.47	m^3
Total Storage Volume:	305.88	m^3

Quantities:

Required Excavation:	325.76	m^3
Required Stone Volume:	18.52	m^3
Estimated Geotextile:	1,702.93	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

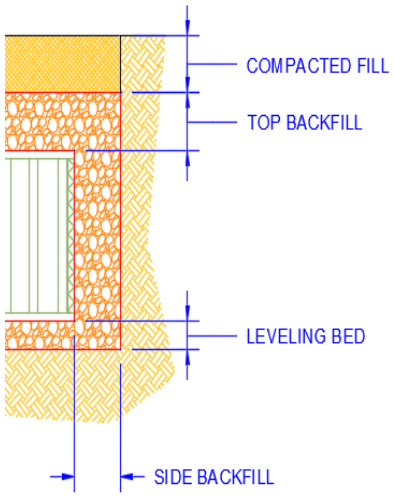


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	804	N/A	804
# of Platens	1,607	N/A	1,607
# of Side Panels	175	N/A	175
# of Columns	6,429	N/A	6,429
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	A100, A101		
Engineer:		Date:	
Units:	SI	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	914.4
Stone Storage:	All	Porosity:	40%

Dimensions

Module		
Length:	26	m
Width:	17.5	m
Excavation		
Length:	26.5	m
Width:	18	m
Stone		
Leveling Bed:	0	m
Top Backfill:	0	m
Compacted Fill:	0	m

Results

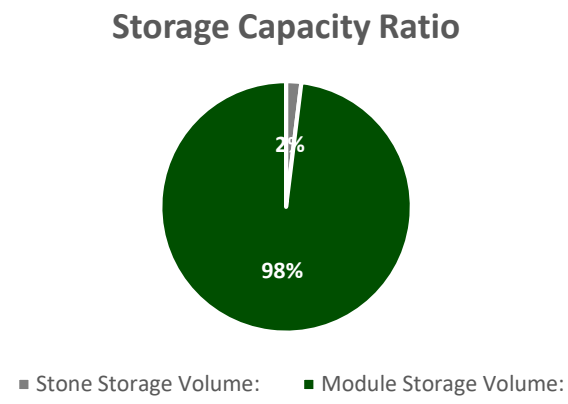
Capacity:

Stone Storage Volume:	8.05	m^3
Module Storage Volume:	404.18	m^3
Total Storage Volume:	412.23	m^3

Quantities:

Required Excavation:	436.17	m^3
Required Stone Volume:	20.12	m^3
Estimated Geotextile:	2,249.93	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

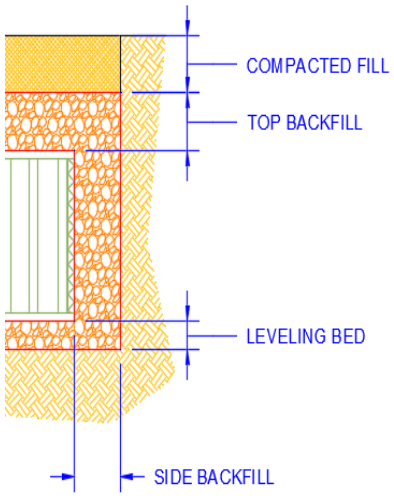


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	1,088	N/A	1,088
# of Platens	2,177	N/A	2,177
# of Side Panels	190	N/A	190
# of Columns	8,706	N/A	8,706
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	A109		
Engineer:		Date:	
Units:	SI	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	914.4
Stone Storage:	All	Porosity:	40%

Dimensions

Module		
Length:	26	m
Width:	13.5	m
Excavation		
Length:	26.5	m
Width:	14	m
Stone		
Leveling Bed:	0	m
Top Backfill:	0	m
Compacted Fill:	0	m

Results

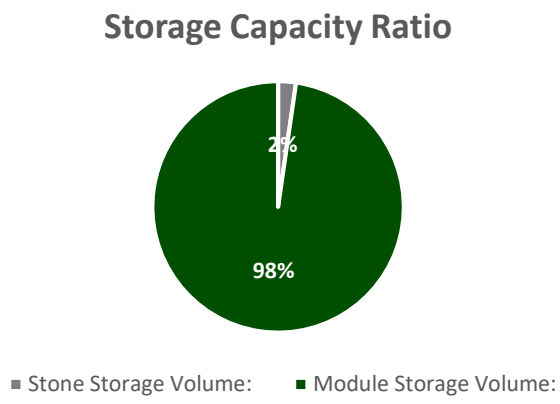
Capacity:

Stone Storage Volume:	7.32	m^3
Module Storage Volume:	311.79	m^3
Total Storage Volume:	319.11	m^3

Quantities:

Required Excavation:	339.24	m^3
Required Stone Volume:	18.29	m^3
Estimated Geotextile:	1,767.00	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

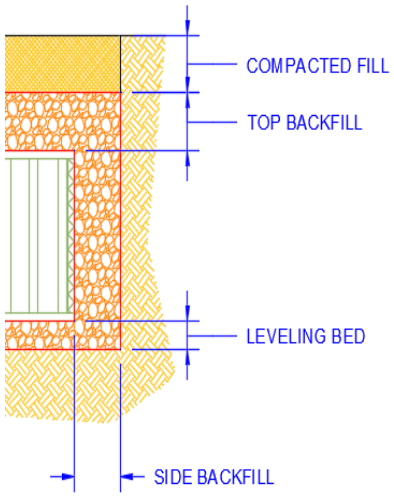


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	840	N/A	840
# of Platens	1,679	N/A	1,679
# of Side Panels	173	N/A	173
# of Columns	6,716	N/A	6,716
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	A122		
Engineer:		Date:	
Units:	SI	Shape:	Square/Rectangle
Liner:	No	Location:	N/A
Stacking:	Single	Height:	914.4
Stone Storage:	All	Porosity:	40%

Dimensions

Module		
Length:	43	m
Width:	8	m
Excavation		
Length:	43.5	m
Width:	8.5	m
Stone		
Leveling Bed:	0	m
Top Backfill:	0	m
Compacted Fill:	0	m

Results

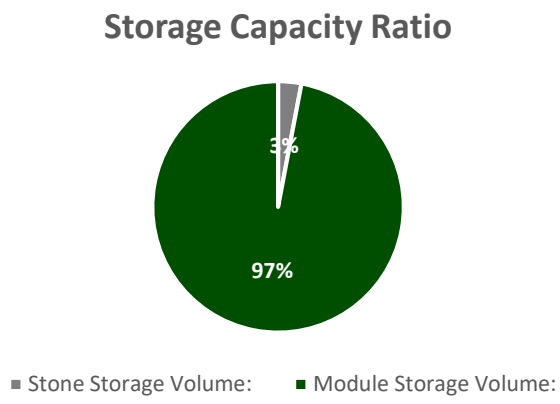
Capacity:

Stone Storage Volume:	9.42	m^3
Module Storage Volume:	305.58	m^3
Total Storage Volume:	314.99	m^3

Quantities:

Required Excavation:	338.10	m^3
Required Stone Volume:	23.55	m^3
Estimated Geotextile:	1,795.41	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

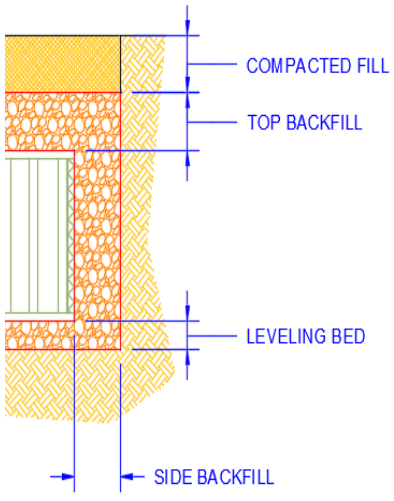


Basin Detail

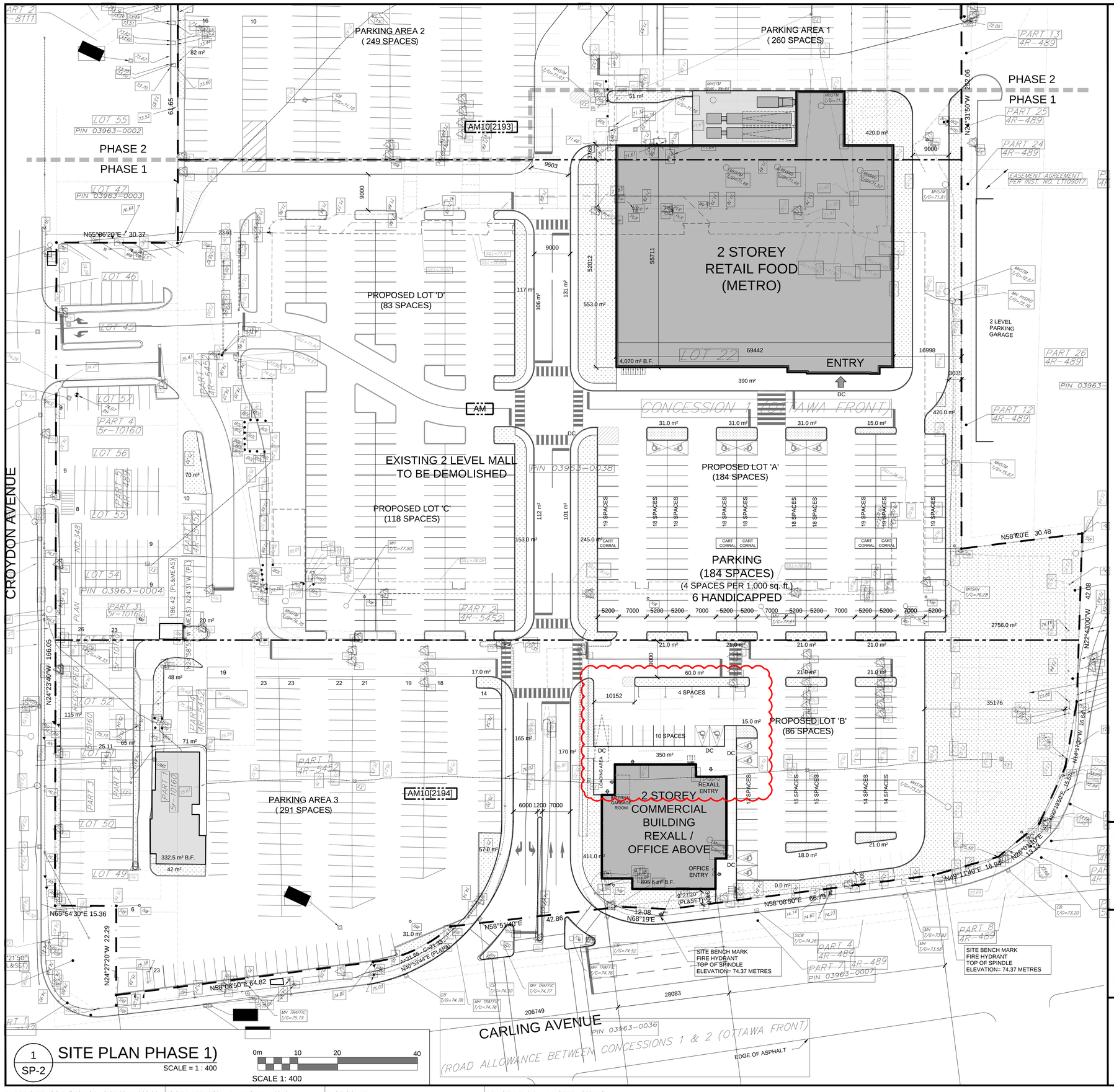
Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	823	N/A	823
# of Platens	1,646	N/A	1,646
# of Side Panels	223	N/A	223
# of Columns	6,582	N/A	6,582
# of Stacking Pins	0	N/A	0

Cross-Section:



DRAWINGS / FIGURES



1 SITE PLAN PHASE 1)
SP-2
SCALE = 1 : 400

0m 10 20 40
SCALE 1: 400

PROJECT INFORMATION

ZONING	AM10[2193] - AM10[2194] - AM
SITE AREA	65,502 sq. m. (705,057) sq. ft.
BUILDING HEIGHT	VARIES WITH MAXIMUM 30.0 M

PROJECT STATISTICS

BUILDING HEIGHT - ESTIMATE	9.0 M
BUILDING FRONTAGE	13.7%
PARKING LOT LANDSCAPE AREA	00.0%
LOADING SPACE - METRO	2
LOADING SPACE - OFFICE	1
LOADING SPACE - REXALL	0
GLAZING ALONG THE FRONTAGE	52%

GROSS BUILDING - AREAS
(CITY OF OTTAWA'S DEFINITION)

EXISTING AREAS

MALL - LEASABLE RETAIL	23,203.7 sq. m. (249,762) sq. ft.
MALL - OFFICE	2,566.5 sq. m. (27,626) sq. ft.
BLDG. 2 - WENDY'S	339.7 sq. m. (3,657) sq. ft.
BLDG. 3 - PIZZA PIZZA	325.2 sq. m. (3,500) sq. ft.
TOTAL AREA	26,435.1 sq. m. (284,545) sq. ft.

PHASE 1 AREAS

BLDG. 1 - METRO - ESTIMATE	2,620.0 sq. m. (28,202) sq. ft.
BLDG. 2 - GROUND FL. COMMERCIAL	746.6 sq. m. (8,036) sq. ft.
BLDG. 2 - SECOND FL. OFFICE	771.0 sq. m. (8,299) sq. ft.
BLDG. 3 - EXISTING WENDY'S	339.7 sq. m. (3,657) sq. ft.
TOTAL AREA	4,632.1 sq. m. (49,859) sq. ft.

LOT COVERAGE

PAVED SURFACE =	519.0 sq. m.	22.0%
BUILDING FOOTPRINT =	5,554.1 sq. m.	45.3%
LANDSCAPE OPEN SPACE =	771.3 sq. m.	32.7%
TOTAL =	65,502 sq. m.	100.0%

CAR PARKING EXISTING SITE

EXISTING TOTAL ON SITE (June 2018)	1,050

CAR PARKING TOTAL SITE - PHASE 1

REQUIRED by ZONING BY-LAW

METRO	2,620.0 sq. m. 28,202 sq. ft.	- AREA 'Z' NOT REQUIRED	0
REXALL	746.6 sq. m. 8,036 sq. ft.	- AREA 'Z' NOT REQUIRED	0
OFFICE	771.0 sq. m. 8,299 sq. ft.	- AREA 'Z' NOT REQUIRED	0
WENDY'S	339.7 sq. m. 3,657 sq. ft.	- AREA 'Z' NOT REQUIRED	0
TOTAL			0

PROVIDED

EXISTING AREA '1'	260
EXISTING AREA '2'	249
EXISTING AREA '3'	291
PROPOSED LOT 'A'	184
PROPOSED LOT 'B'	86
PROPOSED LOT 'C'	118
PROPOSED LOT 'D'	83
TOTAL	1,271

BICYCLE PARKING

REQUIRED

METRO	2,620.0 sq. m. 28,202 sq. ft.	- 1.0 PER 250m² OF G.F.A.	10
REXALL	836.1 sq. m. 9,000 sq. ft.	- 1.0 PER 250m² OF G.F.A.	3
OFFICE	836.1 sq. m. 9,000 sq. ft.	- 1.0 PER 250m² OF G.F.A.	3
WENDY'S	339.7 sq. m. 3,657 sq. ft.	- 1.0 PER 250m² OF G.F.A.	1
TOTAL			17

PROVIDED

METRO	10
REXALL	4
OFFICE	4
WENDY'S	4
TOTAL	22

NOTATION SYMBOLS:

- (00) INDICATES DRAWING NOTES, LISTED ON EACH SHEET.
- (00) INDICATES ASSEMBLIE TYPE; REFER TO TYPICAL ASSEMBLIES SCHEDULE.
- (00) INDICATES WINDOW TYPE; REFER TO WINDOW ELEVATIONS AND DETAILS ON A900 SERIES.
- (000) INDICATES DOOR TYPE; REFER TO DOOR SCHEDULE AND DETAILS ON A900 SERIES.
- 00 TITLE / 00 A900 / SCALE
- DETAIL REFERENCE PAGE
- DETAIL CROSS REFERENCE PAGE

LRT ALIGNMENT DISCLAIMER

APPROXIMATE LRT TUNNEL AND SHORING ALLOWANCE LOCATION TAKEN FROM CITY OF OTTAWA DRAWINGS *CONFEDERATION LINE WEST LRT EXTENSION - TUNNEYS PASTURE STATION TO BASELINE STATION: PLAN AND PROFILE - NEW ORCHARD STATION 95+170 - 95+770 SHEET 16, DATED JUNE 2, 2016 & GENERAL ARRANGEMENT - RICHMOND ROAD TUNNEL SHEET 102, DATED FEBRUARY 10, 2016*

No.	DESCRIPTION	DATE
3		
2	ISSUED FOR SITE PLAN CONTROL	__, __, 18
1	ISSUED TO CONSULTANTS	Sept 7, 18

REVISIONS:

ARCHITECT SEAL: ONTARIO ASSOCIATION OF ARCHITECTS — RODERICK J. LAHEY — LICENCE 4375 — SEAL DATE: STAMP DATE

NORTH ARROW:

CLIENT:
RIO CAN
REAL ESTATE INVESTMENT TRUST

ARCHITECT:
rla/architecture
roderick lahey architect inc.
56 beech street, ottawa, ontario K1S 3J6
t. 613.724.9932 f. 613.724.1209 rlaarchitecture.ca

PROJECT TITLE:
LINCOLN FIELDS
2525 CARLING AVENUE
OTTAWA ONTARIO

SHEET TITLE:
SITE PLAN
PHASE #1

DRAWN:	CHECKED:
RV	RV
SCALE: 1:400	SHEET No. SP-2
PROJECT No. 1803	

D07-12-17-0160

SURVEYOR
Stantec
1331 Clyde Avenue, Suite 400
Ottawa ON K2C 3G4
Phone: (613) 724-4096
Cell: (613) 762-7068
E-Mail: BWebster@stantec.com

LEGAL DESCRIPTION
TOPOGRAPHIC PLAN of
LOTS 45, 46, 50 TO 57 INCLUSIVE AND PART OF LOT 49
REGISTERED PLAN NO. 348 AND PART OF LOT 48, REGISTERED PLAN NO. 311 AND PART OF LOTS 22 & 23
CONCESSION 1 (OTTAWA FRONT)
[GEOGRAPHIC TOWNSHIP OF NEPEAN]
CITY OF OTTAWA

LANDSCAPE ARCHITECT
James B. Lennox & Associates Inc.
Landscape Architects
3332 Carling Ave.
Ottawa, Ontario K2H 5A8
Tel: 613-722-5168
Fax: 1-866-343-3942
Email: JL@jbla.ca

PROJECT DEVELOPER
RioCan
Real Estate Investment Trust
2300 Yonge Street, Suite 500,
Toronto Ontario M4P 1E4
Tel: 416-866-3033; 1-800-465-2733
Fax: 416-866-3020
E-Mail: Ctruong@riocan.com

CIVIL ENGINEER
David Schaeffer Engineering ltd.
120 Iber Road, Unit 203
Stittsville, ON K2S 1E9
Tel: (613) 836-0856
Fax: (613) 836-7183
Email: rfreel@DSEL.ca

URBAN PLANNER
FoTenn Consultants Inc.
223 McLeod Street
Ottawa, ON Canada, K2P 0Z8
Tel.: (613) 730-5709
Fax: (613) 730-1136
E-Mail: morris@fotenn.com