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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.: D07-12-18-0195

JULY 2019 – REV. 2

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

RIOCAN HOLDINGS INC.

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TABLE OF CONTENTS

FIGURES

TABLES

APPENDICES

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

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**CITY OF OTTAWA
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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 1 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 Bldgs A & B will be serviced by a proposed 200 mm diameter looped internal watermain network with connections to the existing 150 mm diameter watermain within Carling Avenue. The existing restaurant will be serviced by a connection to the existing water service currently servicing the existing shopping mall. 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)	Boundary Conditions					
		Connection 1 – Carling Avenue (m H_2O / kPa)		Connection 2 – Richmond Road (m H_2O / kPa)		Connection 3 – Carling Avenue (m H_2O / kPa)	
Average Daily Demand	13.3	42.1	412.9	42.7	418.4	40.5	397.1
Max Day + Fire Flow	20.0 + 6,000	17.5	171.6	36.6	358.6	26.9	263.7
Peak Hour	35.9	35.0	343.3	35.6	348.7	33.4	327.5

1) Water demand calculation per ***Water Supply Guidelines***. See ***Appendix B*** for detailed calculations.
2) Boundary conditions supplied by the City of Ottawa for the demands indicated in the correspondence; assumed ground elevation 73.51m for Connection 1, and 72.95m for Connection 2 and 75.12m for Connection 3. See ***Appendix B.***

The City of Ottawa was contacted to obtain boundary conditions associated with the estimated water demand as shown in ***Table 3***. Correspondence with the City has been included in ***Appendix B***.

The estimated fire flow was calculated 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	6,000	11,356
Building B	3,000	17,034

3.3 Watermain Modelling

EPANet was utilized to determine the availability of pressures throughout the system during average day, max day plus fire flow, and peak hour demands. This static model determines pressures based on the available head obtained from the boundary conditions provided by the City of Ottawa.

The model utilizes the Hazen-Williams equation to determine pressure drop, while the pipe properties have been selected in accordance with ***Water Supply Guidelines***. The model was prepared to assess the available pressure at each building, as well as, the pressures the watermain provides to fire hydrants during fire flow conditions.

The maximum fire flow indicated in ***Table 4*** was used to model fire demand at each of the hydrants servicing the site. Please refer to ***Appendix B*** for a model sketch showing the node locations, fire demands assigned to each hydrant and the resulting pressures. ***Table 5*** indicates the hydrant resulting in the lowest pressure in the fire flow scenario.

Table 5
Fire Demand and Minimum Pressure at Hydrants

Node ID[1]	Fire Demand at Each Node (L/min)	Total Fire Demand (L/min)	Minimum Pressure at Node (kPa)
5 (HYD-2)	6,000	6,000	186.3
1) See EPANET model in ***Appendix B*** for Node ID			

As shown above, all hydrants on-site can provide the required fire flow while maintaining minimum pressures described in ***Table 1***.

The fire flow yielding the lowest pressure, which occurred with ***6,000 L/min*** applied to hydrant 2, was utilized in the analysis below. ***Appendix B*** contains output reports and model schematics for each scenario.

Table 6
Model Simulation Output Summary

Location	Average Day (kPa)	Max Day + Fire Flow (kPa)	Peak Hour (kPa)
3	425.75	242.11	356.10
4	426.74	230.34	357.08
5	430.66	186.29	361.01
6	430.66	206.99	380.63
HYD-1	425.26	241.62	355.61
BLDG-B	425.26	228.87	355.61
HYD-2	430.17	185.80	360.52
BLDG-A	447.83	204.53	378.18
10	424.77	255.55	355.12
11	429.68	187.86	360.03
12	423.79	290.38	354.14
13	417.81	284.39	348.06

As demonstrated in ***Table 6***, the anticipated pressures during the average day, peak hour and max day + fire flow scenarios simulations are within the allowable pressure range described in ***Table 1*** from the ***Water Supply Guidelines***.

3.4 Water Supply Conclusion

It is proposed to service the development through a looped internal watermain network with two connections to the existing 150 mm diameter watermain within Carling Avenue.

Estimated water demand under proposed conditions was submitted to the City of Ottawa for establishing boundary conditions. Pressures are within the desired range during the average day, peak hour and max day + fire flow scenarios as specified by the ***Water Supply Guidelines.***

It is proposed that the development will be serviced by two proposed hydrants.

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

Table 7
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 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 8, below***,*** summarizes the ***City Standards*** employed in the design of the proposed wastewater sewer system.

Table 8
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	$Q = \frac{1}{n} A R^{2/3} S^{1/2}$
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 9, 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 9
Summary of Estimated Peak Wastewater Flow – Building A + Ex. Restaurants

Design Parameter	Anticipated Sanitary Flow[1] (L/s)
Average Dry Weather Flow Rate	0.60
Peak Dry Weather Flow Rate	0.90
Peak Wet Weather Flow Rate	2.17
*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 ***2.17 L/s***, which is a ***3.52 L/s*** decrease compared to the existing conditions. 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 10, 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 10
Summary of Estimated Peak Wastewater Flow – Building B

Design Parameter	Anticipated Sanitary Flow[1] (L/s)
Average Dry Weather Flow Rate	0.18
Peak Dry Weather Flow Rate	0.27
Peak Wet Weather Flow Rate	0.43
*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 Pinecrest 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 ***0.43 L/s.*** Refer to ***Appendix C*** for existing sanitary analysis of Carling Avenue.

4.3 Wastewater Design for Future Phases

Future phases of development are intended for the subject site. Future development areas and unit counts are not available at this time therefore demands have not been estimated at this stage. A 250 mm diameter sanitary sewer is proposed in phase 1 development as per ***City Standards*** and is anticipated to have capacity for future phases, upgrades maybe required should future development exceed capacity of the proposed network.

4.4 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. As a result, it is anticipated 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 and is tributary 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 ***4.965 Ha***, allowable release rate is equal to ***166.3 L/s***
- ii) requirements of City's Sewer Design Guideline. Based on a 2-year storm event, 0.5 run-off coefficient and 19.5 minute time of concentration, a 2-year flow rate of ***364.4 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 ***4.965 Ha***, required retention is equal to ***496.5m³***.

Based on the above criteria, the allowable release rate for the site must be attenuated to ***166.3 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. 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***) and existing drainage to Croydon Avenue storm sewer (***EX-1*** on ***SWM-1***).

The remaining ***4.965 Ha*** of drainage area is proposed to be controlled to the allowable release rate by inlet control devices (ICD) located at various catch basins and manholes. ***Table 11*** below summarizes inlet control details, flow rates and storages for each control area.

Table 11
Stormwater Flow Rate Summary

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)	0.057		6.1	0.0	13.0	0.0	0.0
Roof Controls (BLDG-A)	0.442		22.4	69.1	29.7	154.4	356.3
Roof Controls (BLDG B)	0.092		4.7	14.0	6.2	31.3	73.0
Attenutated Areas (A118+A119)	0.598	TEMPEST LMF 100	14.2	126.5	14.4	291.3	341.2
Attenutated Areas (A120)	0.428	TEMPEST LMF 60	2.8	129.2	4.8	246.1	279.3
Attenutated Areas (A100+A101)	0.531	TEMPEST LMF 90	3.4	49.3	11.8	88.5	97.8
Attenutated Areas (A109+A110)	0.687	TEMPEST LMF 90	7.7	97.0	11.5	229.5	235.3
Attenutated Areas (A122)	0.931	TEMPEST LMF 105	10.2	228.7	10.5	551.1	585.5
Attenutated Areas (A123)	0.093	TEMPEST LMF 45	2.9	1.4	2.9	5.5	17.0
Attenutated Areas (A103-A)	0.026	75mm dia	6.3	0.1	12.7	0.2	0.5
Attenutated Areas (A103-B)	0.043	75mm dia	8.4	0.1	15.3	1.9	3.2
Attenutated Areas (A103-C)	0.069	TEMPEST LMF 65	4.8	6.8	4.9	21.6	28.4
Attenutated Areas (A103-D)	0.056	TEMPEST LMF 65	4.8	6.8	5.0	21.6	25.1
Attenutated Areas (A106)	0.229	TEMPEST LMF 85	8.0	3.1	8.1	13.2	23.9
Attenutated Areas (A125)	0.636	TEMPEST LMF 100	11.3	148.6	15.2	310.3	322.0
Total	**4.965**		**118.2**	**880.6**	**166.0**	**1966.4**	**2388.4**

It is calculated that ***1966.4 m³*** of storage will be required on site to attenuate flow to a release rate of ***166.0 L/s***; Detailed storage calculations are included in ***Appendix D***.

It is proposed to lower the bottom of the storage tanks below the invert of the ICD's to meet the required ***496.5m³*** of retention on-site. A total of ***500m³*** of storage is provided below the invert of the inlet control devices, resulting in excess of ***10mm*** stormwater retention and allowing stormwater to infiltrate 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 two Oil-Grit Separators (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 reports.

5.4 Stormwater Servicing Conclusions

Post development stormwater runoff will be required to be restricted to the target release rate for storm events up to and including the 100-year storm in accordance with the ***Pinecrest Creek SWM***. It is calculated that ***1966.4 m^3*** of storage will be required on site to attenuate flow to the established release rate of ***166.3 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 ***496.5m^3*** to be retained on-site.

Two Oil-Grit Separator units are 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:

- Based on boundary conditions provided by the City, the existing municipal water infrastructure is capable of providing the proposed development with water within the City's required pressure range;
- The EPANET water distribution model confirmed adequate pressure exists within fire hydrants during fire flow, and within the system for the Average Day, Max Day + Fire Flow and Peak Hour scenarios;
- Existing sanitary sewers within Sir John A. Macdonald Parkway and Carling Avenue have sufficient capacity to convey peak wastewater flow of ***2.17 L/s*** and ***0.43 L/s*** from Building A and B, respectively;
- Allowable release rate, quality control requirements and required ***10mm*** runoff retention per ***Pinecrest Creek SWM***;
- Stormwater objectives will be met through retention via rooftop, surface and subsurface storage. It is calculated that ***1966.4 m^3*** 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.

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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: 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.

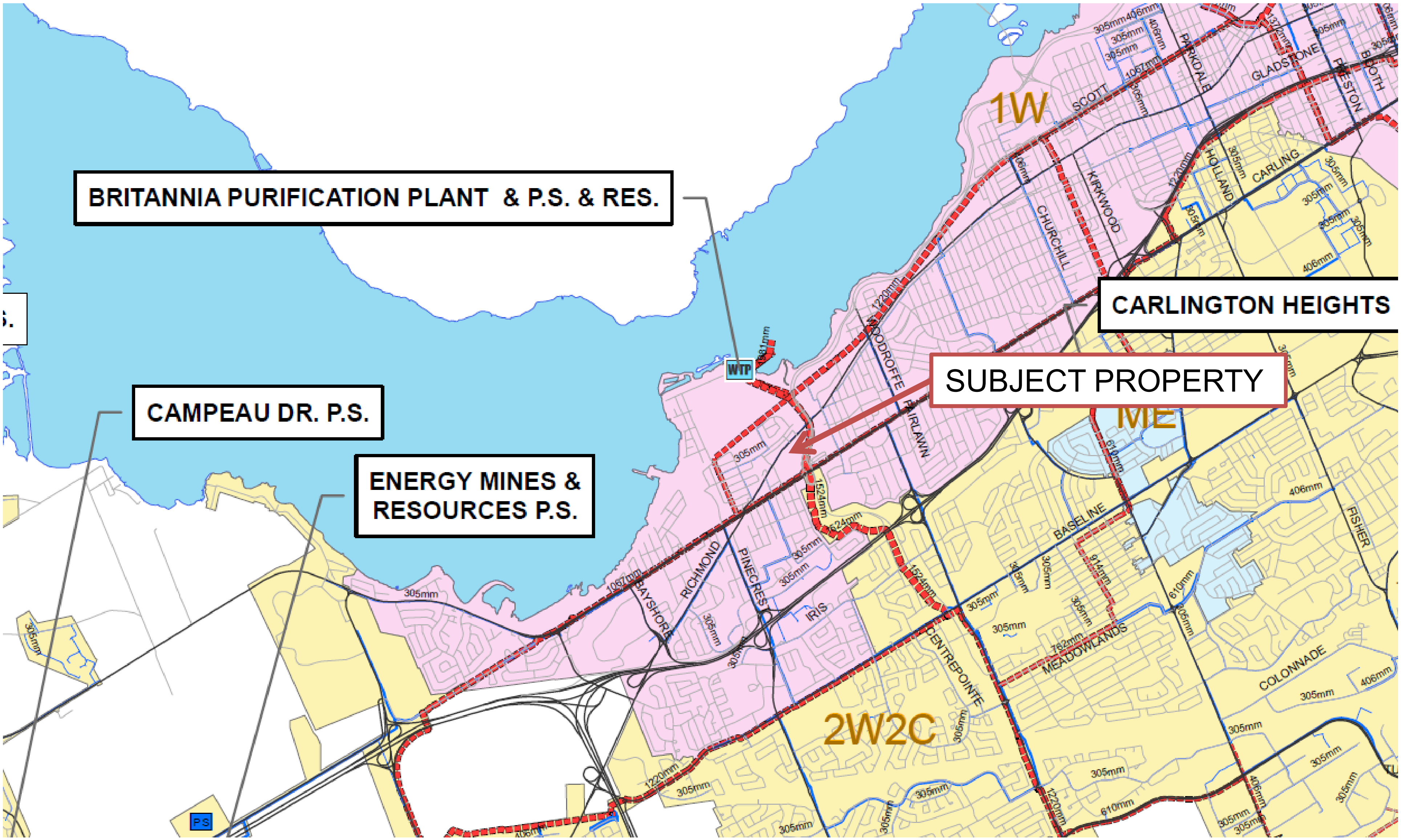
120 Iber Road, Unit 103
Stittsville, ON K2S 1E9

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

APPENDIX B

Water Supply

Pressure Zone Map



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

Property Type	Unit Rate		Units	Avg. Daily m^3/d	Avg. Daily L/min	Max Day m^3/d	Max Day L/min	Peak Hour m^3/d	Peak Hour 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 $9.3m^2$

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

Property Type	Unit Rate		Units	Avg. Daily m^3/d	Avg. Daily L/min	Max Day m^3/d	Max Day L/min	Peak Hour m^3/d	Peak Hour L/min
Commercial floor space	2.5	$L/m^2/d$	5,842	14.60	10.1	21.9	15.2	39.4	27.4
Office	75	$L/9.3m^2/d$		0.00	0.0	0.0	0.0	0.0	0.0
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	35.9
Total Demand				**19.2**	**13.3**	**28.8**	**20.0**	**51.8**	**35.9**

* 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 floor area*

Type of Construction: Non-Combustible Construction

C 0.8 *Type of Construction Coefficient per FUS Part II, Section 1*
A 4278.9 m^2 *Total floor area based on FUS Part II section 1*

Fire Flow 11512.7 L/min
12000.0 L/min *rounded to the nearest 1,000 L/min*

Adjustments

2. Reduction for Occupancy Type

Limited Combustible -15%

Fire Flow **10200.0 L/min**

3. Reduction for Sprinkler Protection

Sprinklered - Supervised -50%

Reduction **-5100 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 **1020.0 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 6120.0 L/min *fire flow not to exceed 45,000 L/min nor be less than 2,000 L/min per FUS Section*
6000.0 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 floor area*

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	1	31	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%*

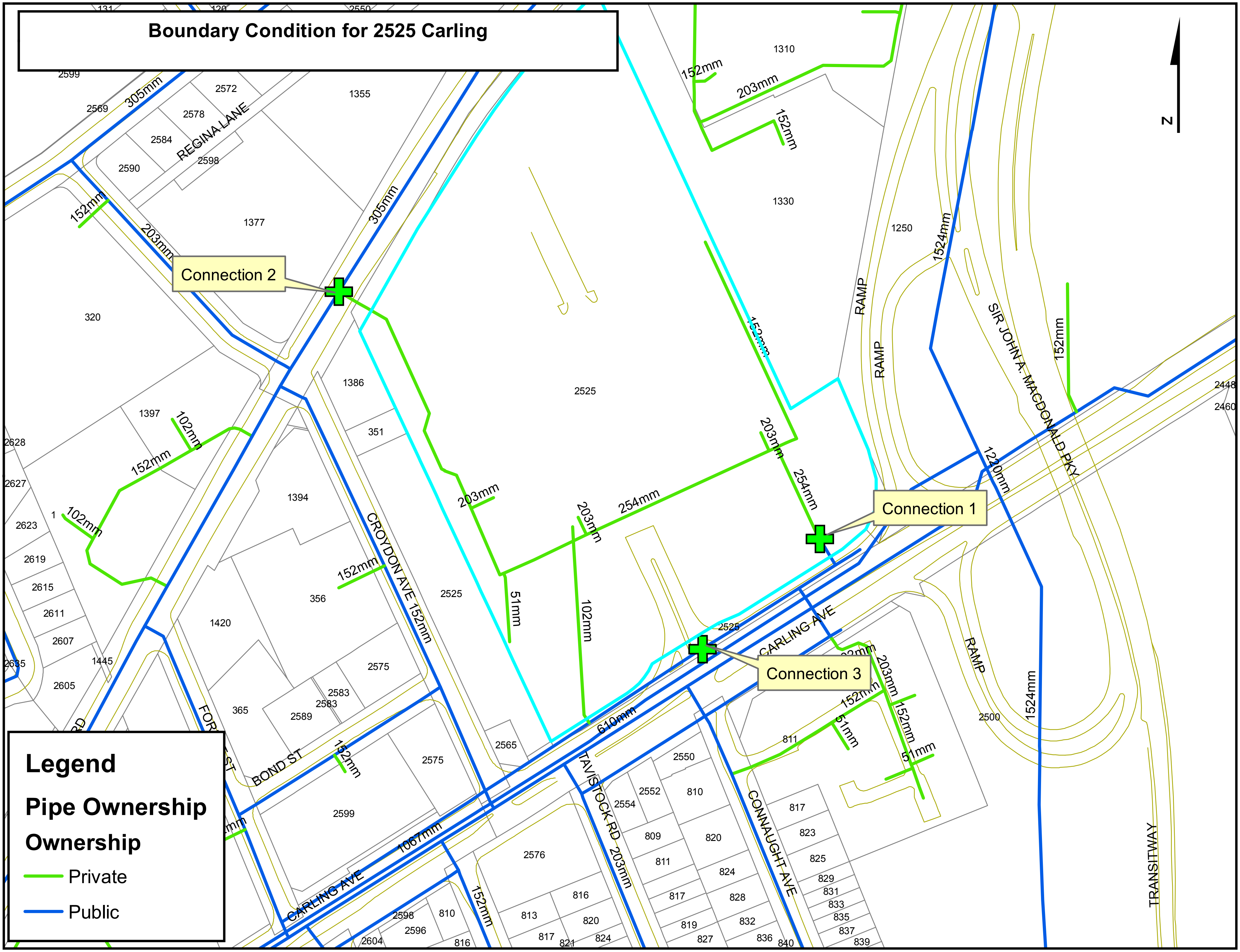
Increase	**0.0 L/min**

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 FUS Section*
	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


Boundary Condition for 2525 Carling
N
Connection 1
Connection 2
Connection 3
REGINA LANE
CROYDON AVE 152mm
CARLING AVE
CARLING AVE
BOND ST
TAVISTOCK RD 203mm
CONNAUGHT AVE
SIR JOHN A. MACDONALD PKY
RAMP
RAMP
RAMP
TRANSITWAY
305mm
305mm
203mm
152mm
152mm
102mm
102mm
203mm
254mm
254mm
203mm
203mm
51mm
102mm
610mm
1067mm
1524mm
1524mm
1220mm
2525
1310
1330
1250
1355
1377
1386
1394
1397
1420
1445
320
351
356
365
2500
2550
2565
2575
2576
2599
Legend
Pipe Ownership
Ownership
Private
Public

Brandon Chow

From: Candow, Julie <julie.candow@ottawa.ca>
Sent: May 24, 2019 2:44 PM
To: Amr Salem
Cc: Brandon Chow; Dickinson, Mary; Kuruvilla, Santhosh
Subject: RE: 997 - 2525 Carling Avenue Boundary Conditions Request
Attachments: 2525 Carling May 2019.pdf

Hi Amr, see below boundary condition request.

The following are boundary conditions, HGL, for hydraulic analysis at 2525 Carling (zone 1W) assumed to be connected to (see attached PDF for locations):

- 152mm stub off the 152mm watermain on Carling (connection 1)
- 305mm on Richmond (connection 2)
- 152mm on Carling (connection 3)

	Connection 1	Connection 2	Connection 3
Minimum HGL	108.5m	108.5m	108.5m
Maximum HGL	115.6m	115.6m	115.6m
MaxDay + FireFlow (100L/s)	91.0m	109.5m	102.0m
MaxDay + FireFlow (50L/s)	104.0m	110.5m	108.0m

These are for current conditions and are based on computer model simulation.

Disclaimer: The boundary condition information is based on current operation of the city water distribution system. The computer model simulation is based on the best information available at the time. The operation of the water distribution system can change on a regular basis, resulting in a variation in boundary conditions. The physical properties of watermains deteriorate over time, as such must be assumed in the absence of actual field test data. The variation in physical watermain properties can therefore alter the results of the computer model simulation.

Julie Candow, P.Eng.
Project Manager - Infrastructure Approvals

City of Ottawa
Development Review - West Branch
Planning, Infrastructure and Economic Development Department
110 Laurier Ave., 4th Floor East;
Ottawa ON K1P 1J1
Tel: 613-580-2424 x 13850

From: Dickinson, Mary <mary.dickinson@ottawa.ca>
Sent: May 21, 2019 1:39 PM
To: Amr Salem <ASalem@dsel.ca>
Cc: Brandon Chow <BChow@dsel.ca>; Candow, Julie <julie.candow@ottawa.ca>
Subject: RE: 997 - 2525 Carling Avenue Boundary Conditions Request

Hi Amr
Brad has moved on from his position here at the city. I can't yet say who will be taking over this file on a permanent basis, but Julie Candow will be able to address your immediate request for boundary conditions.

I have copied Julie on this email. She is away today, but back tomorrow. We will work towards getting this information to you as soon as possible.

Thank you,
Mary

From: Amr Salem <ASalem@dsel.ca>
Sent: May 21, 2019 12:33 PM
To: Dickinson, Mary <mary.dickinson@ottawa.ca>
Cc: Brandon Chow <BChow@dsel.ca>
Subject: FW: 997 - 2525 Carling Avenue Boundary Conditions Request

Hello Mary,

Please see below our boundary conditions request for the proposed development at 2525 Carling Avenue. It was my understanding that Brad Cripps was in charge of that area but I keep getting a bounce back from his e-mail. Can you verify if you are the right contact?

Thank you!

Amr Salem
Project Coordinator

DSEL
david schaeffer engineering ltd.

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

phone: (613) 836-0856 ext. 512
email: asalem@DSEL.ca

From: Amr Salem
Sent: May 21, 2019 12:20 PM
To: 'brad.cripps@ottawa.ca' <brad.cripps@ottawa.ca>
Subject: FW: 997 - 2525 Carling Avenue Boundary Conditions Request

Good morning Brad,

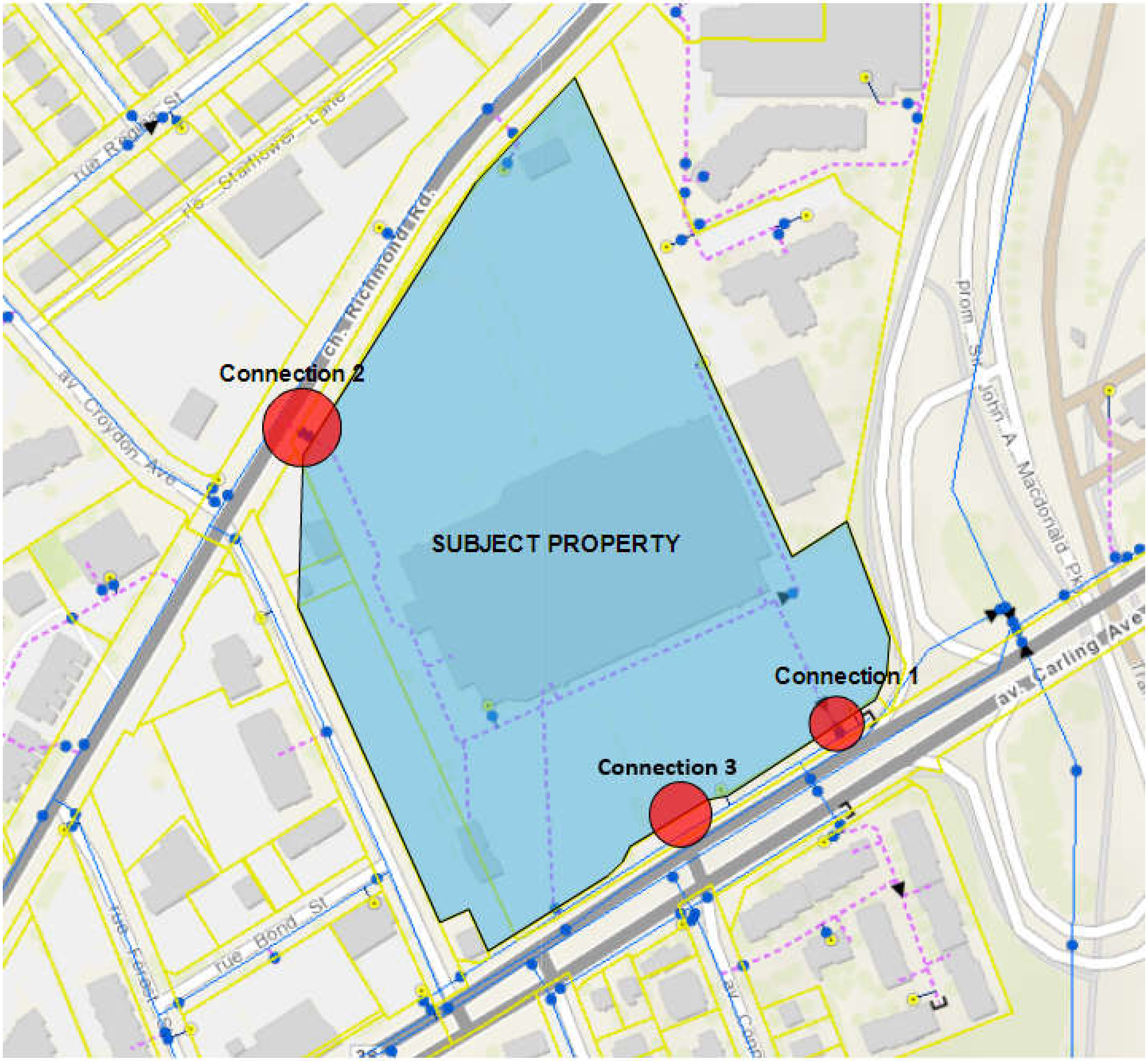
We would like to kindly request boundary conditions for the proposed development at 2525 Carling Avenue using the following proposed development demands:

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

2. Type of development:
   - The proposed development is commercial, consisting of 2 buildings; a one-storey retail food store with 4,069.5m^2 of floor area plus a 209.4m^2 mezzanine, and a two-storey commercial building with 1562.7 m^2 floor area;
   - It is anticipated that the development will be serviced by 3 connections: one connection to the existing 150mm diameter service already accessing the site , a second connection to the existing 305 mm watermain along Richmond Road, and a third connection to the 150mm diameter watermain along the property frontage at Carling Avenue. Please see figure below for reference;
   - The maximum fire flow demand for the proposed development is **6,000L/min** for the retail food store located at the north end of the property and **3,000L/min** for the proposed commercial /retail building at the south-eastern end of the site. Please refer to the attached calculations for details
   - Kindly provide boundary conditions at the proposed connection points shown below at the following demands;

3.

	L/min	L/s
Avg. Daily	13.3	0.22
Max Day	20.0	0.33
Peak Hour	35.9	0.60



Thank you in advance,

Amr Salem
Project Coordinator

DSEL
david schaeffer engineering ltd.

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

phone: (613) 836-0856 ext. 512
email: asalem@DSEL.ca

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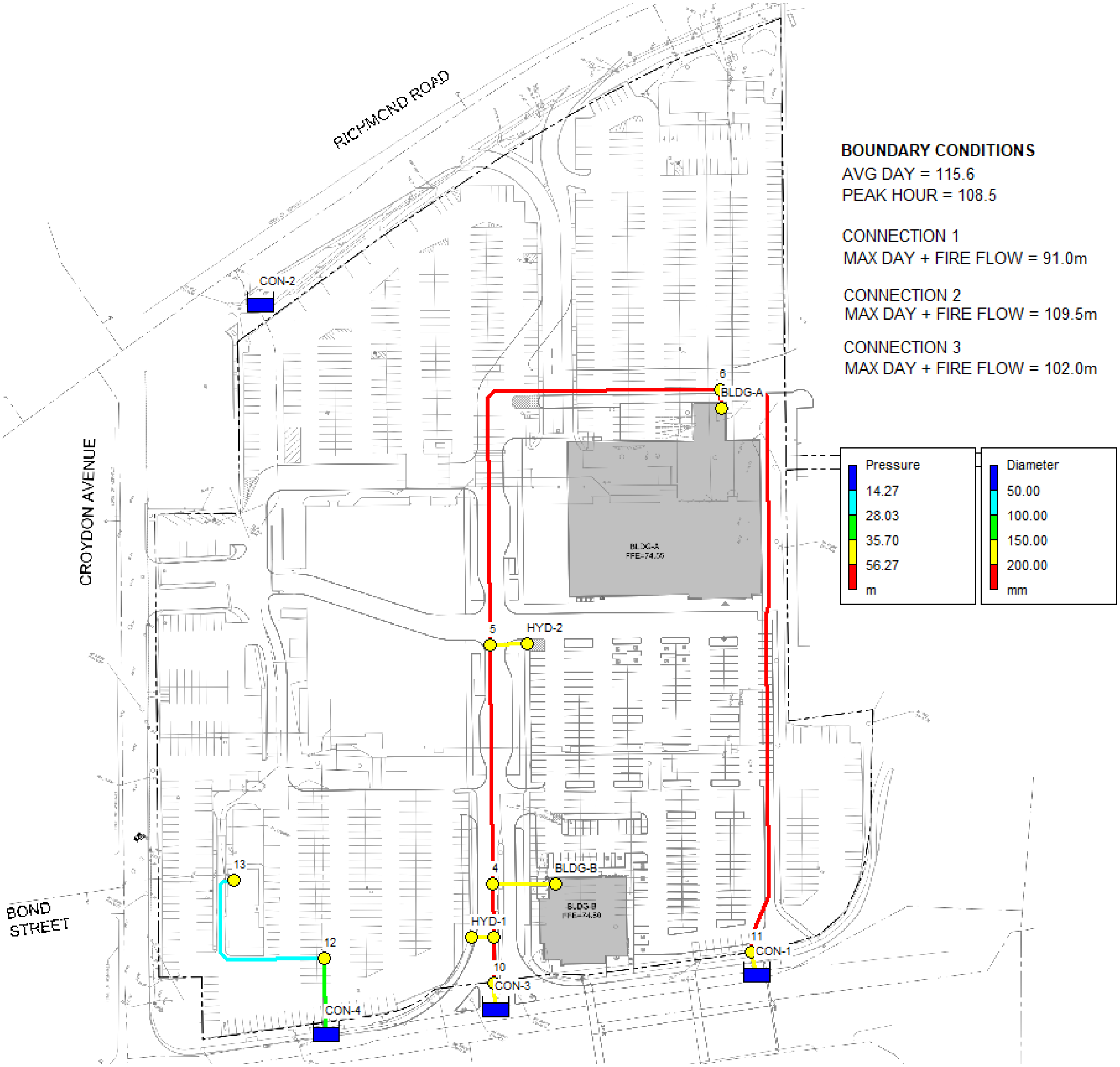
AVERAGE DAY



BOUNDARY CONDITIONS

AVG DAY = 115.6

PEAK HOUR = 108.5

CONNECTION 1

MAX DAY + FIRE FLOW = 91.0m

CONNECTION 2

MAX DAY + FIRE FLOW = 109.5m

CONNECTION 3

MAX DAY + FIRE FLOW = 102.0m

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**********************************************************************
*                             E P A N E T                            *
*                    Hydraulic and Water Quality                     *
*                    Analysis for Pipe Networks                      *
*                           Version 2.0                              *
**********************************************************************
```

Input File: 2019-05-30_997_AVG-DAY.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
2	3	4	19.4	200
3	4	5	85.9	200
4	5	6	173.1	200
6	3	HYD-1	7.5	150
7	4	BLDG-B	18.7	150
8	5	HYD-2	13.1	150
9	6	BLDG-A	1000	200
10	CON-3	10	4.5	150
11	10	3	20.7	200
12	6	11	217.4	200
13	11	CON-1	8.7	150
14	CON-4	12	28.2	100
15	12	13	65	50

Node Results:

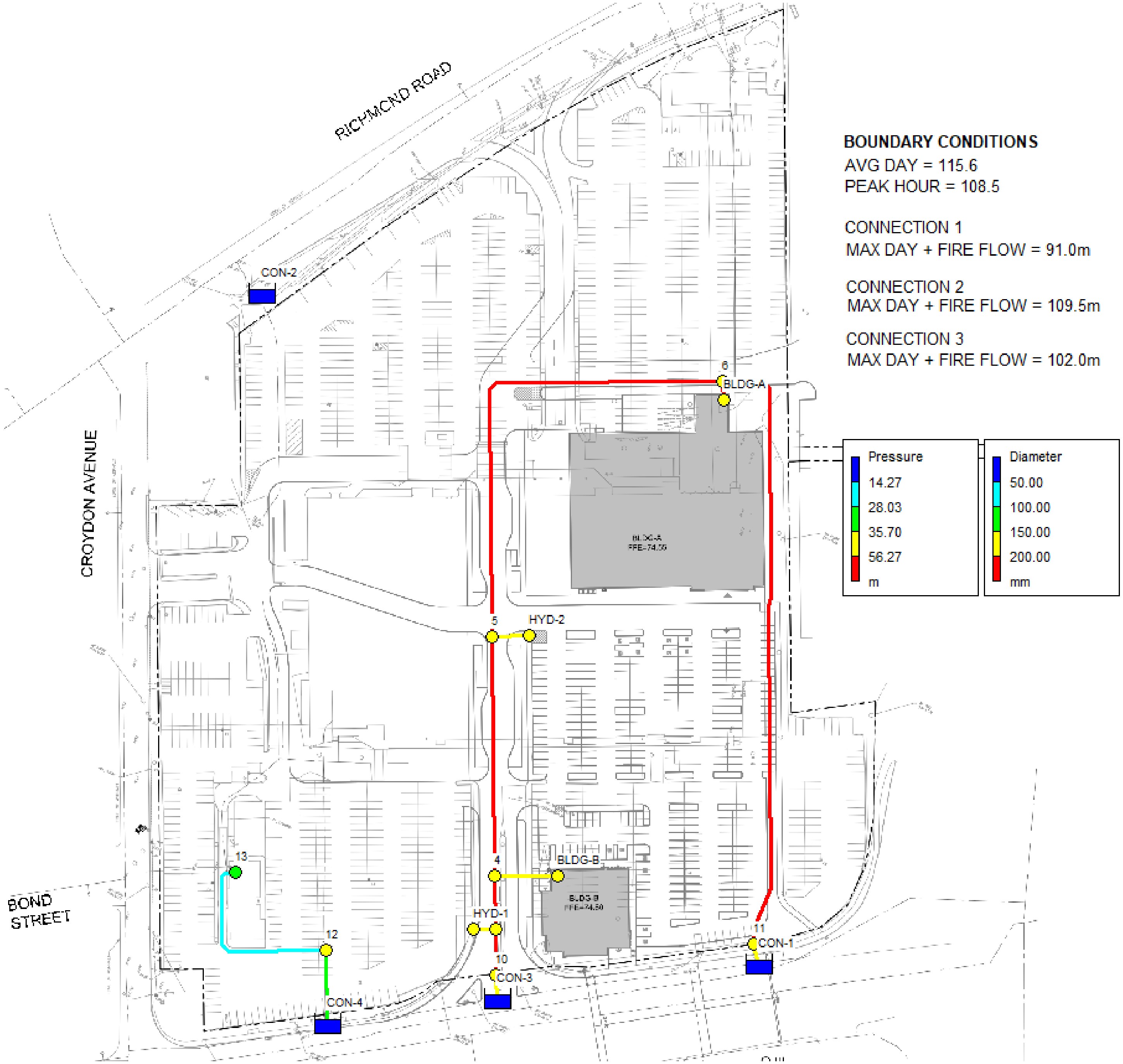
Node ID	Demand LPM	Head m	Pressure m	Quality	
3	0.00	115.60	43.40	0.00	
4	0.00	115.60	43.50	0.00	
5	0.00	115.60	43.90	0.00	
6	0.00	115.60	45.90	0.00	
HYD-1	0.00	115.60	43.35	0.00	
BLDG-B	2.70	115.60	43.35	0.00	
HYD-2	0.00	115.60	43.85	0.00	
BLDG-A	7.40	115.60	45.65	0.00	
10	0.00	115.60	43.30	0.00	
11	0.00	115.60	43.80	0.00	
12	0.00	115.60	43.20	0.00	
13	3.20	115.60	42.60	0.00	
CON-3	-5.78	115.60	0.00	0.00	Reservoir
CON-1	-4.32	115.60	0.00	0.00	Reservoir
CON-4	-3.20	115.60	0.00	0.00	Reservoir
CON-2	0.00	115.60	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
2	5.78	0.00	0.00	Open
3	3.08	0.00	0.00	Open
4	3.08	0.00	0.00	Open
6	0.00	0.00	0.00	Open
7	2.70	0.00	0.00	Open
8	0.00	0.00	0.00	Open
9	7.40	0.00	0.00	Open

				AVERAGE DAY
10	5.78	0.01	0.00	Open
11	5.78	0.00	0.00	Open
12	-4.32	0.00	0.00	Open
13	-4.32	0.00	0.00	Open
14	3.20	0.01	0.00	Open
15	3.20	0.03	0.06	Open

PEAK HOUR



RICHMOND ROAD
CROYDON AVENUE
BOND STREET
CON-2
CON-1
CON-3
CON-4
BLDG-A
BLDG-B
HYD-1
HYD-2
6
5
4
10
11
12
13
BOUNDARY CONDITIONS
AVG DAY = 115.6
PEAK HOUR = 108.5
CONNECTION 1
MAX DAY + FIRE FLOW = 91.0m
CONNECTION 2
MAX DAY + FIRE FLOW = 109.5m
CONNECTION 3
MAX DAY + FIRE FLOW = 102.0m
Pressure
14.27
28.03
35.70
56.27
m
Diameter
50.00
100.00
150.00
200.00
mm

```
**********************************************************************
*                           E P A N E T                              *
*                   Hydraulic and Water Quality                      *
*                   Analysis for Pipe Networks                       *
*                         Version 2.0                                *
**********************************************************************
```

Input File: 2019-05-30_997_PEAK-HOUR.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
2	3	4	19.4	200
3	4	5	85.9	200
4	5	6	173.1	200
6	3	HYD-1	7.5	150
7	4	BLDG-B	18.7	150
8	5	HYD-2	13.1	150
9	6	BLDG-A	1000	200
10	CON-3	10	4.5	150
11	10	3	20.7	200
12	6	11	217.4	200
13	11	CON-1	8.7	150
14	CON-4	12	28.2	100
15	12	13	65	50

Node Results:

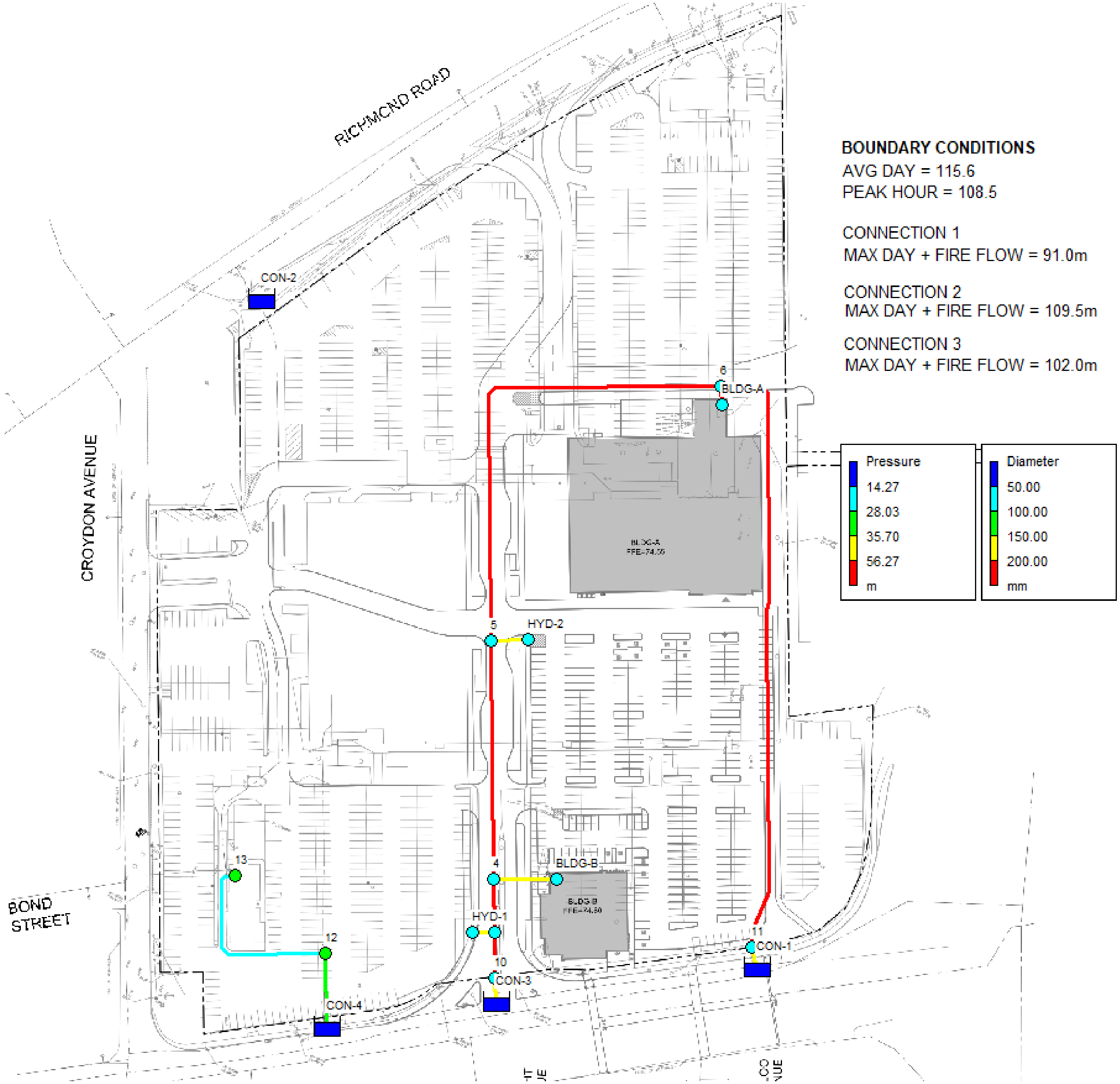
Node ID	Demand LPM	Head m	Pressure m	Quality	
3	0.00	108.50	36.30	0.00	
4	0.00	108.50	36.40	0.00	
5	0.00	108.50	36.80	0.00	
6	0.00	108.50	38.80	0.00	
HYD-1	0.00	108.50	36.25	0.00	
BLDG-B	7.30	108.50	36.25	0.00	
HYD-2	0.00	108.50	36.75	0.00	
BLDG-A	20.10	108.50	38.55	0.00	
10	0.00	108.50	36.20	0.00	
11	0.00	108.50	36.70	0.00	
12	0.00	108.50	36.10	0.00	
13	8.60	108.48	35.48	0.00	
CON-3	-15.66	108.50	0.00	0.00	Reservoir
CON-1	-11.74	108.50	0.00	0.00	Reservoir
CON-4	-8.60	108.50	0.00	0.00	Reservoir
CON-2	0.00	108.50	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
2	15.66	0.01	0.00	Open
3	8.36	0.00	0.00	Open
4	8.36	0.00	0.00	Open
6	0.00	0.00	0.00	Open
7	7.30	0.01	0.00	Open
8	0.00	0.00	0.00	Open
9	20.10	0.01	0.00	Open

				PEAK HOUR
10	15.66	0.01	0.01	Open
11	15.66	0.01	0.00	Open
12	-11.74	0.01	0.00	Open
13	-11.74	0.01	0.00	Open
14	8.60	0.02	0.01	Open
15	8.60	0.07	0.36	Open

MAX DAY + FIRE FLOW



BOUNDARY CONDITIONS
AVG DAY = 115.6
PEAK HOUR = 108.5

CONNECTION 1
MAX DAY + FIRE FLOW = 91.0m

CONNECTION 2
MAX DAY + FIRE FLOW = 109.5m

CONNECTION 3
MAX DAY + FIRE FLOW = 102.0m

```
**********************************************************************
*                            E P A N E T                             *
*                    Hydraulic and Water Quality                     *
*                    Analysis for Pipe Networks                      *
*                           Version 2.0                              *
**********************************************************************
```

Input File: 2019-05-30_997_MAXDAY-FIRE.net

Link - Node Table:

Link ID	Start Node	End Node	Length m	Diameter mm
2	3	4	19.4	200
3	4	5	85.9	200
4	5	6	173.1	200
6	3	HYD-1	7.5	150
7	4	BLDG-B	18.7	150
8	5	HYD-2	13.1	150
9	6	BLDG-A	1000	200
10	CON-3	10	4.5	150
11	10	3	20.7	200
12	6	11	217.4	200
13	11	CON-1	8.7	150
14	CON-4	12	28.2	100
15	12	13	65	50

Node Results:

Node ID	Demand LPM	Head m	Pressure m	Quality	
3	0.00	96.88	24.68	0.00	
4	0.00	95.58	23.48	0.00	
5	6000.00	90.69	18.99	0.00	
6	0.00	90.80	21.10	0.00	
HYD-1	0.00	96.88	24.63	0.00	
BLDG-B	4.10	95.58	23.33	0.00	
HYD-2	0.00	90.69	18.94	0.00	
BLDG-A	11.10	90.80	20.85	0.00	
10	0.00	98.35	26.05	0.00	
11	0.00	90.95	19.15	0.00	
12	0.00	102.00	29.60	0.00	
13	4.80	101.99	28.99	0.00	
CON-3	-5511.33	102.00	0.00	0.00	Reservoir
CON-1	-503.87	91.00	0.00	0.00	Reservoir
CON-4	-4.80	102.00	0.00	0.00	Reservoir
CON-2	0.00	109.50	0.00	0.00	Reservoir

Link Results:

Link ID	Flow LPM	VelocityUnit m/s	Headloss m/km	Status
2	5511.33	2.92	67.39	Open
3	5507.23	2.92	56.88	Open
4	-492.77	0.26	0.65	Open
6	0.00	0.00	0.00	Open
7	4.10	0.00	0.00	Open
8	0.00	0.00	0.00	Open
9	11.10	0.01	0.00	Open

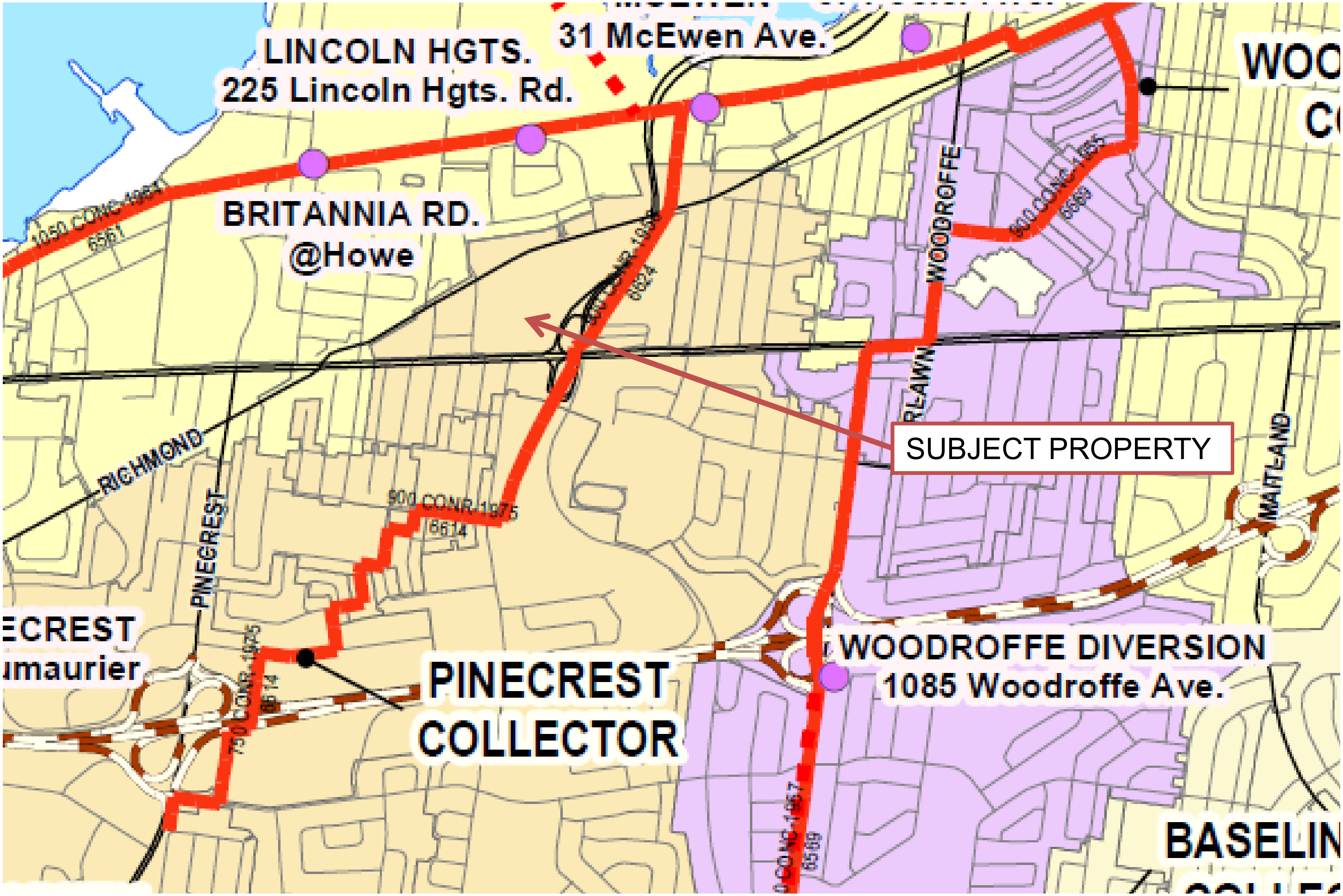
MAX DAY + FIRE FLOW

10	5511.33	5.20	811.73	Open
11	5511.33	2.92	70.75	Open
12	-503.87	0.27	0.68	Open
13	-503.87	0.48	5.76	Open
14	4.80	0.01	0.00	Open
15	4.80	0.04	0.12	Open

APPENDIX C

Wastewater Collection

Sanitary Trunk Sewer and Collection Area Map



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

DSEL

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	71	0.10
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 **2.67**

Peak Institutional / Commercial Flow 4.01
Peak Industrial Flow** 0.00
Peak I/C/I Flow **4.01**

** 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	**2.67**	**L/s**
Total Estimated Peak Dry Weather Flow Rate	**4.01**	**L/s**
Total Estimated Peak Wet Weather Flow Rate	**5.69**	**L/s**

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	4,279	0.50
Office	75	L/9.3m^2/d		0.00
Restaurant***	125	L/seat/d	71	0.10
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 **0.60**

Peak Institutional / Commercial Flow 0.90
Peak Industrial Flow** 0.00
Peak I/C/I Flow **0.90**

** 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	**0.60**	**L/s**
Total Estimated Peak Dry Weather Flow Rate	**0.90**	**L/s**
Total Estimated Peak Wet Weather Flow Rate	**2.17**	**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	$L/m^2/d$	1,563	0.18
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	**0.18**
Peak Institutional / Commercial Flow	0.27
Peak Industrial Flow**	0.00
Peak I/C/I Flow	**0.27**

** 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	**0.18**	**L/s**
Total Estimated Peak Dry Weather Flow Rate	**0.27**	**L/s**
Total Estimated Peak Wet Weather Flow Rate	**0.43**	**L/s**

EXTERNALSANITARY SEWER CALCULATION SHEET

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

DESIGN PARAMETERS

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

Location			Residential Area and Population										Commercial		Institutional		Industrial	
Area ID	Up	Down	Area (ha)	Number of Units by type: Singles	Semi's	Town's	Apt's**	Pop.	Cumulative Area (ha)	Cumulative Pop.	Peak. Fact. (-)	Q_{res} (L/s)	Area (ha)	Accu. Area (ha)	Area (ha)	Accu. Area (ha)	Area (ha)	Accu. Area (ha)
	EX.SAN MH1	EX.SAN MH2	0.000					0.0	0.000	0.0	3.80	0.00		0.00		0.00		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
	EX.SAN MH3	EX.SAN MH4	0.000					0.0	11.640	694.0	3.32	7.46		0.27		0.00		0.00

Location		Infiltration				Pipe Data								
Up	Down	Q_{C+I+I^*} (L/s)	Total Area (ha)	Accu. Area (ha)	Infiltration Flow (L/s)	Total Flow (L/s)	DIA (mm)	Slope (%)	Length (m)	$A_{hydraulic}$ (m^2)	R (m)	Velocity (m/s)	Q_{cap} (L/s)	Q / Q full (-)
EX.SAN MH1	EX.SAN MH2		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	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	0.8	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 Comn	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									
Area ID	Up	Down	Area (ha)	Number of Units by type: Singles	Semi's	Town's	Apt's**	Pop.	Cumulative Area (ha)	Cumulative Pop.	Peak. Fact. (-)	Q_{res} (L/s)
	MH100A	MH101A	0.000					0.0	0.0	0.0	3.80	0.00
BLDGA	MH101A	MH102A	0.000					0.0	0.000	0.0	3.80	0.00
	MH102A	MH103A	0.000					0.0	0.000	0.0	3.80	0.00
	MH103A	MH104A	0.000					0.0	0.000	0.0	3.80	0.00
	MH104A	MH105A	0.000					0.0	0.000	0.0	3.80	0.00
BLDGB	BLDGB	MH201A	0.000					0.0	0.000	0.0	3.80	0.00
	MH201A	EX.SAN MH	0.000					0.0	0.000	0.0	3.80	0.00

Location			Commercial		Institutional		Industrial		Infiltration				Pipe Data								
Area ID	Up	Down	Area (ha)	Accu. Area (ha)	Area (ha)	Accu. Area (ha)	Area (ha)	Accu. Area (ha)	Q_{C+I+I^*} (L/s)	Total Area (ha)	Accu. Area (ha)	Infiltration Flow (L/s)	Total Flow (L/s)	DIA (mm)	Slope (%)	Length (m)	$A_{hydraulic}$ (m^2)	R (m)	Velocity (m/s)	Q_{cap} (L/s)	Q / Q full (-)
	MH100A	MH101A	0.44	0.44		0.00		0.00	0.2	0.442	0.442	0.146	0.36	250	0.25	44.4	0.049	0.063	0.61	29.7	0.01
BLDGA	MH101A	MH102A		0.44		0.00		0.00	0.2	0.000	0.442	0.146	0.36	250	0.25	86.6	0.049	0.063	0.61	29.7	0.01
	MH102A	MH103A		0.44		0.00		0.00	0.8	0.000	0.442	0.146	0.92	250	0.30	78.9	0.049	0.063	0.66	32.6	0.03
	MH103A	MH104A		0.44		0.00		0.00	1.8	0.000	0.442	0.146	1.92	250	0.30	26.3	0.049	0.063	0.66	32.6	0.06
	MH104A	MH105A		0.44		0.00		0.00	2.8	0.000	0.442	0.146	2.92	250	0.30	31.1	0.049	0.063	0.66	32.6	0.09
BLDGB	BLDGB	MH201A	0.09	0.53		0.00		0.00	0.8	0.092	0.534	0.176	0.95	200	1.00	25.4	0.031	0.050	1.04	32.8	0.03
	MH201A	EX.SAN MH		0.53		0.00		0.00	0.8	0.000	0.534	0.176	0.95	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 amended 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 amended 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 amended 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.

Stormceptor®

FORTERRA™

Detailed Stormceptor Sizing Report – OGS 1

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	OGS 1
Recommended Stormceptor Model	EFO10
TSS Removal (%) Provided	81
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	55	61	265 L (70 gal)
EFO6	69	81	610 L (160 gal)
EFO8	75	89	1070 L (280 gal)
EFO10	81	94	1670 L (440 gal)
EFO12	84	97	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)**	1657.4
Elevation (ft)	370	**Total Infiltration (mm)**	4146.2
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	15174.5

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)	2.442
Imperviousness %	80

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

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

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

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)	

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	OGS 1

Site Details

Drainage Area	
Total Area (ha)	2.442
Imperviousness %	80
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)	313.00
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

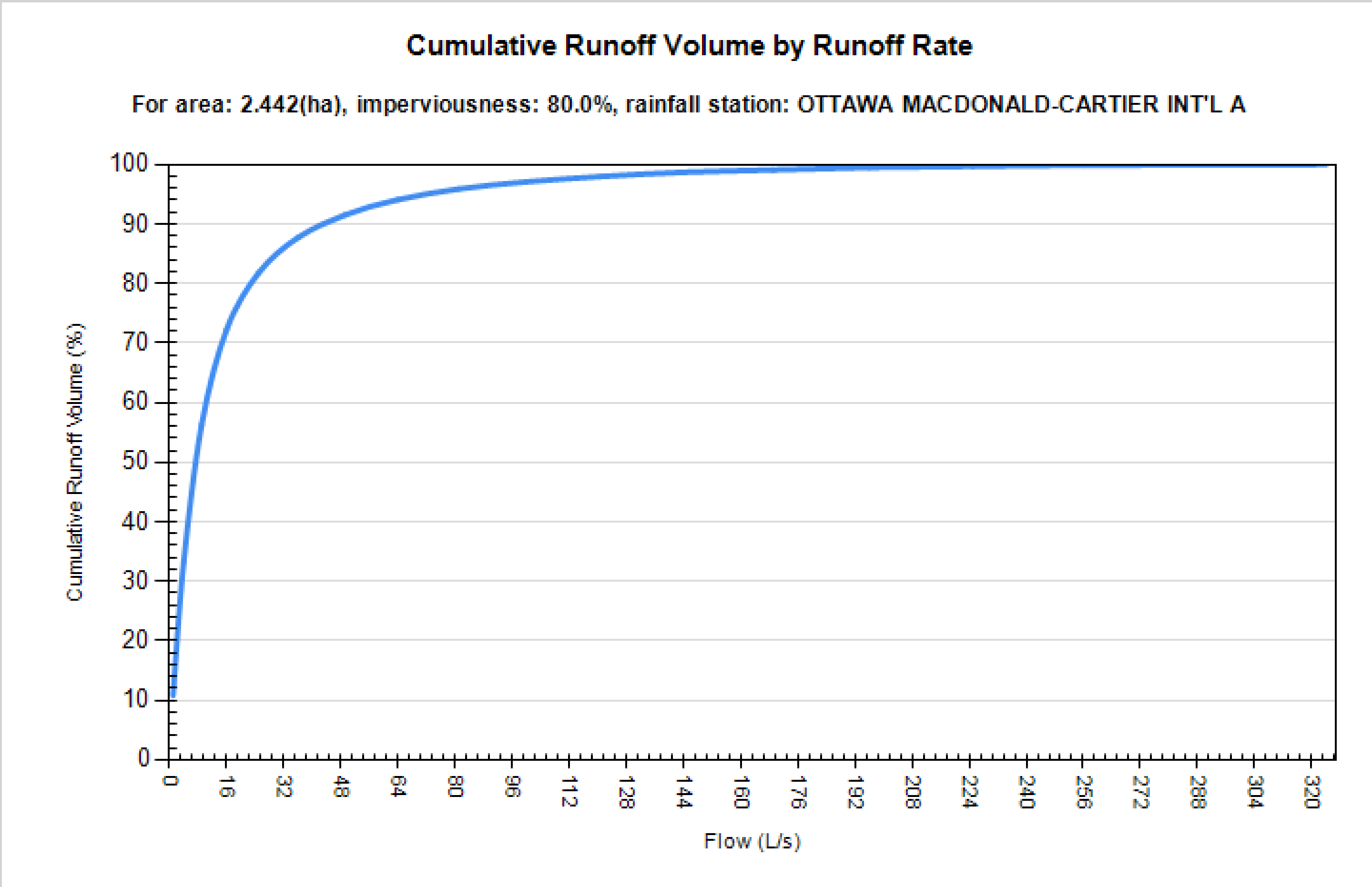
Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	Build Up/ Wash-off

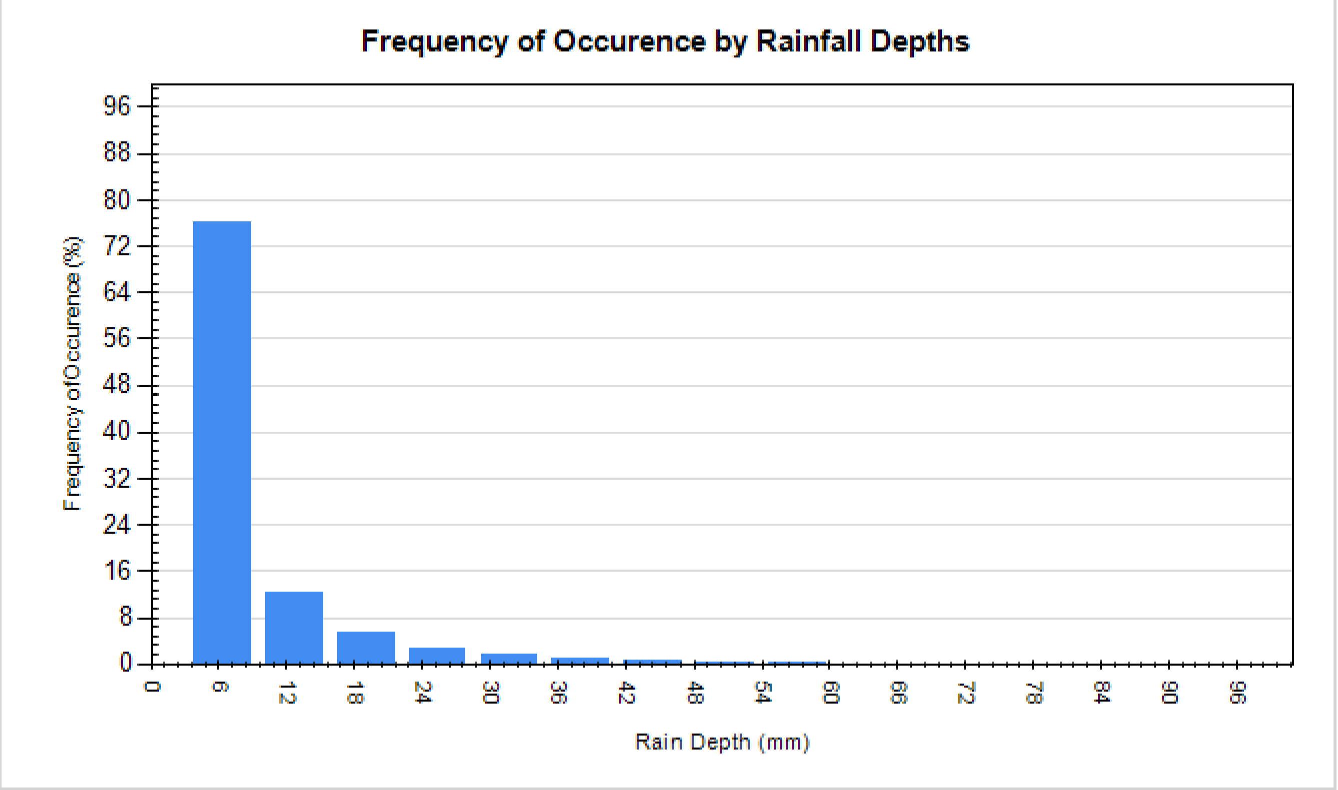
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	125
Exponential Buildup Power	0.40
Exponential Washoff Exponent	0.20

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 (m^3)**	**Volume Over (m^3)**	**Cumulative Runoff Volume (%)**
1	40411	332081	10.8
4	124149	248326	33.3
9	209182	163385	56.2
16	268975	103474	72.2
25	304768	67691	81.8
36	326500	45968	87.7
49	340710	31744	91.5
64	350527	21930	94.1
81	357179	15278	95.9
100	361803	10657	97.1
121	365149	7309	98.0
144	367477	4981	98.7
169	369229	3229	99.1
196	370576	1882	99.5
225	371459	1000	99.7
256	371925	534	99.9
289	372176	284	99.9
324	372343	117	100.0


Cumulative Runoff Volume by Runoff Rate
For area: 2.442(ha), imperviousness: 80.0%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A
Cumulative Runoff Volume (%)
0
10
20
30
40
50
60
70
80
90
100
0
16
32
48
64
80
96
112
128
144
160
176
192
208
224
240
256
272
288
304
320
Flow (L/s)

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



Detailed Stormceptor Sizing Report – OGS 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	OGS 2
Recommended Stormceptor Model	EFO10
TSS Removal (%) Provided	80
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	52	54	265 L (70 gal)
EFO6	66	76	610 L (160 gal)
EFO8	73	86	1070 L (280 gal)
EFO10	80	92	1670 L (440 gal)
EFO12	83	95	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)**	1677.1
Elevation (ft)	370	**Total Infiltration (mm)**	4149.8
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	15151.2

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)	3.147
Imperviousness %	80

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

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

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

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)	

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	OGS 2

Site Details

Drainage Area	
Total Area (ha)	3.147
Imperviousness %	80
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)	355.00
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

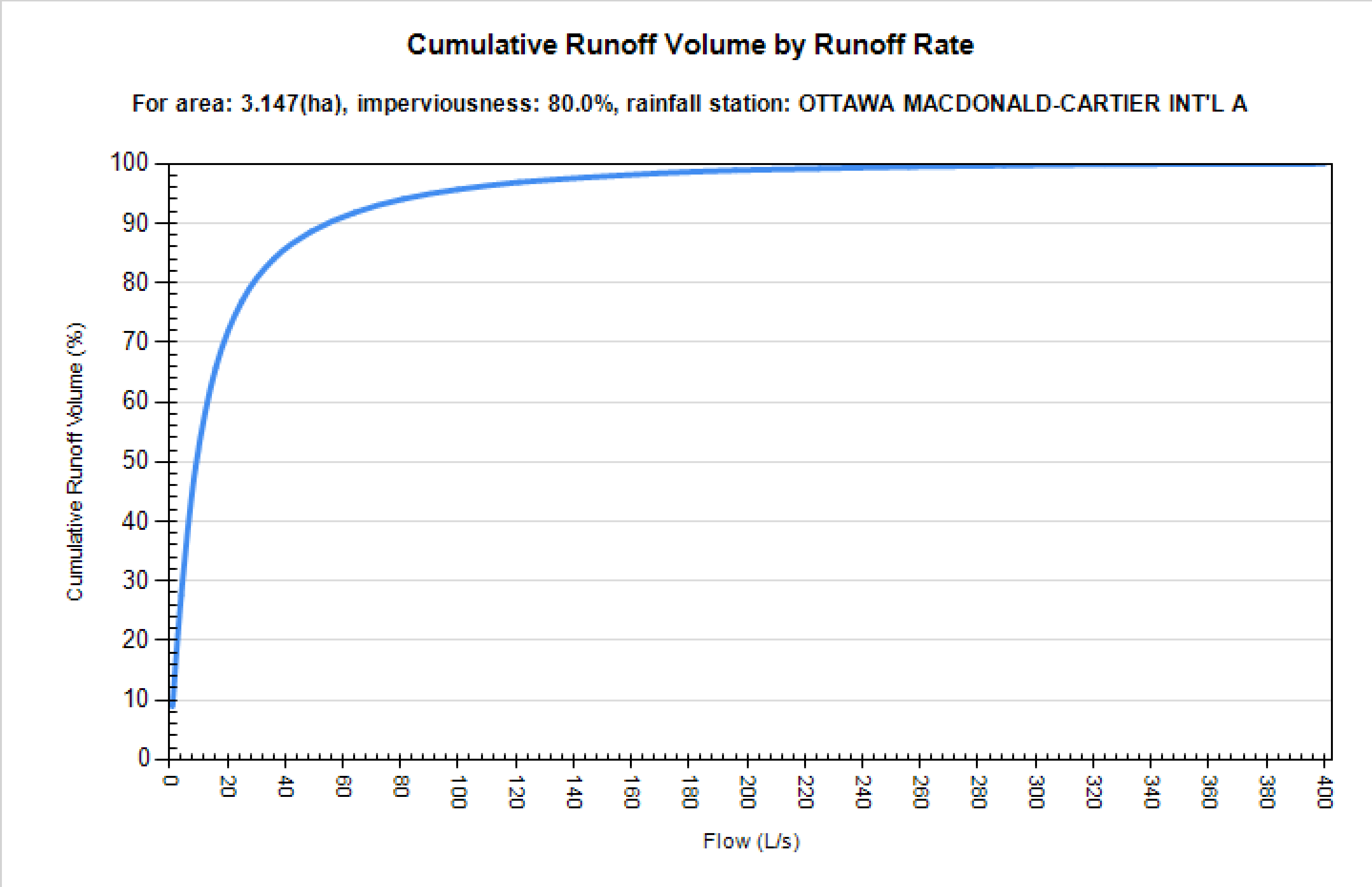
Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	Build Up/ Wash-off

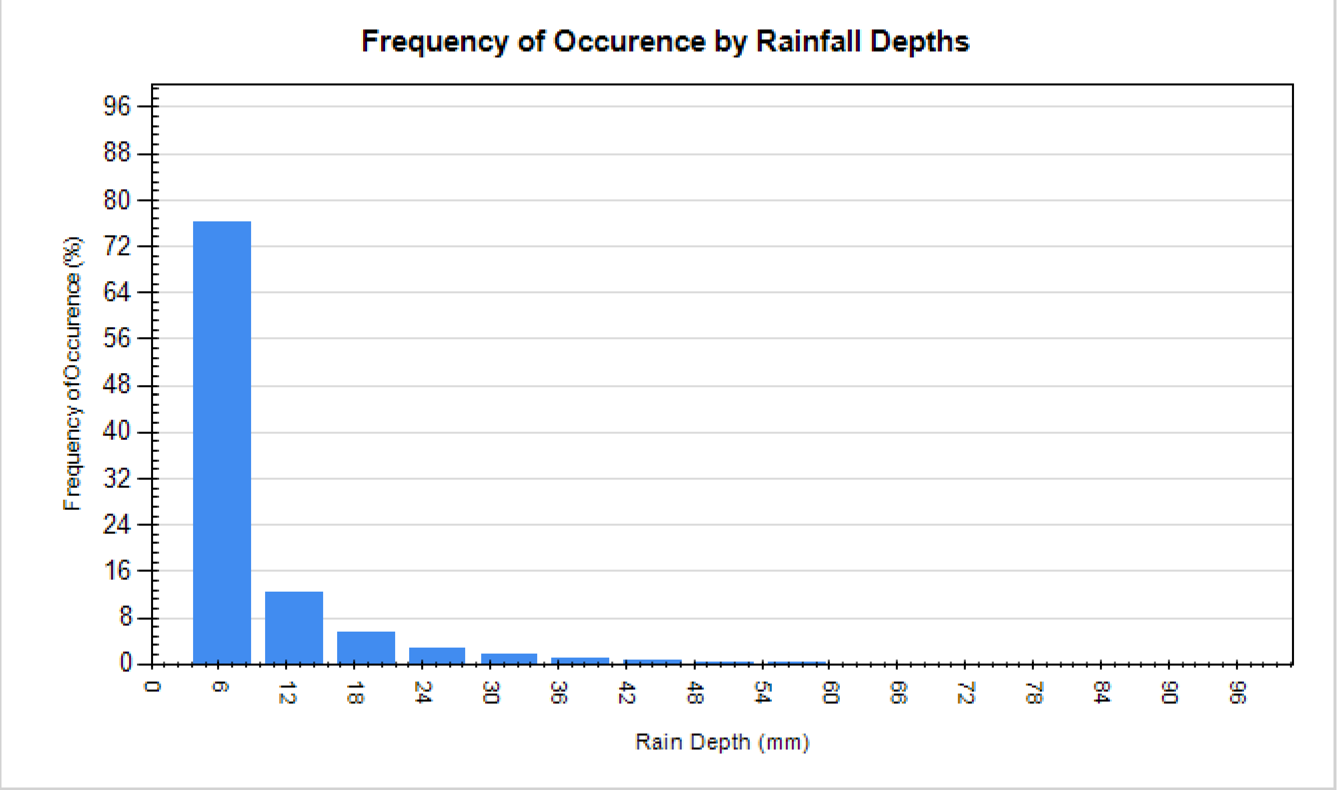
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	125
Exponential Buildup Power	0.40
Exponential Washoff Exponent	0.20

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	42794	436306	8.9
4	132213	346880	27.6
9	235498	243745	49.2
16	315124	163977	65.8
25	368489	110598	76.9
36	402595	76553	84.0
49	424412	54694	88.6
64	439677	39442	91.8
81	450727	28390	94.1
100	458565	20560	95.7
121	464131	14988	96.9
144	468326	10796	97.7
169	471416	7705	98.4
196	473718	5405	98.9
225	475516	3606	99.2
256	476929	2193	99.5
289	477876	1246	99.7
324	478413	710	99.9
361	478709	413	99.9
400	478916	206	100.0


Cumulative Runoff Volume by Runoff Rate
For area: 3.147(ha), imperviousness: 80.0%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A
Cumulative Runoff Volume (%)
0
10
20
30
40
50
60
70
80
90
100
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
Flow (L/s)

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



STANDARD SPECIFICATION FOR "OIL GRIT SEPARATOR" (OGS) STORMWATER QUALITY TREAMENT DEVICE WITH THIRD-PARTY VERIFIED LIGHT LIQUID RE-ENTRAINMENT SIMULATION PERFORMANCE TESTING RESULTS

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, designing, maintaining, and constructing an underground Oil Grit Separator (OGS) device for stormwater quality treatment, **specifically an OGS device that has been third-party tested for oil and fuel retention capability using a protocol for light liquid re-entrainment simulation testing, with t testing results and a Statement of Verification in accordance with all the provisions of ISO 14034 Environmental Management – Environmental Technology Verification (ETV)**. Work includes supply and installation of concrete bases, precast sections, and the appropriate precast section with OGS internal components correctly installed within the system, watertight sealed to the precast concrete prior to arrival to the project site.

1.2 REFERENCE STANDARDS

1.2.1 For Canadian projects only, the following reference standards apply:

CAN/CSA-A257.4-14: Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections, and Fittings Using Rubber Gaskets
CAN/CSA-A257.4-14: Precast Reinforced Circular Concrete Manhole Sections, Catch Basins, and Fittings
CAN/CSA-S6-00: Canadian Highway Bridge Design Code

1.2.2 For ALL projects, the following reference standards apply:

ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C 891: Standard Practice for Installation of Underground Precast Concrete Utility Structures
ASTM D2563: Standard Practice for Classification of Visual Defects in Reinforced Plastics

1.3 SHOP DRAWINGS

1.3.1 Shop drawings shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail the precast concrete components and OGS internal components prior to shipment, including the sequence for installation.

1.3.2 Unless directed otherwise by the Engineer of Record, OGS stormwater quality treatment product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record. Any and all changes to project cost estimates, bonding amounts, plan check fees for revision of approved documents, or design impacts due to regulatory requirements as a result of a product substitution shall be coordinated by the Contractor with the Engineer of Record.

1.4 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

1.4.1 OGS internal components supplied by the Manufacturer for attachment to the precast concrete vessel shall be pre-fabricated, bolted to the precast and watertight sealed to the precast vessel surface prior to site delivery to ensure Manufacturer's internal assembly process and quality control processes are fully adhered to, and to prevent materials damage on site.

1.4.2 Follow all instructions including the sequence for installation in the shop drawings during installation.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The OGS vessel shall be cylindrical and constructed from precast concrete riser and slab components.

2.1.2 The precast concrete OGS internal components shall include a fiberglass insert bolted and watertight sealed inside the precast concrete vessel, prior to site delivery. Primary internal components that are to be anchored and watertight sealed to the precast concrete vessel shall be done so only by the Manufacturer prior to arrival at the job site to ensure product quality.

2.1.3 The OGS shall be allowed to be specified and have the ability to function as a 240-degree bend structure in the stormwater drainage system, or as a junction structure.

2.1.4 The OGS to be specified shall have the capability to accept influent flow from an inlet grate and an inlet pipe.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be designed and manufactured to meet highway loading conditions per State/Provincial or local requirements.

2.3 GASKETS

Only profile neoprene or nitrile rubber gaskets that are oil resistant shall be accepted. For Canadian projects only, gaskets shall be in accordance to CSA A257.4-14. Mastic sealants, butyl tape/rope or Conseal CS-101 alone are not acceptable gasket materials.

2.4 JOINTS

The concrete joints shall be watertight and meet the design criteria according to ASTM C-990. For projects where joints require gaskets, the concrete joints shall be watertight and oil resistant and meet the design criteria according to ASTM C-443. Mastic sealants or butyl tape/rope alone are not an acceptable alternative.

2.5 FRAMES AND COVERS

Frames and covers shall be manufactured in accordance with State/Provincial or local requirements for inspection and maintenance access purposes. A minimum of one cover, at least 22-inch (560 mm) in diameter, shall be clearly embossed with the OGS manufacturer's product name to properly identify this asset's purpose is for stormwater quality treatment.

2.6 PRECAST CONCRETE

All precast concrete components shall conform to the appropriate CSA or ASTM specifications.

2.7 FIBERGLASS

The fiberglass portion of the OGS device shall be constructed in accordance with ASTM D2563, and in accordance with the PS15-69 manufacturing standard, and shall only be installed, bolted and watertight sealed to the precast concrete by the Manufacturer prior to arrival at the project site to ensure product quality.

2.8 OGS POLLUTANT STORAGE

The OGS device shall include a sump for sediment storage, and a fiberglass insert for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants. The total sediment storage capacity shall be a minimum 40 ft^3 (1.1 m^3). The total petroleum hydrocarbon storage capacity shall be a minimum 50 gallons (189 liters). The access opening to the sump of the OGS device for periodic inspection and maintenance purposes shall be a minimum 16 inches (406 mm) in diameter.

2.9 LADDERS

Ladder rungs shall be provided upon request or to comply with State/Provincial or local requirements.

2.10 INSPECTION

All precast concrete sections shall be level and inspected to ensure dimensions, appearance, integrity of internal components, and quality of the product meets State/Provincial or local specifications and associated standards.

PART 3 – PERFORMANCE & DESIGN

3.1 GENERAL

The OGS stormwater quality treatment device shall be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV). The OGS stormwater quality treatment device shall remove oil, sediment and gross pollutants from stormwater runoff during frequent wet weather events, and retain these pollutants during less frequent high flow wet weather events below the insert within the OGS for later removal during maintenance. The Manufacturer shall have at least ten (10) years of local experience, history and success in engineering design, manufacturing and production and supply of OGS stormwater quality treatment device systems, acceptable to the Engineer of Record.

3.2 HYDROLOGY AND RUNOFF VOLUME

The OGS device shall be engineered, designed and sized to treat a minimum of 90 percent of the average annual runoff volume, unless otherwise stated by the Engineer of Record, using historical rainfall data. Rainfall data sets should be comprised of a minimum 15-years of rainfall data or a longer continuous period if available for a given location, but in all cases a minimum 5-year period of rainfall data.

3.3 ANNUAL (TSS) SEDIMIMENT LOAD AND STORAGE CAPACITY

The OGS device shall be capable of removing and have sufficient storage capacity for the calculated annual total suspended solids (TSS) mass load and volume without scouring previously captured pollutants prior to maintenance being required. The annual (TSS) sediment load and volume transported from the drainage area should be calculated and compared to the OGS device's available storage capacity by the specifying Engineer to ensure adequate capacity between maintenance cycles. Sediment loadings shall be determined by land use and defined as a minimum of 450 kg (992 lb) of sediment (TSS) per impervious hectare of drainage area per year, or greater based on land use, as noted in Table 1 below.

Annual sediment volume calculations shall be performed using the projected average annual treated runoff volume, a typical sediment bulk density of 1602 kg/m^3 (100 lbs/ft^3) and an assumed Event Mean

Concentration (EMC) of 125 mg/L TSS in the runoff, or as otherwise determined by the Engineer of Record.

Example calculation for a 1.3-hectares parking lot site:

- 1.28 meters of rainfall depth, per year
- 1.3 hectares of 100% impervious drainage area
- EMC of 125 mg/L TSS in runoff
- Treatment of 90% of the average annual runoff volume
- Target average annual TSS removal rate of 60% by OGS

Annual Runoff Volume:

- 1.28 m rain depth x 1.3 ha x 10,000 m^2/ha= 16,640 m^3 of runoff volume
- 16,640 m^3 x 1000 L/m^3 = 16,640,000 L of runoff volume
- 16,640,000 L x 0.90 = 14,976,000 L to be treated by OGS unit

Annual Sediment Mass and Sediment Volume Load Calculation:

- 14,976,000 L x 125 mg/L x kg/1,000,000 mg = 1,872 kg annual sediment mass
- 1,872 kg x m^3/1602 kg = 1.17 m^3 annual sediment volume
- 1.17 m^3 x 60% TSS removal rate by OGS = 0.70 m^3 minimum expected annual storage requirement in OGS

As a guideline, the U.S. EPA has determined typical annual sediment loads per drainage area for various sites by land use (see Table 1). Certain States, Provinces and local jurisdictions have also established such guidelines.

Table 1 – Annual Mass Sediment Loading by Land Use

	Commercial	Parking Lot	Residential			Highways	Industrial	Shopping Center
			High	Med.	Low			
(lbs/acre/yr)	1,000	400	420	250	10	880	500	440
(kg/hectare/yr)	1,124	450	472	281	11	989	562	494

Source: U.S. EPA Stormwater Best Management Practice Design Guide Volume 1, Appendix D, Table D-1, Burton and Pitt 2002

3.4 SIZING METHODOLOGY

The OGS device shall be engineered, designed and sized to provide stormwater quality treatment based on treating a minimum of 90 percent of the average annual runoff volume and a minimum removal of an annual average 60% of the sediment (TSS) load based on the Particle Size Distribution (PSD) specified in Table 2, Section 3.5, and based on third-party performance testing conducted in accordance with the Canadian Environmental Technology Verification (ETV) Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** Sizing shall be determined using historical rainfall data (as specified in Section 3.2) and a sediment removal performance curve derived from the actual third-party verified laboratory testing data. The OGS device shall also have sufficient annual sediment storage capacity as specified and calculated in Section 3.3.

3.4.1 The Peclet Number is not an approved method or model for calculating TSS removal, sizing, or scaling OGS devices.

3.4.2 If an alternate OGS device is proposed, supporting documentation shall be submitted that demonstrates:

- Canadian ETV or ISO 14034 ETV Verification Statement which verifies third-party performance testing conducted in accordance with the **Procedure for Laboratory Testing of Oil-Grit Separators,** including the Light Liquid Re-entrainment Simulation Testing.
- Equal or better sediment (TSS) removal of the PSD specified in Table 2 at equivalent surface loading rates, as compared to the OGS device specified herein.
- Equal or better Light Liquid Re-entrainment Simulation Test results (using low-density polyethylene beads as a surrogate for light liquids such as oil and fuel) at equivalent

surface loading rates, as compared to the OGS device specified herein. However, an alternative OGS device shall not be allowed as a substitute if the Light Liquid Re-entrainment Simulation Test was performed with screening components within the OGS device that are effective at retaining the low-density polyethylene beads, but would not be expected to retain light liquids such as oil and fuel.

- Equal or greater sediment storage capacity, as compared to the OGS device specified herein.
- Supporting documentation shall be signed and sealed by a local registered Professional Engineer. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.5 PARTICLE SIZE DISTRIBUTION (PSD) FOR SIZING

The OGS device shall be sized to achieve the Engineer-specified average annual percent sediment (TSS) removal based solely on the test sediment used in the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators.** This test sediment is comprised of inorganic ground silica with a specific gravity of 2.65, uniformly mixed, and containing a broad range of particle sizes as specified in Table 2. No alternative PSDs or deviations from Table 2 shall be accepted.

Table 2
Canadian ETV Program Procedure for Laboratory Testing of Oil-Grit Separators
Particle Size Distribution (PSD) of Test Sediment

Particle Diameter (Microns)	% by Mass of All Particles	Specific Gravity
1000	5%	2.65
500	5%	2.65
250	15%	2.65
150	15%	2.65
100	10%	2.65
75	5%	2.65
50	10%	2.65
20	15%	2.65
8	10%	2.65
5	5%	2.65
2	5%	2.65

3.6 CANADIAN ETV or ISO 14034 ETV VERIFICATION OF SCOUR TESTING

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party scour testing conducted and have in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. This scour testing is conducted with the device pre-loaded with test sediment comprised of the particle size distribution (PSD) illustrated in Table 2.

3.6.1 To be acceptable for on-line installation, the OGS device must demonstrate an average scour test effluent concentration less than 10 mg/L at each surface loading rate tested, up to and including 2600 L/min/m^2.

Data generated from laboratory scour testing performed with an OGS device pre-loaded with a coarser PSD than in Table 2 (i.e. the coarser PSD has no particles in the 1-micron to 50-micron size range, or the D_{50} of the test sediment exceeds 75 microns) shall not be acceptable for the determination of the device's suitability for on-line installation.

3.7 DESIGN ACCOUNTING FOR BYPASS

3.7.1 The OGS device shall be specified to achieve the TSS removal performance and water quality objectives without washout of previously captured pollutants. The OGS device shall also have sufficient hydraulic conveyance capacity to convey the peak storm event, in accordance with hydraulic conditions per the Engineer of Record. To ensure this is achieved, there are two design options with associated requirements:

3.7.1.1 The OGS device shall be placed **off-line** with an upstream diversion structure (typically in an upstream manhole) that only allows the water quality volume to be diverted to the OGS device, and excessive flows diverted downstream around the OGS device to prevent high flow washout of pollutants previously captured. This design typically incorporates a triangular layout including an upstream bypass manhole with an appropriately engineered weir wall, the OGS device, and a downstream junction manhole, which is connected to both the OGS device and bypass structure. In this case with an external bypass required, the OGS device manufacturer must provide calculations and designs for all structures, piping and any other required material applicable to the proper functioning of the system, stamped by a Professional Engineer.

3.7.1.2 Alternatively, OGS devices in compliance with Section 3.6 shall be acceptable for an **on-line** design configuration, thereby eliminating the requirement for an upstream bypass manhole and downstream junction manhole.

3.7.2 The OGS device shall also have sufficient hydraulic conveyance capacity to convey the peak storm event, in accordance with hydraulic conditions per the Engineer of Record. If an alternate OGS device is proposed, supporting documentation shall be submitted that demonstrates equal or better hydraulic conveyance capacity as compared to the OGS device specified herein. This documentation shall be signed and sealed by a local registered Professional Engineer. All costs associated with preparing and certifying this documentation shall be born solely by the Contractor.

3.8 <u>LIGHT LIQUID RE-ENTRAINMENT SIMULATION TESTING</u>

The OGS device shall have Canadian ETV or ISO 14034 ETV Verification of completed third-party Light Liquid Re-entrainment Simulation Testing in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**, with results reported within the Canadian ETV or ISO 14034 ETV verification. This re-entrainment testing is conducted with the device pre-loaded with low density polyethylene (LDPE) plastic beads as a surrogate for light liquids such as oil and fuel. Testing is conducted on the same OGS unit tested for sediment removal to assess whether light liquids captured after a spill are effectively retained at high flow rates.

3.8.1 For an OGS device to be an acceptable stormwater treatment device on a site where vehicular traffic occurs and the potential for an oil or fuel spill exists, the OGS device must have reported verified performance results of greater than 99% cumulative retention of LDPE plastic beads for the five specified surface loading rates (ranging 200 L/min/m^2 to 2600 L/min/m^2) in accordance with the Light Liquid Re-entrainment Simulation Testing within the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. However, an OGS device shall not be allowed if the Light Liquid Re-entrainment Simulation Testing was performed with screening components within the OGS device that are effective at retaining the LDPE plastic beads, but would not be expected to retain light liquids such as oil and fuel.

3.9 <u>PETROLEUM HYDROCARBONS AND FLOATABLES STORAGE CAPACITY</u>

Petroleum hydrocarbons and floatables storage capacity in the OGS device shall be a minimum 50 gallons (189 Liters), or more as specified.

3.9.1 The OGS device shall have gasketed precast concrete joints that are watertight, and oil resistant and meet the design criteria according to ASTM C-443 to provide safe oil and other hydrocarbon materials storage and ground water protection. Mastic sealants or butyl tape/rope alone are not an acceptable alternative.

3.10 <u>SURFACE LOADING RATE SCALING OF DIFFERENT MODEL SIZES</u>

The reference device for scaling shall be an OGS device that has been third-party tested in accordance with the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**. Other model sizes of the tested device shall only be scaled such that the claimed TSS removal efficiency of the scaled device shall be no greater than the TSS removal efficiency of the tested device at identical **surface loading rates** (flow rate divided by settling surface area). The depth of other model sizes of the tested device shall be scaled in accordance with the depth scaling provisions within Section 6.0 of the Canadian ETV Program's **Procedure for Laboratory Testing of Oil-Grit Separators**.

3.10.1 The Peclet Number and volumetric scaling are not approved methods for scaling OGS devices.

PART 4 – INSPECTION & MAINTENANCE

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

4.1 A Quality Assurance Plan that provides inspection and maintenance for a minimum of 5 years shall be included with the OGS stormwater quality device, and written into the Environmental Compliance Approval (ECA) or the appropriate State/Provincial or local approval document.

4.2 OGS device inspection shall include determination of sediment depth and presence of petroleum hydrocarbons and floatables below the insert. Inspection shall be easily conducted from finished grade through a Frame and Cover of at least 22 inch (560 mm) in diameter.

4.3 Inspection and pollutant removal from below the OGS's insert shall be conducted as a periodic maintenance practice using a standard maintenance truck and vacuum apparatus, and shall be easily conducted from finished grade through a Frame and Cover of at least 22-inches (560 mm) in diameter, and through an access opening to the OGS device's sump with a minimum 16-inches diameter (406 mm).

4.4 No confined space for sediment removal or inspection of internal components shall be required for normal operation, annual inspection or maintenance activity.

PART 5 – EXECUTION

5.1 PRECAST CONCRETE INSTALLATION

The installation of the precast concrete OGS stormwater quality treatment device shall conform to ASTM C 891, ASTM C 478, ASTM C 443, CAN/CSA-A257.4-14, CAN/CSA-A257.4-14, CAN/CSA-S6-00 and all highway, State/Provincial, or local specifications for the construction of manholes. Selected sections of a general specification that are applicable are summarized below. The Contractor shall furnish all labor, equipment and materials necessary to offload, assemble as needed the OGS internal components as specified in the Shop Drawings.

5.2 EXCAVATION

5.2.1 Excavation for the installation of the OGS stormwater quality treatment device shall conform to highway, State/Provincial or local specifications. Topsoil that is removed during the excavation for the OGS stormwater quality treatment device shall be stockpiled in designated areas and not be mixed with subsoil or other materials. Topsoil stockpiles and the general site preparation for the installation of the OGS stormwater quality device shall conform to highway, State/Provincial or local specifications.

5.2.2 The OGS device shall not be installed on frozen ground. Excavation shall extend a minimum of 12 inch (300 mm) from the precast concrete surfaces plus an allowance for shoring and bracing where required. If the bottom of the excavation provides an unsuitable foundation additional excavation may be required.

5.2.3 In areas with a high water table, continuous dewatering shall be provided to ensure that the excavation is stable and free of water.

5.3 <u>BACKFILLING</u>

Backfill material shall conform to highway, State/Provincial or local specifications. Backfill material shall be placed in uniform layers not exceeding 12 inches (300 mm) in depth and compacted to highway, State/Provincial or local specifications.

5.4 <u>OGS WATER QUALITY DEVICE CONSTRUCTION SEQUENCE</u>

5.4.1 The precast concrete OGS stormwater quality treatment device is installed and leveled in sections in the following sequence:

- aggregate base
- base slab, or base
- riser section(s) (if required)
- riser section w/ pre-installed fiberglass insert
- upper riser section(s)
- internal OGS device components
- connect inlet and outlet pipes
- riser section, top slab and/or transition (if required)
- frame and access cover

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

5.4.3 Adjustment of the OGS stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets shall be repaired or replaced as necessary. Once the OGS stormwater quality treatment device has been constructed, any lift holes must be plugged with mortar.

5.5 <u>DROP PIPE AND OIL INSPECTION PIPE</u>

Once the upper precast concrete riser has been attached to the lower precast concrete riser section, the OGS device Drop Pipe and Oil Inspection Pipe must be attached, and watertight sealed to the fiberglass insert using Sikaflex 1a. Installation instructions and required materials shall be provided by the OGS manufacturer.

5.6 <u>INLET AND OUTLET PIPES</u>

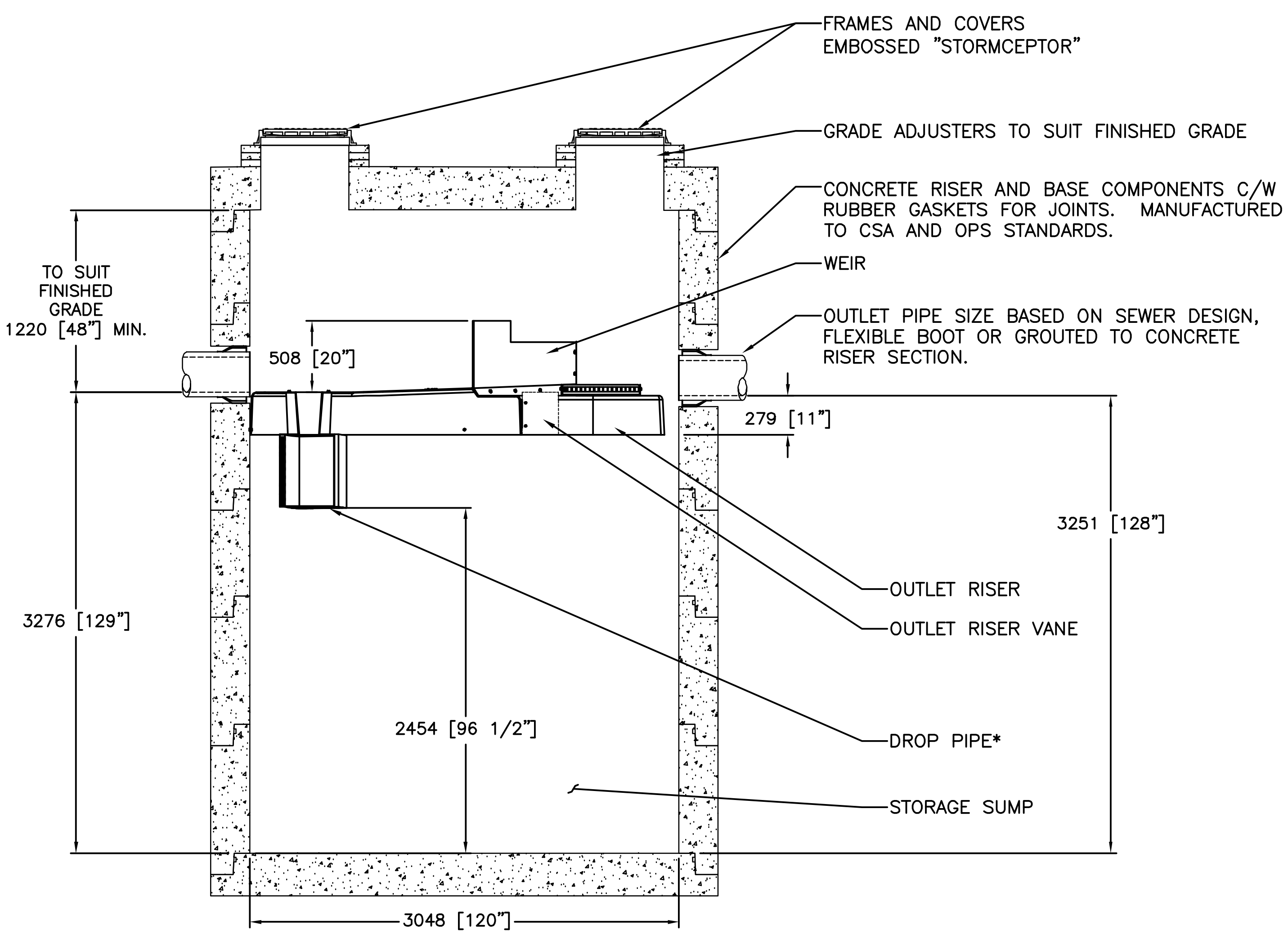
Inlet and outlet pipes shall be securely set using grout or approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight. Non-secure inlets and outlets will result in improper performance.

5.7 <u>FRAME AND COVER OR FRAME AND GRATE INSTALLATION</u>

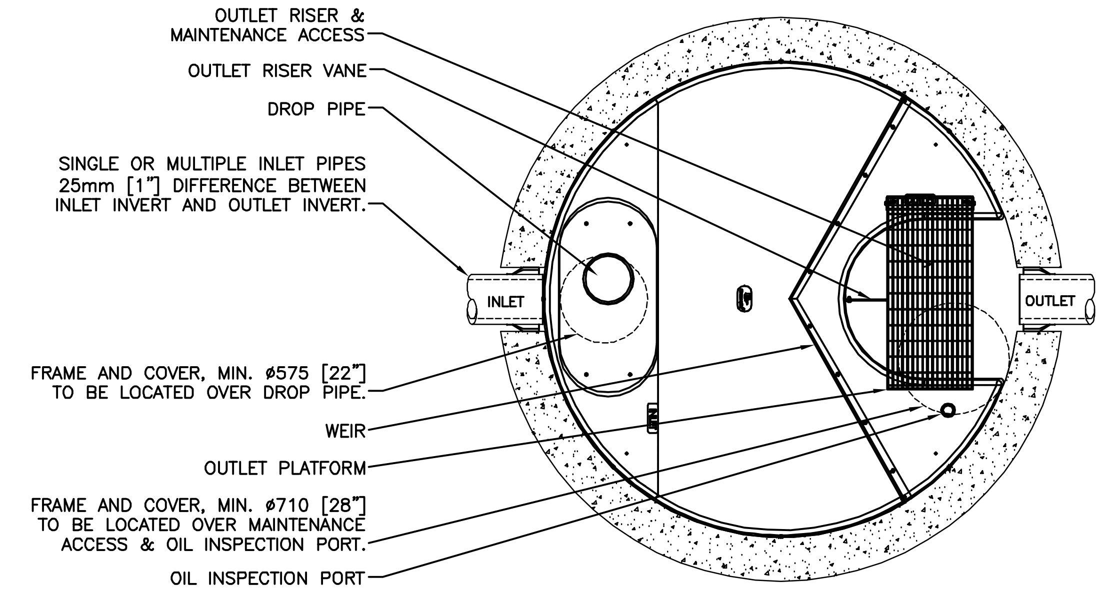
Precast concrete adjustment units shall be installed to set the frame and cover/grate at the required elevation. The adjustment units shall be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover/grate should be set in a full bed of mortar at the elevation specified.

5.7.1 A minimum of one cover, at least 22-inch (560 mm) in diameter, shall be clearly embossed with the OGS device brand or product name to properly identify this asset's purpose is for stormwater quality treatment.

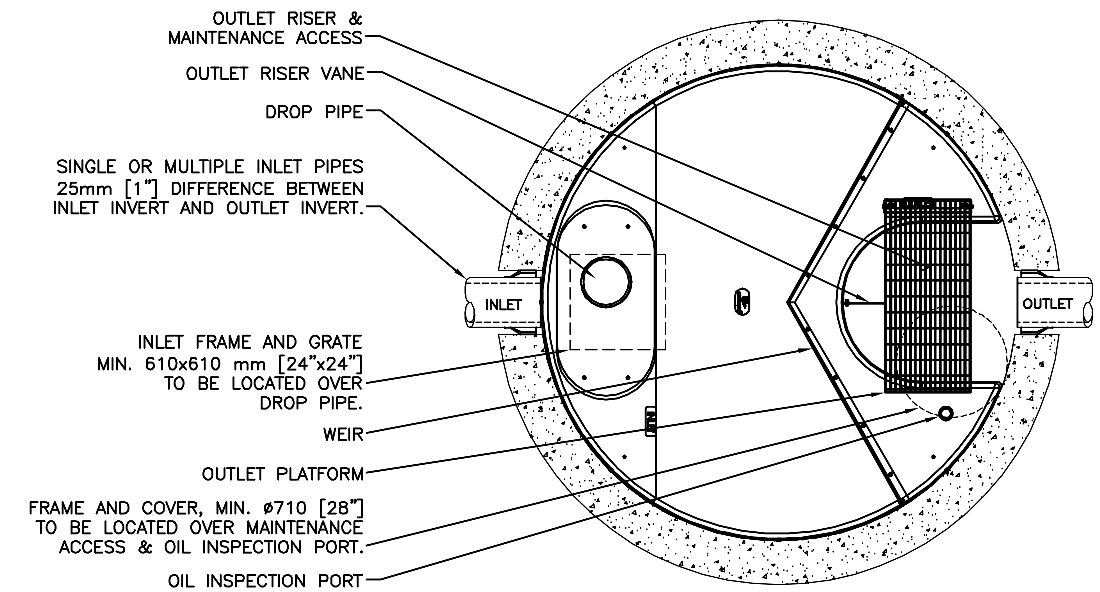
DRAWING NOT TO BE USED FOR CONSTRUCTION



SECTION VIEW



PLAN VIEW (STANDARD)



PLAN VIEW (INLET TOP)

GENERAL NOTES:

* MAXIMUM SURFACE LOADING RATE (SLR) INTO LOWER CHAMBER THROUGH DROP PIPE IS 1135 L/min/m^2 (27.9 gpm/ft^2) FOR STORMCEPTOR EF10 AND 535 L/min/m^2 (13.1 gpm/ft^2) FOR STORMCEPTOR EFO10 (OIL CAPTURE CONFIGURATION).

1. ALL DIMENSIONS INDICATED ARE IN MILLIMETERS (INCHES) UNLESS OTHERWISE SPECIFIED.
2. STORMCEPTOR STRUCTURE INLET AND OUTLET PIPE SIZE AND ORIENTATION SHOWN FOR INFORMATIONAL PURPOSES ONLY.
3. UNLESS OTHERWISE NOTED, BYPASS INFRASTRUCTURE, SUCH AS ALL UPSTREAM DIVERSION STRUCTURES, CONNECTING STRUCTURES, OR PIPE CONDUITS CONNECTING TO COMPLETE THE STORMCEPTOR SYSTEM SHALL BE PROVIDED AND ADDRESSED SEPARATELY.
4. DRAWING FOR INFORMATION PURPOSES ONLY. REFER TO ENGINEER'S SITE/UTILITY PLAN FOR STRUCTURE ORIENTATION.
5. NO PRODUCT SUBSTITUTIONS SHALL BE ACCEPTED UNLESS SUBMITTED 10 DAYS PRIOR TO PROJECT BID DATE, OR AS DIRECTED BY THE ENGINEER OF RECORD.

FOR SITE SPECIFIC DRAWINGS PLEASE CONTACT YOUR LOCAL STORMCEPTOR REPRESENTATIVE. SITE SPECIFIC DRAWINGS ARE BASED ON THE BEST AVAILABLE INFORMATION AT THE TIME. SOME FIELD REVISIONS TO THE SYSTEM LOCATION OR CONNECTION PIPING MAY BE NECESSARY BASED ON AVAILABLE SPACE OR SITE CONFIGURATION REVISIONS. ELEVATIONS SHOULD BE MAINTAINED EXCEPT WHERE NOTED ON BYPASS STRUCTURE (IF REQUIRED).

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE-SPECIFIC DESIGN CONSIDERATIONS AND SHALL BE SPECIFIED BY ENGINEER OF RECORD.
B. CONTRACTOR TO PROVIDE EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING CLUTCHES PROVIDED)
C. CONTRACTOR WILL INSTALL AND LEVEL THE STRUCTURE, SEALING THE JOINTS, LINE ENTRY AND EXIT POINTS (NON-SHRINK GROUT WITH APPROVED WATERSTOP OR FLEXIBLE BOOT)
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT THE DEVICE FROM CONSTRUCTION-RELATED EROSION RUNOFF.
E. DEVICE ACTIVATION, BY CONTRACTOR, SHALL OCCUR ONLY AFTER SITE HAS BEEN STABILIZED AND THE STORMCEPTOR UNIT IS CLEAN AND FREE OF DEBRIS.

STANDARD DETAIL
NOT FOR CONSTRUCTION

SITE SPECIFIC DATA REQUIREMENTS

STORMCEPTOR MODEL	EFO10				
STRUCTURE ID					*
HYDROCARBON STORAGE REQ'D (L)					*
WATER QUALITY FLOW RATE (L/s)					*
PEAK FLOW RATE (L/s)					*
RETURN PERIOD OF PEAK FLOW (yrs)					*
DRAINAGE AREA (HA)					*
DRAINAGE AREA IMPERVIOUSNESS (%)					*
PIPE DATA:	I.E.	MAT'L	DIA	SLOPE %	HGL
INLET #1	*	*	*	*	*
INLET #2	*	*	*	*	*
OUTLET	*	*	*	*	*

* PER ENGINEER OF RECORD

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

MARK	DATE	REVISION DESCRIPTION	BY
####	####	####	####
####	####	####	####
####	####	####	####
1	6/8/18	OUTLET PLATFORM	JSK
0	5/26/17	INITIAL RELEASE	JSK

Stormceptor® EF

SCALE = NTS

imbrium

DATE: 10/24/2017	
DESIGNED: JSK	DRAWN: JSK
CHECKED: BSF	APPROVED: SP
PROJECT No.: EFO10	SEQUENCE No.: *
SHEET: 1 OF 1	

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STORM SEWER CALCULATION SHEET (RATIONAL METHOD)

Ottawa

Manning 0.013

	LOCATION		AREA (Ha)				FLOW				SEWER DATA								
			5 YEAR				Time of	Intensity	Intensity	Peak Flow	DIA. (mm)	DIA. (mm)	TYPE	SLOPE	LENGTH	CAPACITY	VELOCITY	TIME OF	RATIO
			AREA	R	Indiv.	Accum.	Conc.	2 Year	5 Year										
Location	From Node	To Node	(Ha)		2.78 AC	2.78 AC	(min)	(mm/h)	(mm/h)	Q (l/s)	(actual)	(nominal)		(%)	(m)	(l/s)	(m/s)	FLOW (min)	Q/Q full
A109	109	110	0.489	0.51	0.69	0.69	10.00	76.81	104.19	72	375	375	CONC	0.75	58.0	151.8	1.37	0.70	0.48
A110	110	112	0.198	0.64	0.35	1.05	10.70	74.21	100.62	105	375	375	CONC	3.20	25.1	313.6	2.84	0.15	0.34
EX-3	112	113	0.734	0.90	1.84	2.88	10.85	73.69	99.91	288	525	525	CONC	1.50	9.9	526.7	2.43	0.07	0.55
	113	123			0.00	2.88	10.92	73.45	99.58	287	750	750	CONC	0.20	48.1	497.9	1.13	0.71	0.58
To STM 123						2.88	11.63												
A122	122	123	0.923	0.84	2.16	2.16	10.00	76.81	104.19	225	750	750	CONC	0.30	13.3	609.8	1.38	0.16	0.37
To STM 123						2.16	10.16												
	123	114			0.00	5.04	11.63	71.07	96.31	485	900	900	CONC	0.20	58.8	809.6	1.27	0.77	0.60
A123	114	115	0.090	0.20	0.05	5.09	12.40	68.67	93.02	501	900	900	CONC	0.20	25.8	809.6	1.27	0.34	0.62
	115	116			0.00	5.09	12.74	67.68	91.66	494	900	900	CONC	0.20	5.3	809.6	1.27	0.07	0.61
To STM 116						5.09	12.81												
A118	118	119	0.301	0.90	0.75	0.75	10.00	76.81	104.19	78	375	375	PVC	0.75	34.8	151.8	1.37	0.42	0.52
BLDG A*										30									
A119	119	107	0.297	0.90	0.74	1.50	10.42	75.22	102.02	182	450	450	CONC	0.75	28.5	246.9	1.55	0.31	0.74
To STM 107						1.50	10.73												
A120	120	121	0.428	0.90	1.07	1.07	10.00	76.81	104.19	112	450	450	CONC	0.60	35.0	220.8	1.39	0.42	0.51
	121	105			0.00	1.07	10.42	75.23	102.02	109	450	450	CONC	0.60	6.6	220.8	1.39	0.08	0.49
To STM105						1.07	10.50												
A125	125	103B	0.636	0.90	1.59	1.59	10.00	76.81	104.19	166	450	450	PVC	0.80	31.8	255.0	1.60	0.33	0.65
To STM 103B						1.59	10.33												
BLDG B*										6									
A103(A)+A103(B)	103	103B	0.066	0.75	0.14	0.14	10.00	76.81	104.19	21	250	250	PVC	0.75	38.2	51.5	1.05	0.61	0.40
To STM 103B						0.14	10.61												
From STM 125						1.59	10.33												
From STM 103						0.14	10.61												
A103(C)+A103(D)	103B	104	0.125	0.81	0.28	2.01	10.61		101.10	209	450	450	PVC	0.85	18.1	262.9	1.65	0.18	0.80
To STM 104						2.01	10.79												
A100	100	101	0.426	0.24	0.28	0.28	10.00	76.81	104.19	30	375	375	PVC	0.85	43.7	161.6	1.46	0.50	0.18
A101	101	104	0.105	0.79	0.23	0.51	10.50	74.95	101.64	52	450	450	CONC	0.30	35.8	156.2	0.98	0.61	0.34
To STM104						0.51	11.10												
	102	104			0.00	0.00	10.00	76.81	104.19	0	300	300	PVC	0.94	15.0	93.8	1.33	0.19	0.00
From STM101						0.51	11.10												
From STM103B						2.01	10.33												
	104	105			0.00	2.53	11.10	72.81	98.70	255	600	600	CONC	0.30	57.1	336.3	1.19	0.80	0.76
To STM 105						2.53	11.90												
From STM121						1.07	10.50												
	105	106			0.00	3.60	11.90	70.19	95.10	348	675	675	CONC	0.30	42.3	460.4	1.29	0.55	0.76
A106	106	107	0.229	0.20	0.13	3.72	12.45	68.52	92.80	352	750	750	CONC	0.35	40.8	658.6	1.5	0.5	0.53
To STM 107						3.72	12.91												
From STM 119						1.50	10.73												
	107	108			0.00	5.22	12.91	67.19	90.98	511	825	825	CONC	0.65	69.6	1157.3	2.2	0.5	0.44
	108	116			0.00	5.22	13.44	65.70	88.94	500	825	825	CONC	0.65	6.0	1157.3	2.2	0.0	0.43
To STM 117						5.22	13.49												
From STM 115						5.09	12.81												
From STM 108						5.22	13.49												
	116	117			0.00	10.31	13.49	65.57	88.77	951	1050	1050	CONC	0.50	6.2	1930.9	2.2	0.0	0.49

*** 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.	PROJECT: Lincoln Fields Shopping Centre		
Checked: S.L.M.	LOCATION: 2525 Carling Avenue	City of Ottawa	
Dwg. Reference: SWM-1	File Ref:	Date: 2019-05-30	Sheet No. SHEET 1 OF 1

2019-07-17_997_stm_designsheet_aas.xlsx

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

Target Flow Rate

Area 4.965 ha
Q* 166.3 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. 496.5 m³

Estimated Post Development Peak Flow from Unattenuated Areas

Area ID U1
Total Area 0.06 ha
C 0.37 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	6.1	6.1	0.0	0.0	178.6	13.0	13.0	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 0.450 ha
Avail Storage Area 0.428
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 19
m^2 / Drain 225.0 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	267.2	2.2	2.2	0.38	7.22	0.09
0.050	1068.8	15.6	17.8	0.77	14.63	0.38
0.075	2404.7	42.3	60.1	1.14	21.66	0.92
0.100	4275.0	82.4	142.5	1.52	28.88	1.72
0.125	4275.0	106.9	249.4	1.90	36.10	2.54
0.150	4275.0	106.9	356.3	2.28	43.32	3.22

* 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	117.2	22.4	94.8	56.9	178.6	223.2	29.7	193.5	116.1
15	83.6	94.0	22.4	71.6	64.4	142.9	178.6	29.7	148.9	134.0
20	70.3	79.0	22.4	56.6	67.9	120.0	149.9	29.7	120.3	144.3
25	60.9	68.5	22.4	46.1	69.1	103.8	129.8	29.7	100.1	150.2
30	53.9	60.7	22.4	38.2	68.8	91.9	114.8	29.7	85.1	153.3
35	48.5	54.6	22.4	32.1	67.5	82.6	103.2	29.7	73.5	154.4
40	44.2	49.7	22.4	27.3	65.4	75.1	93.9	29.7	64.2	154.2
45	40.6	45.7	22.4	23.3	62.8	69.1	86.3	29.7	56.6	152.9
50	37.7	42.4	22.4	19.9	59.7	64.0	79.9	29.7	50.3	150.8
55	35.1	39.5	22.4	17.1	56.3	59.6	74.5	29.7	44.8	148.0
60	32.9	37.1	22.4	14.6	52.6	55.9	69.9	29.7	40.2	144.7
65	31.0	34.9	22.4	12.5	48.7	52.6	65.8	29.7	36.1	140.9
70	29.4	33.0	22.4	10.6	44.5	49.8	62.2	29.7	32.6	136.7
75	27.9	31.4	22.4	8.9	40.2	47.3	59.1	29.7	29.4	132.2
80	26.6	29.9	22.4	7.4	35.7	45.0	56.2	29.7	26.6	127.5
85	25.4	28.5	22.4	6.1	31.1	43.0	53.7	29.7	24.0	122.4
90	24.3	27.3	22.4	4.9	26.3	41.1	51.4	29.7	21.7	117.2
95	23.3	26.2	22.4	3.8	21.5	39.4	49.3	29.7	19.6	111.8
100	22.4	25.2	22.4	2.8	16.6	37.9	47.4	29.7	17.7	106.2
105	21.6	24.3	22.4	1.8	11.6	36.5	45.6	29.7	15.9	100.4
110	20.8	23.4	22.4	1.0	6.5	35.2	44.0	29.7	14.3	94.5

5-year Q_{roof}	**22.45**	**L/s**	**100-year Q_{roof}**	**29.69**	**L/s**
5-year Max. Storage Required	**69.1**	**m^3**	**100-year Max. Storage Required**	**154.4**	**m^3**
5-year Storage Depth	**0.078**	**m**	**100-year Storage Depth**	**0.103**	**m**
5-year Estimated Drawdown Time	**1.01**	**hr**	**00-year Estimated Drawdown Time**	**1.81**	**hr**

Building ID	BLDG-B	
Roof Area	0.092	ha
Avail Storage Area	0.088	
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	4	
m^2 / Drain	219.0	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	54.7	0.5	0.5	0.38	1.52	0.08
0.050	219.0	3.2	3.6	0.77	3.08	0.37
0.075	492.7	8.7	12.3	1.14	4.56	0.90
0.100	875.9	16.9	29.2	1.52	6.08	1.67
0.125	875.9	21.9	51.1	1.90	7.60	2.47
0.150	875.9	21.9	73.0	2.28	9.12	3.14

* 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	24.0	4.7	19.3	11.6	178.6	45.7	6.2	39.5	23.7
15	83.6	19.3	4.7	14.5	13.1	142.9	36.6	6.2	30.4	27.3
20	70.3	16.2	4.7	11.5	13.8	120.0	30.7	6.2	24.5	29.4
25	60.9	14.0	4.7	9.3	14.0	103.8	26.6	6.2	20.4	30.6
30	53.9	12.4	4.7	7.7	13.9	91.9	23.5	6.2	17.3	31.1
35	48.5	11.2	4.7	6.5	13.6	82.6	21.1	6.2	14.9	31.3
40	44.2	10.2	4.7	5.5	13.1	75.1	19.2	6.2	13.0	31.2
45	40.6	9.4	4.7	4.7	12.6	69.1	17.7	6.2	11.5	30.9
50	37.7	8.7	4.7	4.0	11.9	64.0	16.4	6.2	10.2	30.5
55	35.1	8.1	4.7	3.4	11.2	59.6	15.3	6.2	9.0	29.8
60	32.9	7.6	4.7	2.9	10.4	55.9	14.3	6.2	8.1	29.1
65	31.0	7.2	4.7	2.4	9.5	52.6	13.5	6.2	7.3	28.3
70	29.4	6.8	4.7	2.1	8.7	49.8	12.8	6.2	6.5	27.4
75	27.9	6.4	4.7	1.7	7.7	47.3	12.1	6.2	5.9	26.4
80	26.6	6.1	4.7	1.4	6.8	45.0	11.5	6.2	5.3	25.4
85	25.4	5.8	4.7	1.1	5.8	43.0	11.0	6.2	4.8	24.3
90	24.3	5.6	4.7	0.9	4.8	41.1	10.5	6.2	4.3	23.2
95	23.3	5.4	4.7	0.7	3.8	39.4	10.1	6.2	3.9	22.1
100	22.4	5.2	4.7	0.5	2.7	37.9	9.7	6.2	3.5	20.9
105	21.6	5.0	4.7	0.3	1.7	36.5	9.3	6.2	3.1	19.6
110	20.8	4.8	4.7	0.1	0.6	35.2	9.0	6.2	2.8	18.4

5-year Q_{roof}	**4.71**	**L/s**	**100-year Q_{roof}**	**6.23**	**L/s**
5-year Max. Storage Required	**14.0**	**m^3**	**100-year Max. Storage Required**	**31.3**	**m^3**
5-year Storage Depth	**0.077**	**m**	**100-year Storage Depth**	**0.102**	**m**
5-year Estimated Drawdown Time	**0.98**	**hr**	**00-year Estimated Drawdown Time**	**1.75**	**hr**

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	71.82	71.48	72.35	72.35
Depth	2.03	2.37	1.50	1.50
$V_{structure}$ (m^3)	2.3	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) 11.1

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage (m)	Ponding (m^2)	h_o (m)	delta d (m)	V* (m^3)	V_{acc}** (m^3)	$Q_{release}$† (L/s)	$V_{drawdown}$ (hr)
Orifice INV	71.48		0.00			0.0	0.0	0.00
	72.60		1.12	1.12	5.8	5.8	9.1	0.18
T/L	73.85	1	2.37	1.25	5.4	11.1	14.0	0.22
0.15m Ponding	74.00	958	2.52	0.15	49.8	61.0	14.1	1.20
0.30m Ponding	74.15	2963	2.67	0.15	280.2	341.2	14.5	6.54

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

Orifice Location **CBMH 119 TEMPEST LMF 100**
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 (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	155.8	14.2	141.6	85.0	178.6	296.7	14.4	282.3	169.4
15	83.6	125.0	14.2	110.8	99.7	142.9	237.4	14.4	223.0	200.7
20	70.3	105.1	14.2	90.9	109.0	120.0	199.3	14.4	184.9	221.8
25	60.9	91.1	14.2	76.9	115.3	103.8	172.5	14.4	158.1	237.2
30	53.9	80.6	14.2	66.5	119.6	91.9	152.6	14.4	138.2	248.8
35	48.5	72.6	14.2	58.4	122.6	82.6	137.2	14.4	122.8	257.8
40	44.2	66.1	14.2	51.9	124.5	75.1	124.9	14.4	110.4	265.0
45	40.6	60.8	14.2	46.6	125.7	69.1	114.7	14.4	100.3	270.8
50	37.7	56.3	14.2	42.1	126.3	64.0	106.3	14.4	91.8	275.5
55	35.1	52.5	14.2	38.3	126.5	59.6	99.1	14.4	84.6	279.3
60	32.9	49.3	14.2	35.1	126.3	55.9	92.9	14.4	78.4	282.4
65	31.0	46.4	14.2	32.2	125.7	52.6	87.5	14.4	73.0	284.9
70	29.4	43.9	14.2	29.7	124.9	49.8	82.7	14.4	68.3	286.9
75	27.9	41.7	14.2	27.5	123.8	47.3	78.5	14.4	64.1	288.4
80	26.6	39.7	14.2	25.5	122.5	45.0	74.8	14.4	60.3	289.6
85	25.4	37.9	14.2	23.7	121.1	43.0	71.4	14.4	56.9	290.4
90	24.3	36.3	14.2	22.1	119.5	41.1	68.3	14.4	53.9	290.9
95	23.3	34.9	14.2	20.7	117.8	39.4	65.5	14.4	51.1	291.2
100	22.4	33.5	14.2	19.3	115.9	37.9	63.0	14.4	48.5	291.3
105	21.6	32.3	14.2	18.1	113.9	36.5	60.6	14.4	46.2	291.1
110	20.8	31.1	14.2	16.9	111.9	35.2	58.5	14.4	44.1	290.8

5-year $Q_{attenuated}$	**14.19 L/s**	**100-year $Q_{attenuated}$**	**14.43 L/s**
5-year Max. Storage Required	**126.5 m^3**	**100-year Max. Storage Required**	**291.3 m^3**
Est. 5-year Storage Elevation	**74.04 m**	**Est. 100-year Storage Elevation**	**74.12 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*	74.45	74.29	74.05	74.05	74.05
INV	72.27	71.97	72.55	72.55	72.55
Depth	2.18	2.32	1.50	1.50	1.50
$V_{structure}$ (m^3)	2.5	2.6	0.2	0.2	0.2

Sewers

ID	250mm	450mm		U/G STORG.*
Storage Pipe Dia (mm)	250	450		
L (m)	43.7	42		
V_{sewer} (m^3)	2.1	6.7		125.0
	*Top of lid or max ponding elevation			74.30

Note*
Total U/G Storage Provided = 240m3
Infiltration Volume below ICD invert = 115m3

Total Subsurface Storage (m^3) 139.5

Stage Attenuated Areas Storage Summary

	Stage	Surface Storage Ponding	h$_o$	delta d	Surface and Subsurface Storage 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 SL	72.21		0.24	0.24	62.8	62.8	1.5	11.62
Storage Pipe OBV	72.45		0.48	0.24	62.8	125.5	2.2	15.85
T/L	74.05	1	2.08	1.60	14.0	139.5	4.6	8.42
0.15m Ponding	74.20	533	2.23	0.15	27.9	167.4	4.7	9.89
0.25m Ponding	74.30	1836.0	2.33	0.10	111.9	279.3	4.8	16.16

* 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 60**
Total Area 0.428 ha
C 0.90 Rational Method runoff coefficient *Note: Rational Method Coefficient "C" increased by 25% for 100-year calculations*

t_c	5-year i	Q_{actual}‡	$Q_{release}$	Q_{stored}	V_{stored}	100-year 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	111.5	2.8	108.7	65.2	178.6	212.4	4.8	207.6	124.6
20	70.3	75.2	2.8	72.4	86.9	120.0	142.7	4.8	137.9	165.5
25	60.9	65.2	2.8	62.4	93.6	103.8	123.5	4.8	118.7	178.1
30	53.9	57.7	2.8	54.9	98.8	91.9	109.3	4.8	104.5	188.1
35	48.5	51.9	2.8	49.1	103.1	82.6	98.2	4.8	93.4	196.2
40	44.2	47.3	2.8	44.5	106.7	75.1	89.4	4.8	84.6	203.1
45	40.6	43.5	2.8	40.7	109.8	69.1	82.1	4.8	77.4	208.9
50	37.7	40.3	2.8	37.5	112.5	64.0	76.1	4.8	71.3	213.9
55	35.1	37.6	2.8	34.8	114.8	59.6	70.9	4.8	66.1	218.3
60	32.9	35.3	2.8	32.4	116.8	55.9	66.5	4.8	61.7	222.2
65	31.0	33.2	2.8	30.4	118.6	52.6	62.6	4.8	57.8	225.6
70	29.4	31.4	2.8	28.6	120.2	49.8	59.2	4.8	54.4	228.7
75	27.9	29.9	2.8	27.0	121.7	47.3	56.2	4.8	51.4	231.4
80	26.6	28.4	2.8	25.6	122.9	45.0	53.5	4.8	48.7	233.9
85	25.4	27.2	2.8	24.3	124.1	43.0	51.1	4.8	46.3	236.2
90	24.3	26.0	2.8	23.2	125.2	41.1	48.9	4.8	44.1	238.3
95	23.3	24.9	2.8	22.1	126.1	39.4	46.9	4.8	42.1	240.1
100	22.4	24.0	2.8	21.2	127.0	37.9	45.1	4.8	40.3	241.9
105	21.6	23.1	2.8	20.3	127.8	36.5	43.4	4.8	38.6	243.4
110	20.8	22.3	2.8	19.5	128.5	35.2	41.9	4.8	37.1	244.8
115	20.1	21.5	2.8	18.7	129.2	34.0	40.4	4.8	35.7	246.1

‡ Includes controlled flow from BLDG-B

5-year $Q_{attenuated}$	**2.82 L/s**	**100-year $Q_{attenuated}$**	**4.77 L/s**
5-year Max. Storage Required	**129.2 m^3**	**100-year Max. Storage Required**	**246.1 m^3**
Est. 5-year Storage Elevation	**72.86 m**	**Est. 100-year Storage Elevation**	**74.27 m**

Estimated Post Development Peak Flow from Attenuated Areas

Area ID A100, A101
Available Sub-surface Storage
Maintenance Structures

ID	MH 100	MH 101	CB 100A	CB 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		55.5
	*Top of lid or max ponding elevation			74.20

Note*
Total U/G Storage Provided = 222m3
Infiltration Volume below ICD invert = 165m3

Total Subsurface Storage (m^3) 68.3

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	71.50		0.00			0.0	0.0	0.00
Storage Pipe SL	71.61		0.11	0.11	27.9	27.9	2.2	3.52
Storage Pipe OBV	71.73		0.23	0.12	27.9	55.8	3.9	3.97
T/L	74.00	2	2.50	2.27	12.6	68.3	11.4	1.66
0.10m Ponding	74.10	108	2.60	0.10	4.1	72.5	11.6	1.74
0.20m Ponding	74.20	435.0	2.70	0.10	25.3	97.8	11.9	2.28

* 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 90**
Total Area 0.531 ha
C 0.35 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	53.8	3.4	50.3	30.2	178.6	115.2	11.8	103.4	62.1
15	83.6	43.1	3.4	39.7	35.7	142.9	92.2	11.8	80.4	72.4
20	70.3	36.3	3.4	32.8	39.4	120.0	77.4	11.8	65.6	78.7
25	60.9	31.4	3.4	28.0	42.0	103.8	67.0	11.8	55.2	82.8
30	53.9	27.8	3.4	24.4	43.9	91.9	59.3	11.8	47.5	85.5
35	48.5	25.0	3.4	21.6	45.4	82.6	53.3	11.8	41.5	87.1
40	44.2	22.8	3.4	19.4	46.5	75.1	48.5	11.8	36.7	88.1
45	40.6	21.0	3.4	17.5	47.3	69.1	44.6	11.8	32.8	88.5
50	37.7	19.4	3.4	16.0	48.0	64.0	41.3	11.8	29.5	88.4
55	35.1	18.1	3.4	14.7	48.5	59.6	38.5	11.8	26.7	88.1
60	32.9	17.0	3.4	13.6	48.8	55.9	36.1	11.8	24.3	87.4
65	31.0	16.0	3.4	12.6	49.1	52.6	34.0	11.8	22.2	86.5
70	29.4	15.2	3.4	11.7	49.2	49.8	32.1	11.8	20.3	85.4
75	27.9	14.4	3.4	11.0	49.3	47.3	30.5	11.8	18.7	84.2
80	26.6	13.7	3.4	10.3	49.3	45.0	29.0	11.8	17.2	82.8
85	25.4	13.1	3.4	9.6	49.2	43.0	27.7	11.8	15.9	81.2
90	24.3	12.5	3.4	9.1	49.1	41.1	26.5	11.8	14.7	79.6
95	23.3	12.0	3.4	8.6	48.9	39.4	25.4	11.8	13.7	77.9
100	22.4	11.6	3.4	8.1	48.7	37.9	24.5	11.8	12.7	76.0
105	21.6	11.1	3.4	7.7	48.5	36.5	23.6	11.8	11.8	74.1
110	20.8	10.7	3.4	7.3	48.2	35.2	22.7	11.8	10.9	72.1

5-year $Q_{attenuated}$	**3.45**	**L/s**	**100-year $Q_{attenuated}$**	**11.79**	**L/s**
5-year Max. Storage Required	**49.3**	**m^3**	**100-year Max. Storage Required**	**88.5**	**m^3**
Est. 5-year Storage Elevation	**71.70**	**m**	**Est. 100-year Storage Elevation**	**74.16**	**m**

Area ID A109+A110
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	73.05	73.05	73.20
INV	71.26	70.78	71.55	71.55	71.55	71.70
Depth	1.99	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 STORAGE*
Storage Pipe Dia (mm)	250	375		
L (m)	28.5	47.15		
V_{sewer} (m^3)	1.4	5.2		93.9
	*Top of lid or max ponding elevation			73.35

*Note**
Total U/G Storage Provided = 90m3
Infiltration Volume below ICD invert = 0m3

Total Subsurface Storage (m^3) 106.3

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	70.78		0.00			0.0	0.0	0.00
Storage Pipe SL	71.24		0.46	0.46	47.5	47.5	5.0	2.64
Storage Pipe OBV	71.70		0.92	0.46	47.5	94.9	7.0	3.77
T/L	73.05	0	2.27	1.35	11.3	106.3	10.9	2.71
0.15m Ponding	73.20	262	2.42	0.15	13.6	119.8	11.3	2.95
0.18m Ponding	73.23	396	2.45	0.03	9.8	129.6	11.3	3.19
0.30m Ponding	73.35	1067.5	2.57	0.15	105.6	235.3	11.5	5.68

* 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 90**
Total Area 0.687 ha
C 0.55 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	109.4	7.7	101.6	61.0	178.6	234.3	11.5	222.8	133.7
15	83.6	87.7	7.7	80.0	72.0	142.9	187.5	11.5	176.0	158.4
20	70.3	73.7	7.7	66.0	79.2	120.0	157.4	11.5	145.9	175.1
25	60.9	63.9	7.7	56.2	84.3	103.8	136.2	11.5	124.8	187.1
30	53.9	56.6	7.7	48.9	88.0	91.9	120.5	11.5	109.0	196.3
35	48.5	50.9	7.7	43.2	90.7	82.6	108.3	11.5	96.9	203.4
40	44.2	46.4	7.7	38.6	92.8	75.1	98.6	11.5	87.1	209.0
45	40.6	42.6	7.7	34.9	94.3	69.1	90.6	11.5	79.1	213.6
50	37.7	39.5	7.7	31.8	95.4	64.0	83.9	11.5	72.4	217.3
55	35.1	36.9	7.7	29.1	96.2	59.6	78.2	11.5	66.7	220.2
60	32.9	34.6	7.7	26.8	96.7	55.9	73.3	11.5	61.8	222.7
65	31.0	32.6	7.7	24.9	96.9	52.6	69.1	11.5	57.6	224.6
70	29.4	30.8	7.7	23.1	97.0	49.8	65.3	11.5	53.8	226.1
75	27.9	29.3	7.7	21.5	96.9	47.3	62.0	11.5	50.5	227.3
80	26.6	27.9	7.7	20.2	96.7	45.0	59.0	11.5	47.5	228.2
85	25.4	26.6	7.7	18.9	96.4	43.0	56.4	11.5	44.9	228.8
90	24.3	25.5	7.7	17.8	95.9	41.1	53.9	11.5	42.5	229.2
95	23.3	24.5	7.7	16.7	95.4	39.4	51.7	11.5	40.3	229.4
100	22.4	23.5	7.7	15.8	94.7	37.9	49.7	11.5	38.2	229.5
105	21.6	22.7	7.7	14.9	94.0	36.5	47.9	11.5	36.4	229.3
110	20.8	21.9	7.7	14.1	93.2	35.2	46.2	11.5	34.7	229.0

5-year $Q_{attenuated}$	**7.73 L/s**	**100-year $Q_{attenuated}$**	**11.49 L/s**
5-year Max. Storage Required	**97.0 m^3**	**100-year Max. Storage Required**	**229.5 m^3**
Est. 5-year Storage Elevation	**71.95 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			153.0
	*Top of lid or max ponding elevation			72.00

Note*
Total U/G Storage Provided = 198m3
Infiltration Volume below ICD invert = 45m3

Total Subsurface Storage (m^3) 160.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage (m)	Ponding (m^2)	h_o (m)	delta d (m)	V* (m^3)	V_{acc}** (m^3)	$Q_{release}$† (L/s)	$V_{drawdown}$ (hr)
Orifice INV	69.77		0.00		0.0	0.0	0.0	0.00
Storage Pipe SL	70.13		0.36	0.36	76.9	76.9	5.5	3.88
Storage Pipe OBV	70.48		0.71	0.36	76.9	153.8	5.5	7.77
T/L	71.70	2	1.93	1.22	6.4	160.2	10.0	4.45
0.15m Ponding	71.85	1,385	2.08	0.15	71.9	232.0	10.2	6.32
0.30m Ponding	72.00	3487	2.23	0.15	353.5	585.5	10.5	15.49

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

Orifice Location **CBMH 122** **TEMPEST LMF 105**
Total Area 0.923 ha
C 0.84 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	224.4	10.2	214.2	128.5	178.6	457.8	10.5	447.3	268.4
20	70.3	151.3	10.2	141.1	169.3	120.0	307.5	10.5	297.1	356.5
30	53.9	116.1	10.2	106.0	190.7	91.9	235.5	10.5	225.1	405.1
40	44.2	95.2	10.2	85.0	203.9	75.1	192.7	10.5	182.2	437.3
50	37.7	81.1	10.2	70.9	212.7	64.0	164.0	10.5	153.5	460.5
60	32.9	70.9	10.2	60.8	218.7	55.9	143.3	10.5	132.8	478.2
70	29.4	63.3	10.2	53.1	222.9	49.8	127.7	10.5	117.2	492.2
80	26.6	57.2	10.2	47.0	225.7	45.0	115.4	10.5	104.9	503.4
90	24.3	52.3	10.2	42.1	227.4	41.1	105.4	10.5	94.9	512.6
100	22.4	48.3	10.2	38.1	228.4	37.9	97.2	10.5	86.7	520.2
110	20.8	44.8	10.2	34.7	228.7	35.2	90.3	10.5	79.8	526.6
120	19.5	41.9	10.2	31.7	228.5	32.9	84.3	10.5	73.9	531.8
130	18.3	39.4	10.2	29.2	227.8	30.9	79.2	10.5	68.7	536.2
140	17.3	37.2	10.2	27.0	226.8	29.2	74.7	10.5	64.3	539.9
150	16.4	35.2	10.2	25.0	225.4	27.6	70.8	10.5	60.3	542.9
160	15.6	33.5	10.2	23.3	223.8	26.2	67.3	10.5	56.8	545.3
170	14.8	31.9	10.2	21.8	221.9	25.0	64.1	10.5	53.7	547.3
180	14.2	30.5	10.2	20.3	219.8	23.9	61.3	10.5	50.8	548.8
190	13.6	29.3	10.2	19.1	217.4	22.9	58.7	10.5	48.2	549.9
200	13.0	28.1	10.2	17.9	215.0	22.0	56.4	10.5	45.9	550.7
210	12.6	27.0	10.2	16.8	212.3	21.1	54.2	10.5	43.7	551.1

5-year $Q_{attenuated}$	**10.19 L/s**	**100-year $Q_{attenuated}$**	**10.47 L/s**
5-year Max. Storage Required	**228.7 m^3**	**100-year Max. Storage Required**	**551.1 m^3**
Est. 5-year Storage Elevation	**71.84 m**	**Est. 100-year Storage Elevation**	**71.99 m**

Area ID A123
Available Sub-surface Storage
Maintenance Structures

ID	CB 123A				
Structure Dia./Area (mm/mm^2)	360				
T/L*	71.95				
INV	70.45				
Depth	1.50				
$V_{structure}$ (m^3)	0.2				

Sewers

ID	250mm			
Storage Pipe Dia (mm)	250			
L (m)	2			
V_{sewer} (m^3)	0.1			

*Top of lid or max ponding elevation 72.20

Total Subsurface Storage (m^3) 0.3

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	69.50		0.00			0.0	0.0	0.00
T/L	71.95	0	2.45	2.45	0.3	0.3	2.9	0.03
0.05m Ponding	72.00	10	2.50	0.05	0.2	0.5	2.9	0.05
0.10m Ponding	72.05	36.7	2.55	0.05	1.1	1.6	2.9	0.15
0.15m Ponding	72.20	187.9	2.70	0.15	15.4	17.0	3.0	1.57

* V=Incremental storage volume
**V_{acc}=Total surface and sub-surface
† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **CB123A TEMPEST LMF 45**
Total Area 0.090 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	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	5.2	2.9	2.3	1.4	178.6	11.1	2.9	8.2	4.9
15	83.6	4.2	2.9	1.3	1.1	142.9	8.9	2.9	6.0	5.4
20	70.3	3.5	2.9	0.6	0.7	120.0	7.5	2.9	4.5	5.5
25	60.9	3.0	2.9	0.1	0.2	103.8	6.5	2.9	3.5	5.3
30	53.9	2.7	2.7	0.0	0.0	91.9	5.7	2.9	2.8	5.0
35	48.5	2.4	2.4	0.0	0.0	82.6	5.1	2.9	2.2	4.6
40	44.2	2.2	2.2	0.0	0.0	75.1	4.7	2.9	1.8	4.2
45	40.6	2.0	2.0	0.0	0.0	69.1	4.3	2.9	1.4	3.7
50	37.7	1.9	1.9	0.0	0.0	64.0	4.0	2.9	1.1	3.2
55	35.1	1.8	1.8	0.0	0.0	59.6	3.7	2.9	0.8	2.6
60	32.9	1.6	1.6	0.0	0.0	55.9	3.5	2.9	0.6	2.0
65	31.0	1.5	1.5	0.0	0.0	52.6	3.3	2.9	0.3	1.4
70	29.4	1.5	1.5	0.0	0.0	49.8	3.1	2.9	0.2	0.7
75	27.9	1.4	1.4	0.0	0.0	47.3	2.9	2.9	0.0	0.1
80	26.6	1.3	1.3	0.0	0.0	45.0	2.8	2.9	0.0	0.0
85	25.4	1.3	1.3	0.0	0.0	43.0	2.7	2.9	0.0	0.0
90	24.3	1.2	1.2	0.0	0.0	41.1	2.6	2.9	0.0	0.0
95	23.3	1.2	1.2	0.0	0.0	39.4	2.5	2.9	0.0	0.0
100	22.4	1.1	1.1	0.0	0.0	37.9	2.4	2.9	0.0	0.0
105	21.6	1.1	1.1	0.0	0.0	36.5	2.3	2.9	0.0	0.0
110	20.8	1.0	1.0	0.0	0.0	35.2	2.2	2.9	0.0	0.0

5-year $Q_{attenuated}$	**2.90 L/s**	**100-year $Q_{attenuated}$**	**2.93 L/s**
5-year Max. Storage Required	**1.4 m^3**	**100-year Max. Storage Required**	**5.5 m^3**
Est. 5-year Storage Elevation	**72.04 m**	**Est. 100-year Storage Elevation**	**72.09 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 74.55

Total Subsurface Storage (m^3) 0.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage (m)	Ponding (m^2)	h_o (m)	delta d (m)	V* (m^3)	V_{acc}** (m^3)	$Q_{release}$† (L/s)	$V_{drawdown}$ (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	14.6	0.00
0.05m Ponding	74.55	17.6	1.55	0.05	0.3	0.5	14.9	0.01

* 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** **Dia** 75
Total Area 0.026 ha
C 0.85 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	6.4	6.3	0.1	0.1	178.6	13.0	12.7	0.3	0.2
15	83.6	5.2	5.2	0.0	0.0	142.9	10.4	10.4	0.0	0.0
20	70.3	4.3	4.3	0.0	0.0	120.0	8.7	10.4	0.0	0.0
25	60.9	3.8	3.8	0.0	0.0	103.8	7.6	10.4	0.0	0.0
30	53.9	3.3	3.3	0.0	0.0	91.9	6.7	10.4	0.0	0.0
35	48.5	3.0	3.0	0.0	0.0	82.6	6.0	10.4	0.0	0.0
40	44.2	2.7	2.7	0.0	0.0	75.1	5.5	10.4	0.0	0.0
45	40.6	2.5	2.5	0.0	0.0	69.1	5.0	10.4	0.0	0.0
50	37.7	2.3	2.3	0.0	0.0	64.0	4.7	10.4	0.0	0.0
55	35.1	2.2	2.2	0.0	0.0	59.6	4.3	10.4	0.0	0.0
60	32.9	2.0	2.0	0.0	0.0	55.9	4.1	10.4	0.0	0.0
65	31.0	1.9	1.9	0.0	0.0	52.6	3.8	10.4	0.0	0.0
70	29.4	1.8	1.8	0.0	0.0	49.8	3.6	10.4	0.0	0.0
75	27.9	1.7	1.7	0.0	0.0	47.3	3.4	10.4	0.0	0.0
80	26.6	1.6	1.6	0.0	0.0	45.0	3.3	10.4	0.0	0.0
85	25.4	1.6	1.6	0.0	0.0	43.0	3.1	10.4	0.0	0.0
90	24.3	1.5	1.5	0.0	0.0	41.1	3.0	10.4	0.0	0.0
95	23.3	1.4	1.4	0.0	0.0	39.4	2.9	10.4	0.0	0.0
100	22.4	1.4	1.4	0.0	0.0	37.9	2.8	10.4	0.0	0.0
105	21.6	1.3	1.3	0.0	0.0	36.5	2.7	10.4	0.0	0.0
110	20.8	1.3	1.3	0.0	0.0	35.2	2.6	10.4	0.0	0.0

5-year $Q_{attenuated}$	**6.31 L/s**	**100-year $Q_{attenuated}$**	**12.71 L/s**
5-year Max. Storage Required	**0.1 m^3**	**100-year Max. Storage Required**	**0.2 m^3**
Est. 5-year Storage Elevation	**73.65 m**	**Est. 100-year Storage Elevation**	**74.30 m**

Area ID A103-B
Available Sub-surface Storage
Maintenance Structures

ID	CB 103B				
Structure Dia./Area (mm/mm^2)	360				
T/L*	74.40				
INV	72.90				
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 74.55

Total Subsurface Storage (m^3) 0.2

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage (m)	Ponding (m^2)	h_o (m)	delta d (m)	V* (m^3)	V_{acc}** (m^3)	$Q_{release}$† (L/s)	$V_{drawdown}$ (hr)
Orifice INV	72.85		0.00			0.0	0.0	0.00
T/L	74.40	0	1.55	1.55	0.2	0.2	14.9	0.00
0.15m Ponding	74.55	54.8	1.70	0.15	3.0	3.2	15.6	0.06

* 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** **dia** 75
Total Area 0.043 ha
C 0.69 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	8.6	8.4	0.2	0.1	178.6	18.4	15.3	3.1	1.9
15	83.6	6.9	6.9	0.0	0.0	142.9	14.7	14.7	0.0	0.0
20	70.3	5.8	5.8	0.0	0.0	120.0	12.4	14.7	0.0	0.0
25	60.9	5.0	5.0	0.0	0.0	103.8	10.7	14.7	0.0	0.0
30	53.9	4.4	4.4	0.0	0.0	91.9	9.5	14.7	0.0	0.0
35	48.5	4.0	4.0	0.0	0.0	82.6	8.5	14.7	0.0	0.0
40	44.2	3.6	3.6	0.0	0.0	75.1	7.7	14.7	0.0	0.0
45	40.6	3.3	3.3	0.0	0.0	69.1	7.1	14.7	0.0	0.0
50	37.7	3.1	3.1	0.0	0.0	64.0	6.6	14.7	0.0	0.0
55	35.1	2.9	2.9	0.0	0.0	59.6	6.1	14.7	0.0	0.0
60	32.9	2.7	2.7	0.0	0.0	55.9	5.8	14.7	0.0	0.0
65	31.0	2.6	2.6	0.0	0.0	52.6	5.4	14.7	0.0	0.0
70	29.4	2.4	2.4	0.0	0.0	49.8	5.1	14.7	0.0	0.0
75	27.9	2.3	2.3	0.0	0.0	47.3	4.9	14.7	0.0	0.0
80	26.6	2.2	2.2	0.0	0.0	45.0	4.6	14.7	0.0	0.0
85	25.4	2.1	2.1	0.0	0.0	43.0	4.4	14.7	0.0	0.0
90	24.3	2.0	2.0	0.0	0.0	41.1	4.2	14.7	0.0	0.0
95	23.3	1.9	1.9	0.0	0.0	39.4	4.1	14.7	0.0	0.0
100	22.4	1.8	1.8	0.0	0.0	37.9	3.9	14.7	0.0	0.0
105	21.6	1.8	1.8	0.0	0.0	36.5	3.8	14.7	0.0	0.0
110	20.8	1.7	1.7	0.0	0.0	35.2	3.6	14.7	0.0	0.0

5-year $Q_{attenuated}$	**8.40 L/s**	**100-year $Q_{attenuated}$**	**15.26 L/s**
5-year Max. Storage Required	**0.1 m^3**	**100-year Max. Storage Required**	**1.9 m^3**
Est. 5-year Storage Elevation	**73.73 m**	**Est. 100-year Storage Elevation**	**74.48 m**

Area ID A103-C
Available Sub-surface Storage
Maintenance Structures

ID	**CB 103C**				
Structure Dia./Area (mm/mm^2)	360				
T/L*	74.12				
INV	72.12				
Depth	2.00				
$V_{structure}$ (m^3)	0.3				

Sewers

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

*Top of lid or max ponding elevation 74.42

Total Subsurface Storage (m^3) 0.3

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	72.62		0.00			0.0	0.0	0.00
T/L	74.12	0	1.50	1.50	0.3	0.3	4.6	0.02
0.15m Ponding	74.27	86	1.65	0.15	4.6	4.9	4.8	0.28
0.30m Ponding	74.42	241.1	1.80	0.15	23.6	28.4	5.0	1.58

* 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 65**
Total Area 0.069 ha
C 0.77 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	15.4	4.8	10.6	6.3	178.6	32.9	4.9	28.0	16.8
15	83.6	12.3	4.8	7.5	6.8	142.9	26.4	4.9	21.4	19.3
20	70.3	10.4	4.8	5.5	6.7	120.0	22.1	4.9	17.2	20.6
25	60.9	9.0	4.8	4.2	6.3	103.8	19.2	4.9	14.2	21.3
30	53.9	8.0	4.8	3.1	5.6	91.9	16.9	4.9	12.0	21.6
35	48.5	7.2	4.8	2.3	4.9	82.6	15.2	4.9	10.3	21.6
40	44.2	6.5	4.8	1.7	4.1	75.1	13.9	4.9	8.9	21.4
45	40.6	6.0	4.8	1.2	3.2	69.1	12.7	4.9	7.8	21.1
50	37.7	5.6	4.8	0.7	2.2	64.0	11.8	4.9	6.9	20.6
55	35.1	5.2	4.8	0.4	1.2	59.6	11.0	4.9	6.1	20.0
60	32.9	4.9	4.8	0.0	0.2	55.9	10.3	4.9	5.4	19.3
65	31.0	4.6	4.6	0.0	0.0	52.6	9.7	4.9	4.8	18.6
70	29.4	4.3	4.3	0.0	0.0	49.8	9.2	4.9	4.2	17.8
75	27.9	4.1	4.1	0.0	0.0	47.3	8.7	4.9	3.8	17.0
80	26.6	3.9	3.9	0.0	0.0	45.0	8.3	4.9	3.4	16.1
85	25.4	3.7	3.7	0.0	0.0	43.0	7.9	4.9	3.0	15.2
90	24.3	3.6	3.6	0.0	0.0	41.1	7.6	4.9	2.6	14.3
95	23.3	3.4	3.4	0.0	0.0	39.4	7.3	4.9	2.3	13.3
100	22.4	3.3	3.3	0.0	0.0	37.9	7.0	4.9	2.1	12.3
105	21.6	3.2	3.2	0.0	0.0	36.5	6.7	4.9	1.8	11.3
110	20.8	3.1	3.1	0.0	0.0	35.2	6.5	4.9	1.6	10.3

5-year $Q_{attenuated}$	**4.82 L/s**	**100-year $Q_{attenuated}$**	**4.94 L/s**
5-year Max. Storage Required	**6.8 m^3**	**100-year Max. Storage Required**	**21.6 m^3**
Est. 5-year Storage Elevation	**74.28 m**	**Est. 100-year Storage Elevation**	**74.38 m**

Area ID A103-D
Available Sub-surface Storage
Maintenance Structures

ID	**CB103D**				
Structure Dia./Area (mm/mm^2)	360				
T/L*	74.12				
INV	72.18				
Depth	1.94				
$V_{structure}$ (m^3)	0.3				

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) 0.3

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	72.62		0.00			0.0	0.0	0.00
T/L	74.12	0	1.50	1.50	0.3	0.3	4.6	0.02
0.15m Ponding	74.27	80	1.65	0.15	4.3	4.5	4.8	0.26
0.30m Ponding	74.42	204.2	1.80	0.15	20.6	25.1	5.0	1.40

* 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 103D TEMPEST LMF 65**
Total Area 0.056 ha
C 0.85 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	15.4	4.8	10.6	6.3	178.6	32.9	5.0	28.0	16.8
15	83.6	12.3	4.8	7.5	6.8	142.9	26.4	5.0	21.4	19.3
20	70.3	10.4	4.8	5.5	6.7	120.0	22.1	5.0	17.2	20.6
25	60.9	9.0	4.8	4.2	6.3	103.8	19.2	5.0	14.2	21.3
30	53.9	8.0	4.8	3.1	5.6	91.9	16.9	5.0	12.0	21.6
35	48.5	7.2	4.8	2.3	4.9	82.6	15.2	5.0	10.3	21.6
40	44.2	6.5	4.8	1.7	4.1	75.1	13.9	5.0	8.9	21.3
45	40.6	6.0	4.8	1.2	3.2	69.1	12.7	5.0	7.8	21.0
50	37.7	5.6	4.8	0.7	2.2	64.0	11.8	5.0	6.8	20.5
55	35.1	5.2	4.8	0.4	1.2	59.6	11.0	5.0	6.0	19.9
60	32.9	4.9	4.8	0.0	0.2	55.9	10.3	5.0	5.3	19.2
65	31.0	4.6	4.6	0.0	0.0	52.6	9.7	5.0	4.7	18.5
70	29.4	4.3	4.3	0.0	0.0	49.8	9.2	5.0	4.2	17.7
75	27.9	4.1	4.1	0.0	0.0	47.3	8.7	5.0	3.7	16.9
80	26.6	3.9	3.9	0.0	0.0	45.0	8.3	5.0	3.3	16.0
85	25.4	3.7	3.7	0.0	0.0	43.0	7.9	5.0	3.0	15.1
90	24.3	3.6	3.6	0.0	0.0	41.1	7.6	5.0	2.6	14.1
95	23.3	3.4	3.4	0.0	0.0	39.4	7.3	5.0	2.3	13.1
100	22.4	3.3	3.3	0.0	0.0	37.9	7.0	5.0	2.0	12.1
105	21.6	3.2	3.2	0.0	0.0	36.5	6.7	5.0	1.8	11.1
110	20.8	3.1	3.1	0.0	0.0	35.2	6.5	5.0	1.5	10.1

5-year $Q_{attenuated}$	**4.82 L/s**	**100-year $Q_{attenuated}$**	**4.97 L/s**
5-year Max. Storage Required	**6.8 m^3**	**100-year Max. Storage Required**	**21.6 m^3**
Est. 5-year Storage Elevation	**74.29 m**	**Est. 100-year Storage Elevation**	**74.39 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)				

*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	8.0	0.01
0.05m Ponding	73.07	86	1.55	0.05	1.5	1.7	8.0	0.06
0.18m Ponding	73.20	271.5	1.68	0.13	22.1	23.9	8.1	0.82

* 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 TEMPEST LMF 85**
Total Area 0.229 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	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	13.3	8.0	5.2	3.1	178.6	28.4	8.1	20.3	12.2
15	83.6	10.6	8.0	2.6	2.4	142.9	22.7	8.1	14.7	13.2
20	70.3	8.9	8.0	0.9	1.1	120.0	19.1	8.1	11.0	13.2
25	60.9	7.7	7.7	0.0	0.0	103.8	16.5	8.1	8.5	12.7
30	53.9	6.9	6.9	0.0	0.0	91.9	14.6	8.1	6.6	11.8
35	48.5	6.2	6.2	0.0	0.0	82.6	13.1	8.1	5.1	10.7
40	44.2	5.6	5.6	0.0	0.0	75.1	12.0	8.1	3.9	9.4
45	40.6	5.2	5.2	0.0	0.0	69.1	11.0	8.1	2.9	7.9
50	37.7	4.8	4.8	0.0	0.0	64.0	10.2	8.1	2.1	6.4
55	35.1	4.5	4.5	0.0	0.0	59.6	9.5	8.1	1.4	4.7
60	32.9	4.2	4.2	0.0	0.0	55.9	8.9	8.1	0.8	3.0
65	31.0	3.9	3.9	0.0	0.0	52.6	8.4	8.1	0.3	1.3
70	29.4	3.7	3.7	0.0	0.0	49.8	7.9	8.1	0.0	0.0
75	27.9	3.5	3.5	0.0	0.0	47.3	7.5	8.1	0.0	0.0
80	26.6	3.4	3.4	0.0	0.0	45.0	7.2	8.1	0.0	0.0
85	25.4	3.2	3.2	0.0	0.0	43.0	6.8	8.1	0.0	0.0
90	24.3	3.1	3.1	0.0	0.0	41.1	6.5	8.1	0.0	0.0
95	23.3	3.0	3.0	0.0	0.0	39.4	6.3	8.1	0.0	0.0
100	22.4	2.9	2.9	0.0	0.0	37.9	6.0	8.1	0.0	0.0
105	21.6	2.7	2.7	0.0	0.0	36.5	5.8	8.1	0.0	0.0
110	20.8	2.6	2.6	0.0	0.0	35.2	5.6	8.1	0.0	0.0

5-year $Q_{attenuated}$	**8.01 L/s**	**100-year $Q_{attenuated}$**	**8.05 L/s**
5-year Max. Storage Required	**3.1 m^3**	**100-year Max. Storage Required**	**13.2 m^3**
Est. 5-year Storage Elevation	**73.08 m**	**Est. 100-year Storage Elevation**	**73.14 m**

Area ID A125
Available Sub-surface Storage
Maintenance Structures

ID	DCB125A	DCBMH125			
Structure Dia./Area (mm/mm^2)	720	1200			
T/L*	74.12	74.12			
INV	72.62	72.24			
Depth	1.50	1.88			
$V_{structure}$ (m^3)	0.8	2.1			

Sewers

ID	450mm			U/G STORG.*
Storage Pipe Dia (mm)	450			
L (m)	31.8			
V_{sewer} (m^3)	5.1			180.0
	*Top of lid or max ponding elevation			74.42

Note*
Total U/G Storage Provided = 355m3
Infiltration Volume below ICD invert = 175m3

Total Subsurface Storage (m^3) 188.0

Stage Attenuated Areas Storage Summary

		Surface Storage			Surface and Subsurface Storage			
	Stage (m)	Ponding (m^2)	h_o (m)	delta d (m)	V* (m^3)	V_{acc}** (m^3)	$Q_{release}$† (L/s)	$V_{drawdown}$ (hr)
Orifice INV	72.24		0.00			0.0	0.0	0.00
Storage Pipe SL	72.48		0.23	0.23	90.3	90.3	4.9	5.12
Storage Pipe OBV	72.71		0.47	0.23	90.3	180.5	6.2	8.09
T/L	74.12	0	1.88	1.41	7.4	188.0	14.3	3.65
0.15m Ponding	74.27	389	2.03	0.15	20.0	208.0	14.8	3.90
0.30m Ponding	74.42	1206.8	2.18	0.15	114.0	322.0	15.3	5.85

* V=Incremental storage volume
**V_{acc}=Total surface and sub-surface
† $Q_{release}$ = Release rate per IPEX TEMPEST LMF flow curves graph

Orifice Location **CBMH125A TEMPEST LMF 100**
Total Area 0.636 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	165.7	11.3	154.4	92.6	178.6	315.5	15.3	300.2	180.1
15	83.6	132.9	11.3	121.5	109.4	142.9	252.4	15.3	237.2	213.5
20	70.3	111.7	11.3	100.4	120.5	120.0	211.9	15.3	196.7	236.0
25	60.9	96.8	11.3	85.5	128.3	103.8	183.5	15.3	168.2	252.3
30	53.9	85.7	11.3	74.4	134.0	91.9	162.3	15.3	147.1	264.7
35	48.5	77.1	11.3	65.8	138.3	82.6	145.9	15.3	130.6	274.3
40	44.2	70.3	11.3	58.9	141.5	75.1	132.8	15.3	117.5	282.0
45	40.6	64.6	11.3	53.3	143.9	69.1	122.0	15.3	106.7	288.2
50	37.7	59.9	11.3	48.6	145.7	64.0	113.0	15.3	97.7	293.2
55	35.1	55.8	11.3	44.5	147.0	59.6	105.3	15.3	90.1	297.3
60	32.9	52.4	11.3	41.1	147.9	55.9	98.7	15.3	83.5	300.6
65	31.0	49.4	11.3	38.1	148.4	52.6	93.0	15.3	77.8	303.3
70	29.4	46.7	11.3	35.4	148.6	49.8	88.0	15.3	72.7	305.4
75	27.9	44.3	11.3	33.0	148.6	47.3	83.5	15.3	68.2	307.1
80	26.6	42.2	11.3	30.9	148.4	45.0	79.5	15.3	64.2	308.3
85	25.4	40.3	11.3	29.0	148.0	43.0	75.9	15.3	60.6	309.2
90	24.3	38.6	11.3	27.3	147.5	41.1	72.6	15.3	57.4	309.8
95	23.3	37.1	11.3	25.7	146.8	39.4	69.7	15.3	54.4	310.2
100	22.4	35.6	11.3	24.3	145.9	37.9	67.0	15.3	51.7	310.3
105	21.6	34.3	11.3	23.0	144.9	36.5	64.5	15.3	49.2	310.1
110	20.8	33.1	11.3	21.8	143.9	35.2	62.2	15.3	46.9	309.8

5-year $Q_{attenuated}$	**11.31 L/s**		**100-year $Q_{attenuated}$**	**15.25 L/s**
5-year Max. Storage Required	**148.6 m^3**		**100-year Max. Storage Required**	**310.3 m^3**
Est. 5-year Storage Elevation	**73.73 m**		**Est. 100-year Storage Elevation**	**74.40 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)	0.057		6.1	0.0	13.0	0.0	0.0
Roof Controls (BLDG-A)	0.450		22.4	69.1	29.7	154.4	356.3
Roof Controls (BLDG B)	0.092		4.7	14.0	6.2	31.3	73.0
Attenuated Areas (A118+A119)	0.598	TEMPEST LMF 100	14.2	126.5	14.4	291.3	341.2
Attenutated Areas (A120)	0.428	TEMPEST LMF 60	2.8	129.2	4.8	246.1	279.3
Attenuated Areas (A100+A101)	0.531	TEMPEST LMF 90	3.4	49.3	11.8	88.5	97.8
Attenuated Areas (A109+A110)	0.687	TEMPEST LMF 90	7.7	97.0	11.5	229.5	235.3
Attenutated Areas (A122)	0.923	TEMPEST LMF 105	10.2	228.7	10.5	551.1	585.5
Attenutated Areas (A123)	0.093	TEMPEST LMF 45	2.9	1.4	2.9	5.5	17.0
Attenutated Areas (A103-A)	0.026	75mm dia	6.3	0.1	12.7	0.2	0.5
Attenutated Areas (A103-B)	0.043	75mm dia	8.4	0.1	15.3	1.9	3.2
Attenutated Areas (A103-C)	0.069	TEMPEST LMF 65	4.8	6.8	4.9	21.6	28.4
Attenutated Areas (A103-D)	0.056	TEMPEST LMF 65	4.8	6.8	5.0	21.6	25.1
Attenutated Areas (A106)	0.229	TEMPEST LMF 85	8.0	3.1	8.1	13.2	23.9
Attenutated Areas (A125)	0.636	TEMPEST LMF 100	11.3	148.6	15.2	310.3	322.0
Total	**4.965**		**118.2**	**880.6**	**166.0**	**1966.4**	**2388.4**

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:	27	m
Width:	9	m
Excavation		
Length:	27.5	m
Width:	9.5	m
Stone		
Leveling Bed:		m
Top Backfill:		m
Compacted Fill:		m

Results

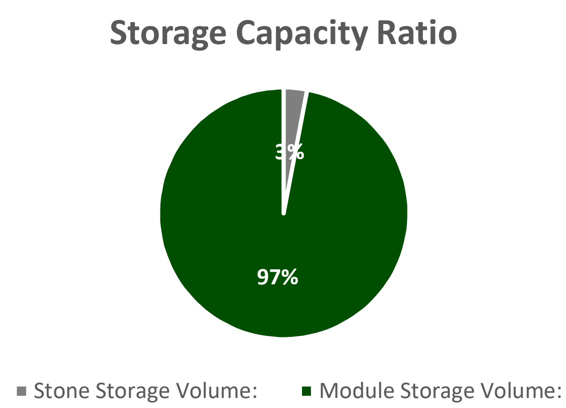
Capacity:

Stone Storage Volume:	6.68	m^3
Module Storage Volume:	215.86	m^3
Total Storage Volume:	222.53	m^3

Quantities:

Required Excavation:	238.89	m^3
Required Stone Volume:	16.69	m^3
Estimated Geotextile:	1,268.89	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

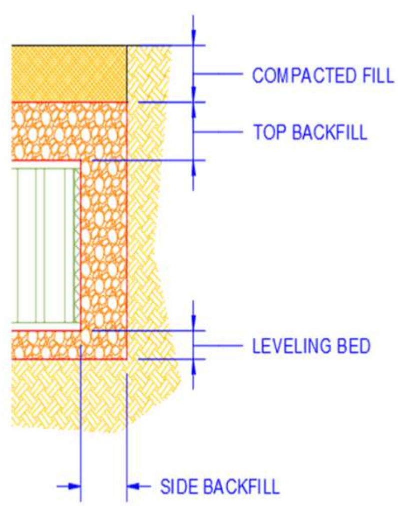


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	581	N/A	581
# of Platens	1,162	N/A	1,162
# of Side Panels	157	N/A	157
# of Columns	4,650	N/A	4,650
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module **Volume Calculator**

Inputs

Project Name:	A109-A110		
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:	13.5	m
Width:	7.5	m

Excavation

Length:	14	m
Width:	8	m

Stone

Leveling Bed:		m
Top Backfill:		m
Compacted Fill:		m

Results

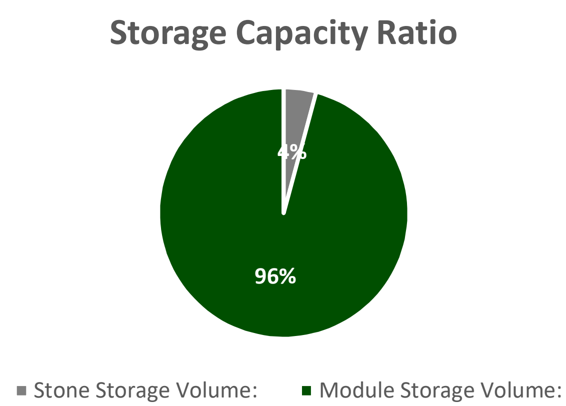
Capacity:

Stone Storage Volume:	3.93	m^3
Module Storage Volume:	89.94	m^3
Total Storage Volume:	93.87	m^3

Quantities:

Required Excavation:	102.41	m^3
Required Stone Volume:	9.83	m^3
Estimated Geotextile:	561.26	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

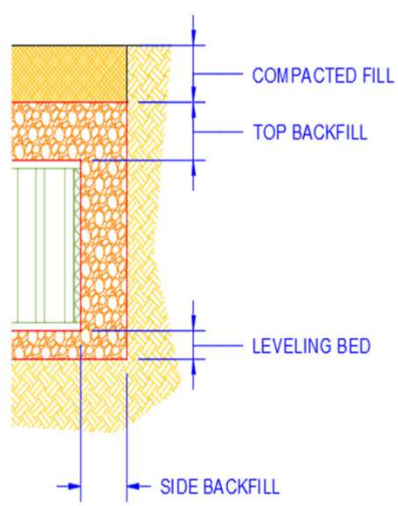


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	242	N/A	242
# of Platens	484	N/A	484
# of Side Panels	92	N/A	92
# of Columns	1,937	N/A	1,937
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name: A120-A

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: 27.5 m
Width: 5.5 m

Excavation
Length: 28 m
Width: 6 m

Stone
Leveling Bed: 0 m
Top Backfill: 0 m
Compacted Fill: 0 m

Results

Capacity:

Stone Storage Volume: 6.13 m^3
Module Storage Volume: 134.36 m^3
Total Storage Volume: 140.48 m^3

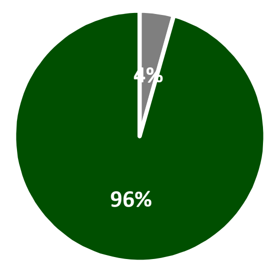
Quantities:

Required Excavation: 153.62 m^3
Required Stone Volume: 15.32 m^3

Estimated Geotextile: 845.59 m^2
Estimated Liner: 0.00 m^2

(Estimations include 10% for scrap and overlap)

Storage Capacity Ratio

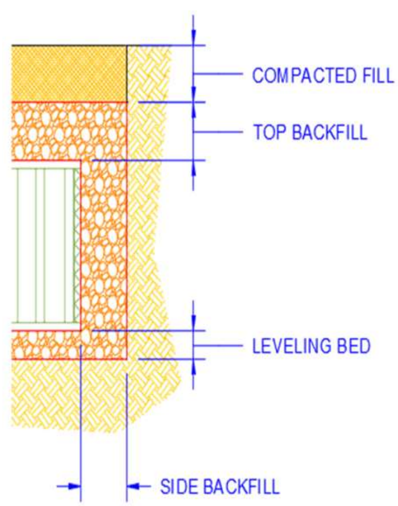


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	362	N/A	362
# of Platens	724	N/A	724
# of Side Panels	144	N/A	144
# of Columns	2,894	N/A	2,894
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module Volume Calculator

Inputs

Project Name:	A120-B		
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:	13	m
Width:	12	m
Excavation		
Length:	13.5	m
Width:	12.5	m
Stone		
Leveling Bed:	0	m
Top Backfill:	0	m
Compacted Fill:	0	m

Results

Capacity:

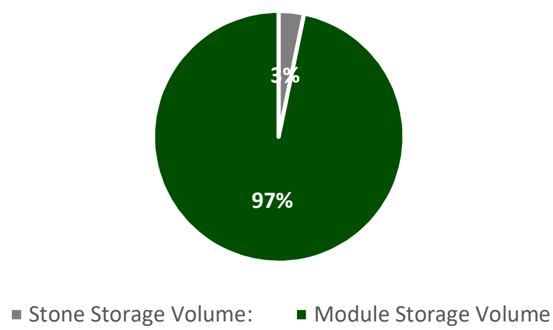
Stone Storage Volume:	4.66	m^3
Module Storage Volume:	138.58	m^3
Total Storage Volume:	143.24	m^3

Quantities:

Required Excavation:	154.31	m^3
Required Stone Volume:	11.66	m^3
Estimated Geotextile:	825.30	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

Storage Capacity Ratio

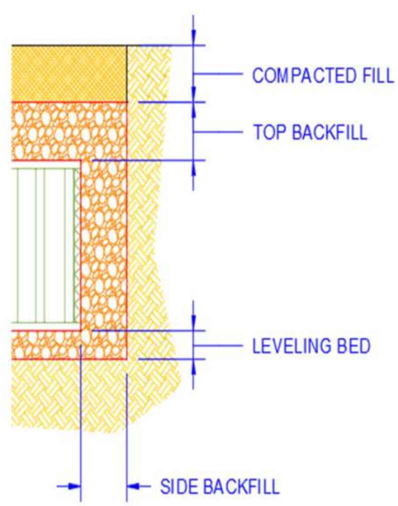


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	373	N/A	373
# of Platens	746	N/A	746
# of Side Panels	109	N/A	109
# of Columns	2,985	N/A	2,985
# 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:	27	m
Width:	8	m
Excavation		
Length:	27.5	m
Width:	8.5	m
Stone		
Leveling Bed:	0	m
Top Backfill:	0	m
Compacted Fill:	0	m

Results

Capacity:

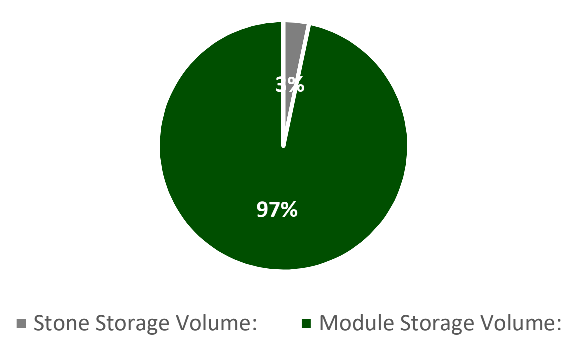
Stone Storage Volume:	6.49	m^3
Module Storage Volume:	191.87	m^3
Total Storage Volume:	198.37	m^3

Quantities:

Required Excavation:	213.74	m^3
Required Stone Volume:	16.23	m^3
Estimated Geotextile:	1,143.72	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

Storage Capacity Ratio

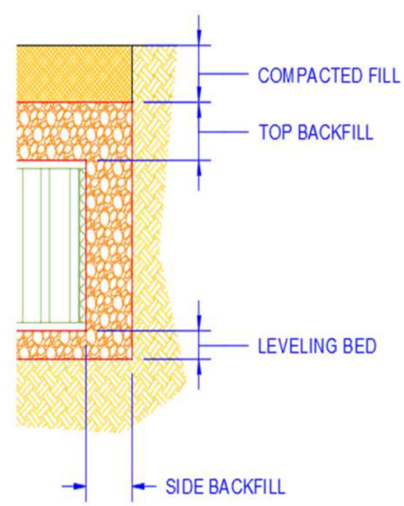


Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	517	N/A	517
# of Platens	1,033	N/A	1,033
# of Side Panels	153	N/A	153
# of Columns	4,133	N/A	4,133
# of Stacking Pins	0	N/A	0

Cross-Section:



STORMTANK® Module

Volume Calculator

Inputs

Project Name: A125

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: 24.5 m

Width: 16 m

Excavation

Length: 25 m

Width: 16.5 m

Stone

Leveling Bed: ______ m

Top Backfill: 0 m

Compacted Fill: ______ m

Results

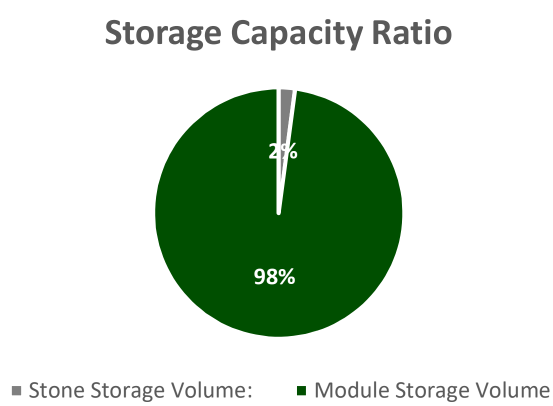
Capacity:

Stone Storage Volume:	7.50	m^3
Module Storage Volume:	348.22	m^3
Total Storage Volume:	355.71	m^3

Quantities:

Required Excavation:	377.19	m^3
Required Stone Volume:	18.75	m^3
Estimated Geotextile:	1,954.40	m^2
Estimated Liner:	0.00	m^2

(Estimations include 10% for scrap and overlap)

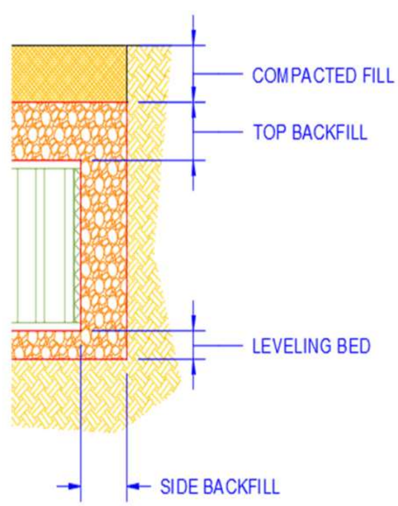


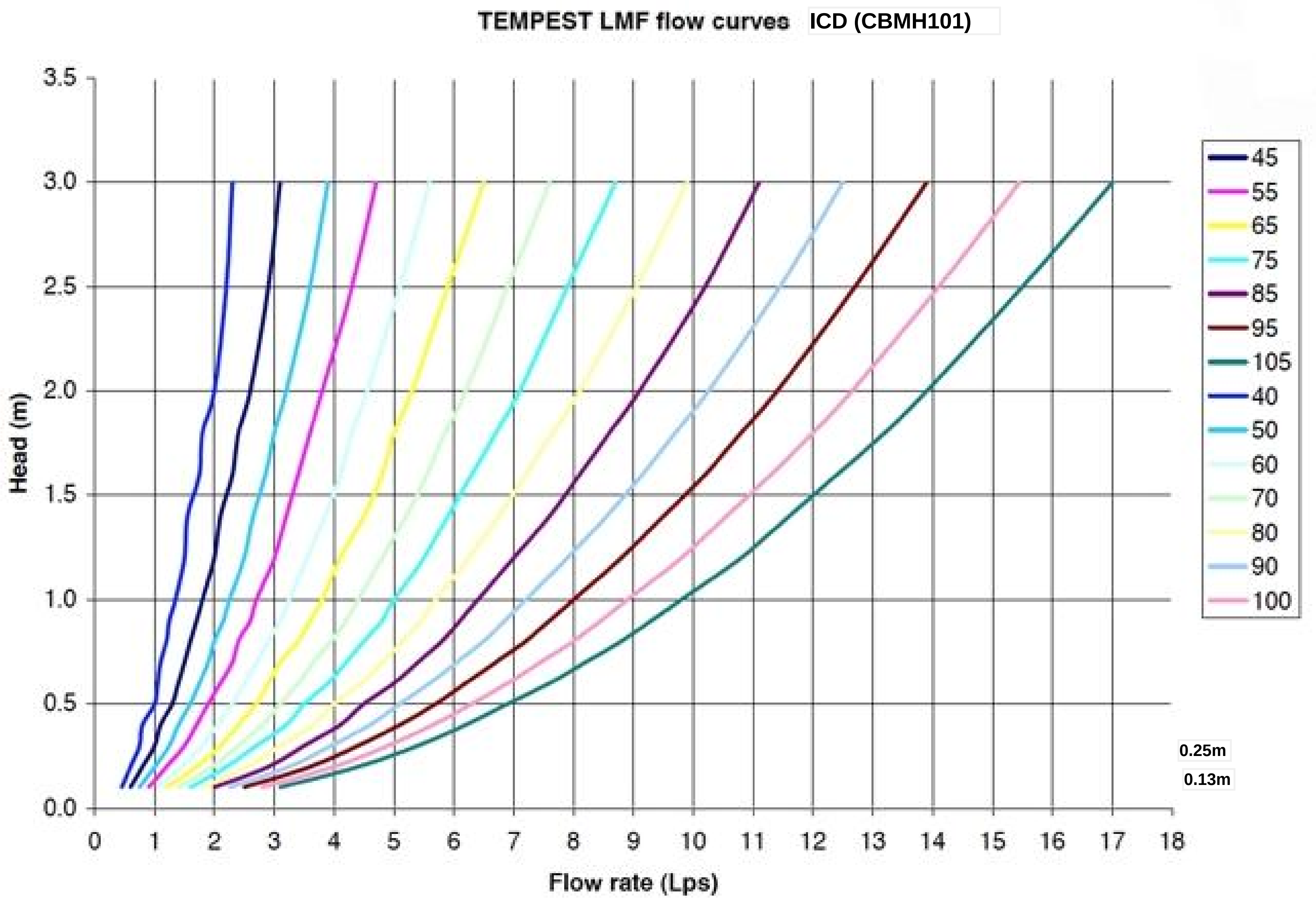
Basin Detail

Component Quantities:

	Bottom Layer	Top Layer	Total
Height	914.4	N/A	914.4
# of Modules	938	N/A	938
# of Platens	1,875	N/A	1,875
# of Side Panels	177	N/A	177
# of Columns	7,501	N/A	7,501
# of Stacking Pins	0	N/A	0

Cross-Section:




TEMPEST LMF flow curves
ICD (CBMH101)
Head (m)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
Flow rate (Lps)
45
55
65
75
85
95
105
40
50
60
70
80
90
100
0.25m
0.13m

Zurn Roof Drains

ZURN® Control-Flo . . . Today's Successful Answer to More

THE ZURN "CONTROL-FLO CONCEPT"

Originally, Zurn introduced the scientifically- advanced "Control-Flo" drainage principle for dead-level roofs. Today, after thousands of successful applications in modern, large dead-level roof areas, Zurn engineers have adapted the comprehensive "Control-Flo" data to **sloped roof** areas.

WHAT IS "CONTROL-FLO"?

It is an advanced method of removing rain water off dead-level or sloped roofs. As contrasted with conventional drainage practices, which attempt to drain off storm water as quickly as it falls on the roof's surface, "Control- Flo" drains the roof at a controlled rate. Excess water accumulates on the roof under controlled conditions... then drains off at a lower rate after a storm abates.

CUTS DRAINAGE COSTS

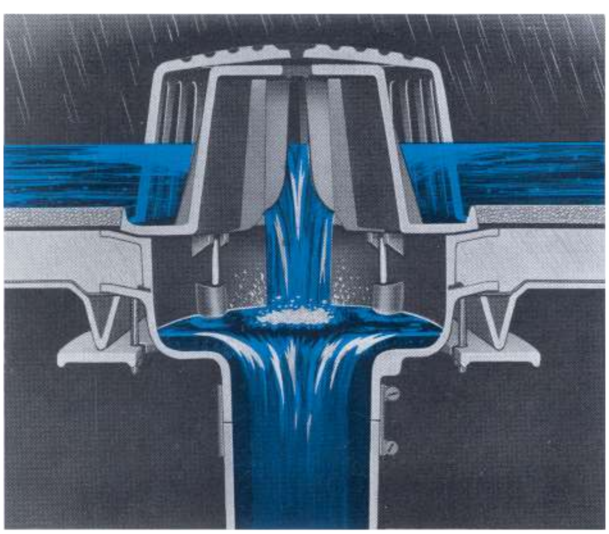
Fewer roof drains, smaller diameter piping, smaller sewer sizes, and lower installation costs are possible with a "Control-Flo" drainage system because roof areas are utilized as temporary storage reservoirs.

REDUCES PROBABILITY OF STORM DAMAGE

Lightens load on combination sewers by reducing rate of water drain from roof tops during severe storms thereby reducing probability of flooded sewers, and consequent backflow into basements and other low areas.

THANKS TO EXCLUSIVE ZURN "AQUA-WEIR" ACTION

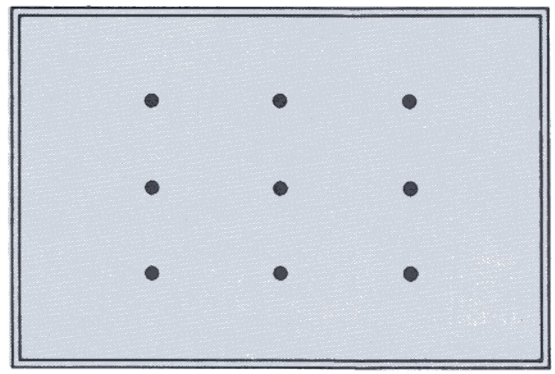
Key to successful "Control-Flo" drainage is a unique, scientifically-designed weir containing accurately calibrated notches with sides formed by parabolic curves which provide flow rates directly proportional to the head. Shape and size of notches are based on pre- determined flow rates, and all factors involved in roof drainage to assure permanent regulation of drainage flow rates for specific geographic locations and rainfall intensities.



DEFINITION

DEAD LEVEL ROOFS

A dead-level roof for purposes of applying the Zurn "Control-Flo" drainage principle is one which has been designed for zero slope across its entire surface.



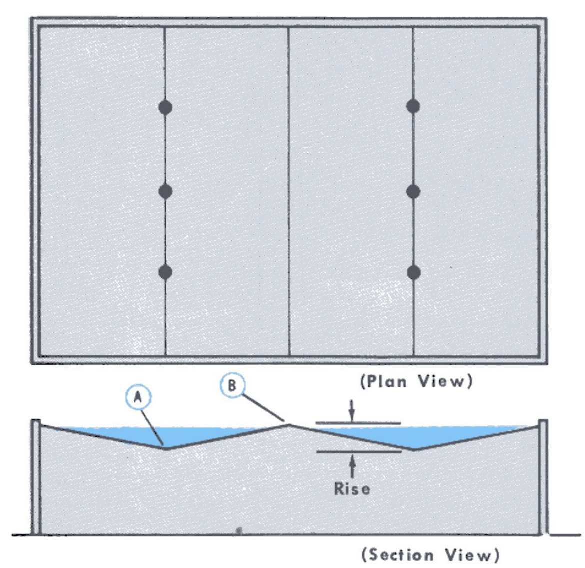
(Plan View)

(Section View)

SLOPED ROOFS

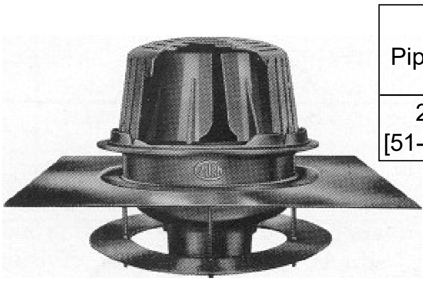
A sloped roof is one designed commonly with a shallow slope. The Zurn "Control-Flo" drainage system can be applied to any slope which results in a total rise up to 6"... and data can be calculated for rises exceeding 6".

The total rise of a roof as calculated for "Control-Flo" application is defined as the vertical increase in height in inches, from the low point or valley of a sloping roof (A) to the top of the sloping section (B). (Example: a roof that slopes 1/8" per foot having a 24-foot span would have a rise of 24 x 1/8 or 3")

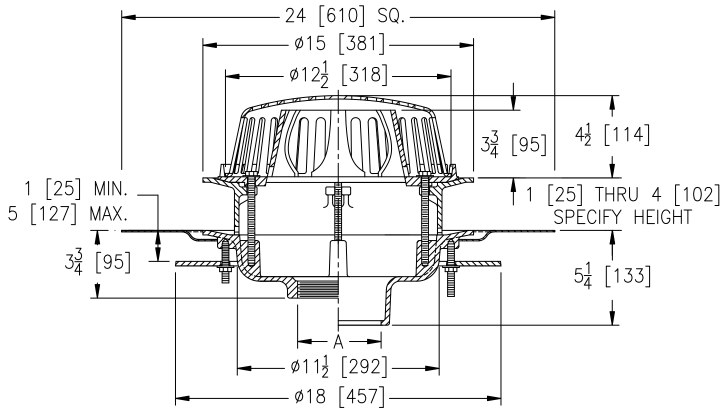


Economical Roof Drainage Installation

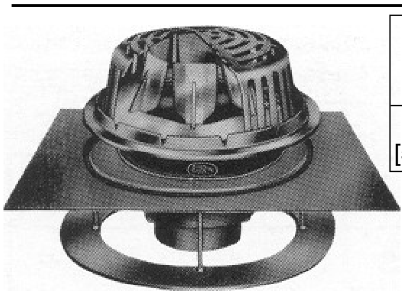
SPECIFICATION DATA



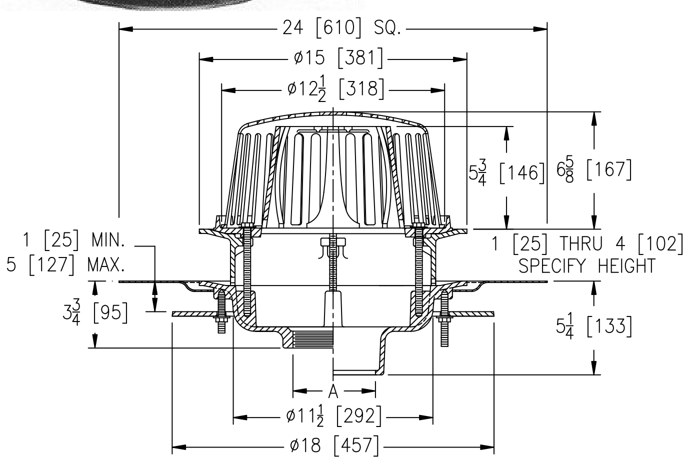
A Pipe Size	Approx. Wt. Lbs. [kg]	Dome Open Area Sq. In. [cm²]
2-3-4 [51-76-102]	56 [25]	103 [665]



ENGINEERING SPECIFICATION: ZURN Z105-C-E-R 15" Diameter "Control-Flo" roof drain for dead-level roof construction, Dura-Coated cast iron body, "Control-Flo" weir shall be linear functioning with integral membrane flashing clamp/gravel guard, static extension, secondary clamping collar with O-ring, Poly-Dome, roof sump receiver and underdeck clamp. All data shall be verified proportional to flow rates.



A Pipe Size	Approx. Wt. Lbs. [kg]	Dome Open Area Sq. In. [cm²]
2-3-4 [51-76-102]	60 [27]	148 [955]



ENGINEERING SPECIFICATION: ZURN Z105-C-E-R-10 "Control-Flo" roof drain for Sloped Roof construction, Dura-Coated cast iron body, "Control-Flo" weir shall be linear functioning with integral membrane flashing clamp/gravel guard and 6 5/8 [168] high Aluminum dome. All data shall be verified proportional to flow rates.

ROOF DESIGN RECOMMENDATIONS

Basic roofing design should incorporate protection that will prevent roof overloading by installing adequate overflow scuppers in parapet walls.

GENERAL RECOMMENDATIONS

On dead-level roofs, our general recommendations are to design for a 3" depth for the 10-year storm. In this case, even the 100-year storm will not result in a maximum depth of 6". A 6" depth represents a roof load of 31.2 pounds per square foot which approximates the 30 pound per square foot factor commonly used in roof design.

NOTE: A more conservative practice used by a few engineers in the past, depending upon other design considerations, has been to design for the 3" depth with the 25, 50, or even 100-year storm . . . and to also lower scuppers to 5" or 4" above roof level. In either case, the final determination rests with the engineering personnel responsible for this phase of the design.

GENERAL RECOMMENDATIONS

On sloping roofs, we again recommend a 3" design depth for the l0-year storm, but by 3" we refer to an equivalent depth of 3". An equivalent depth is the depth of water attained at the drains that results in the same roof stresses as those realized on a dead-level roof. In all cases this equivalent depth is almost equal to that attained by using the same notch area rating for the different rises to 6". With the same depth of water at the drain the roof stresses will decrease with increasing total rise. Therefore, it would be possible to have a depth in excess of 6" at the drain on a sloping roof without exceeding stresses normally encountered in a 6" depth on a dead-level roof. However, it is recommended that scuppers be placed to limit the maximum water depth on any roof to 6" to prevent the over flow of the weirs on the drains and consequent overloading of drain piping.

NOTE: An equivalent depth is that depth of water attained at the drains at the lowest line or valley of the roof with all other conditions such as notch area and rainfall intensity being equal. For Galveston, Texas a notch area of 1800 square feet results in a 3" depth on a **dead-level** roof for a 10-year storm. For the same notch area and a 10-year storm, equivalent depths for a 2", 4", and 6" rise respectively on a **sloped roof** would be 3.4", 3.8", and 4.6". Roof stresses will be approximately equal in all cases.

The exclusive Zurn “Selecta-Drain”. Chart (pages 6, 7, 8, 9) tabulates recommended selection data for several hundred localities in the United States. It constitutes your best assurance of sure, safe, economical additional data for your Zurn “Control-Flo” systems for your specific geographical area.

If the “Selecta-Drain” Chart doesn’t not suit your specific design criteria, write directly to Zurn Industries, Inc. Field Service Engineering, Specification Drainage Operations, Erie, Pa for additional date for your locality. Listed below is additional information pertinent to proper engineering of the “Control-Flo” system.

ROOF USED AS TEMPORARY RETENTION

The key to economical “Control-Flo” drainage is the utilization of large roof areas to temporarily store the maximum amount of water without overloading average roofs or creating excessive drain down time during periods of heavy rainfall.

The data shown in the “Selecta-Drain” Chart, which takes all these factors into consideration, represents only one point on a series of curves prepared for each locality and was determined after careful study and research as imparting optimum economy in design.

ROOF LOADING AND RUN-OFF RATES

The values for notch areas selected from the design curves were based on a 3" head on a dead-level roof for the 10-year storm. In low rainfall localities the area per notch was limited to 25,000 square feet to keep the drain down time within reasonable limits. The same area for each respective locality was used for the various roof rises for sloping roofs.

Extensive studies show that stresses due to water load on a sloping roof for any fixed set of conditions are very nearly the same as those on a dead-level roof. A sloping roof tends to concentrate more water in the valleys and increase the water depth at this point. The greater depth around the drain leads to a faster run-off rate, particularly a faster early run-off rate. As a result, the total volume of water stored on the roof is less, and the total load on the sloping roof is less. By using the same area on the sloping roof as on the dead-level roof the increase in roof stresses due to increased water depth in the valleys is offset by the decrease in the total load due to less water stored. The net result is the maximum roof stresses are approximately the same for single span, rise and fixed set of conditions. A fixed set of conditions would be the same notch area, the same frequency storm, and the same locality.

NOTCH FLOW AND WATER DEPTH

The flow through each notch of the “Control-Flo” weir is 10 GPM per inch of head. To compute the depth of water in inches at the drain, obtain the total flow for any fixed set of conditions and locale from the “Selecta-Drain” Chart and divide by 10. For example, for Anniston, Alabama the discharge rates are 30, 35, 39 and 43 GPM for the 10, 25, 50 and 100-year storms respectively on a dead-level roof.

Since the possibility of exceeding 4.3" of water exists only once every 100 years, the drains can be sized to carry 43 GPM per notch and scuppers can be set at a height of 4.3" above the roof to prevent overloading the drains if a worse than 100-year storm occurs. On a similar basis, drain pipe sizes and scupper heights can be selected for various roof slopes and storm frequencies.

ADDITIONAL NOTCH RATINGS

The “Selecta-Drain” Chart along with Tables I and II enables the engineer to select “Control-Flo” Drains and drain pipe sizes for most applications. The “Selecta-Drain” Chart and Tables I and II are computed for a proportional flow weir that is sized to give a flow of 10 GPM per inch of head. However, this data can be applied to other sizes of proportional flow weirs by simple multiplication or division. For example, if a similar weir that is sized to give a flow of 5 GPM per inch is substituted for the 10 GPM per inch weir, the notch area and discharge in GPM would be divided by two, and this opening would be given a 7’2 notch area rating.

PROPER DRAIN LOCATION

The following good design practice is recommended for selecting the proper number of “Control-Flo” drains for a given area.

On dead-level roofs, drains should be located no further than 50 feet from each edge of the roof to assure good run-off regardless of wind direction. Weir should be flush with roof surface, not recessed.
On sloping roofs, drains should be located in the valleys at a distance no greater than 50 feet from each end of the valleys. Weir should be flush with the valley roof surface, not recessed.
On large roof areas, drains should not be spaced at a distance greater than 200 feet.

FLOW CONTROL ROOF DRAINAGE DECLARATION

THIS FORM TO BE COMPLETED BY THE MECHANICAL AND STRUCTURAL ENGINEERS RESPONSIBLE FOR DESIGN

Permit Application No.

Project Name: LINCOLN FIELDS - PHASE 1

Building Location: 2525 CARLING AVE

Municipality:

The roof drainage system has been designed in accordance with the following criteria: (please check one of the following).

M1. ☐ Conventionally drained roof (no flow control roof drains used).

M2. ☑ Flow control roof drains meeting the following conditions have been incorporated in this design:

(a) the maximum drain down time does not exceed 24h,
(b) one or more scuppers are installed so that the maximum depth of water on the roof cannot exceed 150mm,
(c) drains are located not more than 15m from the edge of roof and not more than 30m from adjacent drains, and
(d) there is at least one drain for each 900 sq.m.

M3. ☐ A flow control drainage system that does not meet the minimum drainage criteria described in M2 has been incorporated in this design.

PROFESSIONAL SEAL APPLIED BY:

Practitioner's Name: MICHAEL J. ST. LOUIS

Firm: SMITH + ANDERSEN

Phone #: 613-230-1186

City: OTTAWA Province: ONTARIO

LICENSED PROFESSIONAL ENGINEER
19/06/13
M. J. ST. LOUIS
40382509
14400
PROVINCE OF ONTARIO

Mechanical Engineer's Seal

S1. ☒ The design parameters incorporated into the overall structural design are consistent with the information provided by the Mechanical Engineer in M2. Loads due to rain are not considered to act simultaneously with loads due to snow as per Sentence 4.1.7.3 (3) OBC.

S2. ☐ The structure has been designed incorporating the additional structural loading due to rain acting simultaneously with the snow load. The design parameters are consistent with the control flow drainage system designed by the mechanical engineer.

PROFESSIONAL SEAL APPLIED BY:

Practitioner's Name: RICHARD CUNLIFFE

Firm: CUNLIFFE & ASSOCIATES

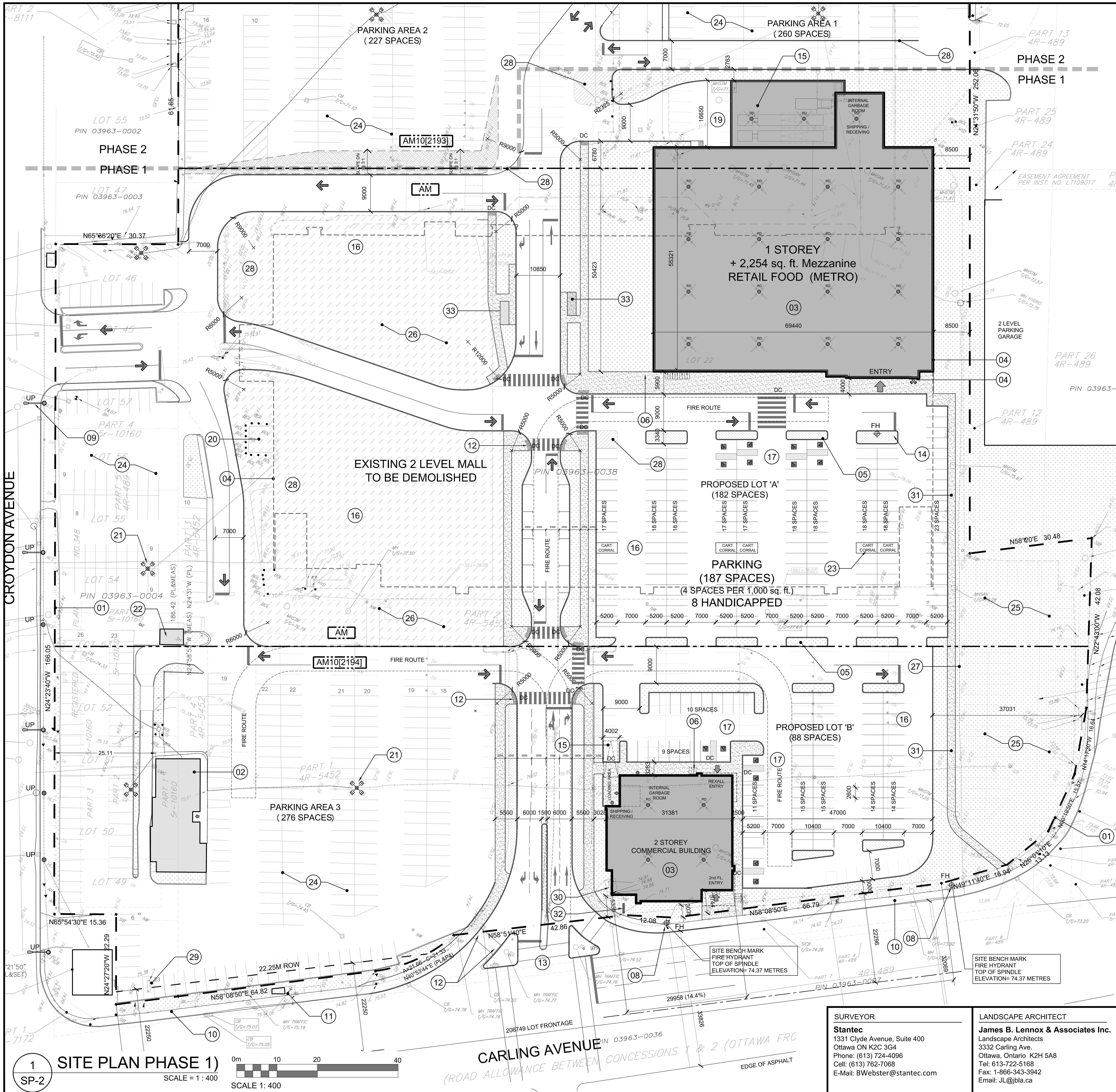
Phone #: 613 729-7242

City: OTTAWA Province: ON

LICENSED PROFESSIONAL ENGINEER
R. I. CUNLIFFE
19/06/13
PROVINCE OF ONTARIO

Structural Engineer's Seal

DRAWINGS / FIGURES



DRAWING NOTES

1. PROPERTY LINE
2. EXISTING COMMERCIAL BUILDING
3. PROPOSED COMMERCIAL BUILDING
4. EXISTING 2 LEVEL COMMERCIAL MALL TO BE REMOVED
5. LANDSCAPE ISLAND WITH 150mm BARRIER CURB
6. BICYCLE PARKING SPACES (0.6 x 1.8M) WITH RACK
7. NOT IN USE
8. EXISTING FIRE HYDRANT
9. EXISTING UTILITY POLE - SOME WITH LIGHTS
10. EXISTING CONCRETE SIDEWALK WITH STREET CURB
11. EXISTING BUS STOP
12. TWSI TO BE LOCATED AND INSTALLED AS PER CITY REQUIREMENTS
13. EXISTING CONTROLLED INTERSECTION TO REMAIN
14. FIRE HYDRANT
15. ENCLOSED LOADING SPACE
16. STANDARD PARKING SPACE (2.6 X 5.2 M)
17. BARRIER FREE PARING SPACE
18. DEPRESSED CURB AND WALK
19. ENCLOSED GARBAGE / LOADING BAYS
20. EXISTING BUILDING UTILITIES TO BE REMOVED
21. EXISTING LIGHT STANDARD TO REMAIN
22. EXISTING GARBAGE ENCLOSER
23. CART CORRAL
24. EXISTING ASPHALT PARKING LOT TO REMAIN
25. EXISTING ASPHALT PARKING LOT TO BE RE-GRADE AS REQUIRED, REPLACE WITH SOFT LANDSCAPING TILL FINAL PHASE IS DEVELOPED
26. VACANT AREA LEFT OVER FROM MALL AND RE-GRADING, TO BE CLOSED OFF TILL NEXT PHASE
27. REMOVE EX. UNDERGROUND UTILITIES, SEE CIVIL
28. PAINTED ISLAND AND OR CURBS
29. EXISTING COMMERCIAL SIGN TO REMAIN
30. EXISTING COMMERCIAL SIGN TO BE REMOVED
31. INTERN PEDESTRIAN PATHWAY
32. PYLON SIGN
33. BUS STOP WITH CONCRETE PAD AS PER CITY DETAILS

SITE PLAN SYMBOLS

- BUILDING OUTLINE
- CONCRETE WALK
- SOFT LANDSCAPING
- BIKE RACK
- TWO WAY VEHICLE CIRCULATION
- MAIN ENTRANCE
- SERVICE DOOR / FIRE EXIT
- PROPERTY LINE
- CHANGE IN ZONING
- PARKING LOT LIGHTING
- BARRIER FREE PARING SPACE AS PER PARKING BYLAW SECTION 3.1
  TYPE 'A' = 3.4M X 5.2M
  TYPE 'B' = 2.4M X 5.2M
  ACCESS AISLE = 1.5M WIDE
- BUILDING ROOF DRAINS

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

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

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

SURVEYOR

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

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

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

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	11.5 M
BUILDING FRONTAGE	14.4%
PARKING LOT LANDSCAPE AREA	13.76%
LOADING SPACE - COMMERCIAL RETAIL FOOD	2
LOADING SPACE - COMMERCIAL RETAIL / OFFICE	1
GLAZING ALONG THE FRONTAGE	52%
CARLING AVENUE FRONTAGE	206.749 M
RICHMOND ROAD FRONTAGE	226.786 M

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. 3 - WENDY'S	339.7 sq. m. (3,657) sq. ft.
BLDG. 4 - PIZZA PIZZA	325.2 sq. m. (3,500) sq. ft.
TOTAL AREA	26,435.1 sq. m. (284,545) sq. ft.

PROPOSED AREAS

BLDG. 1 - METRO COMMERCIAL FOOD	2,630.0 sq. m. (28,310) sq. ft.
BLDG. 2 - GROUND FL. COMMERCIAL RETAIL	753.0 sq. m. (8,105) sq. ft.
BLDG. 2 - SECOND FL. COMMERCIAL OFFICE	809.7 sq. m. (8,716) sq. ft.
BLDG. 3 - EXISTING WENDY'S	339.7 sq. m. (3,657) sq. ft.
BLDG. 4 - PIZZA PIZZA	325.2 sq. m. (3,500) sq. ft.
TOTAL AREA	4,857.6 sq. m. (52,287) sq. ft.

GROSS LEASABLE FLOOR AREA
(CITY OF OTTAWA'S DEFINITION)

PROPOSED AREAS

BLDG. 1 - METRO COMMERCIAL FOOD	3,137.3 sq. m. (33,770) sq. ft.
BLDG. 2 - GROUND FL. COMMERCIAL RETAIL	791.5 sq. m. (8,520) sq. ft.
BLDG. 2 - SECOND FL. COMMERCIAL OFFICE	798.9 sq. m. (8,600) sq. ft.
BLDG. 3 - EXISTING WENDY'S	339.7 sq. m. (3,657) sq. ft.
BLDG. 4 - PIZZA PIZZA	325.2 sq. m. (3,500) sq. ft.
TOTAL AREA	5,392.6 sq. m. (58,045) sq. ft.

LOT COVERAGE

PAVED SURFACE =	50,583 sq. m.	77.23%
BUILDING FOOTPRINT =	5,903 sq. m.	9.01%
LANDSCAPE OPEN SPACE =	9,016 sq. m.	13.76%
TOTAL =	65,502 sq. m.	100.0%

CAR PARKING EXISTING SITE

EXISTING TOTAL ON SITE (June 2018)	1,150

CAR PARKING TOTAL SITE

REQUIRED by ZONING BY-LAW

METRO	2,630.0 sq. m. (28,310) sq. ft.	- AREA 'Z' NOT REQUIRED	0
RETAIL - REXALL	753.0 sq. m. (8,105) sq. ft.	- AREA 'Z' NOT REQUIRED	0
OFFICE	809.7 sq. m. (8,716) sq. ft.	- AREA 'Z' NOT REQUIRED	0
WENDY'S	339.7 sq. m. (3,657) sq. ft.	- AREA 'Z' NOT REQUIRED	0
PIZZA PIZZA	325.2 sq. m. (3,500) sq. ft.	- AREA 'Z' NOT REQUIRED	0
TOTAL			0

MAXIMUM PARKING - AREA B, SCHEDULE 1

SHOPPING CENTER	4,857.6 sq. m. (52,287) sq. ft.	-3.6 PER 100m² OF G.F.A.	175

PROVIDED

EXISTING AREA '1'	260
EXISTING AREA '2'	227
EXISTING AREA '3'	276
PROPOSED LOT 'A'	182
PROPOSED LOT 'B'	88
PROPOSED LOT 'C' - CLOSED OFF	0
PROPOSED LOT 'D' - CLOSED OFF	0
TOTAL	1,033

BICYCLE PARKING

REQUIRED

METRO	2,630.0 sq. m. (28,310) sq. ft.	- 1.0 PER 500m² OF G.F.A.	6
RETAIL - REXALL	753.0 sq. m. (8,105) sq. ft.	- 1.0 PER 500m² OF G.F.A.	2
OFFICE	809.7 sq. m. (8,716) sq. ft.	- 1.0 PER 500m² OF G.F.A.	2
WENDY'S	339.7 sq. m. (3,657) sq. ft.	- 1.0 PER 500m² OF G.F.A.	1
PIZZA PIZZA	339.7 sq. m. (3,657) sq. ft.	- 1.0 PER 500m² OF G.F.A.	1
TOTAL			11

PROVIDED

METRO	10
RETAIL - REXALL	4
OFFICE	4
WENDY'S	4
PIZZA PIZZA	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.
- DETAIL NUMBER
- 00 TITLE / A000 A000 / SCALE
- DETAIL REFERENCE PAGE
- DETAIL CROSS REFERENCE PAGE

No.	DESCRIPTION	DATE
5		
4	REVISED AS PER SPC 1st ROUND COMMENTS	July 8, 19
3	REVISED AS PER SPC 1st ROUND COMMENTS	May 31, 19
2	ISSUED FOR SITE PLAN CONTROL	Dec. 19, 18
1	ISSUED TO CONSULTANTS	Sept 7, 18

REVISIONS:

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

NORTH ARROW:

CLIENT: RIO CAN

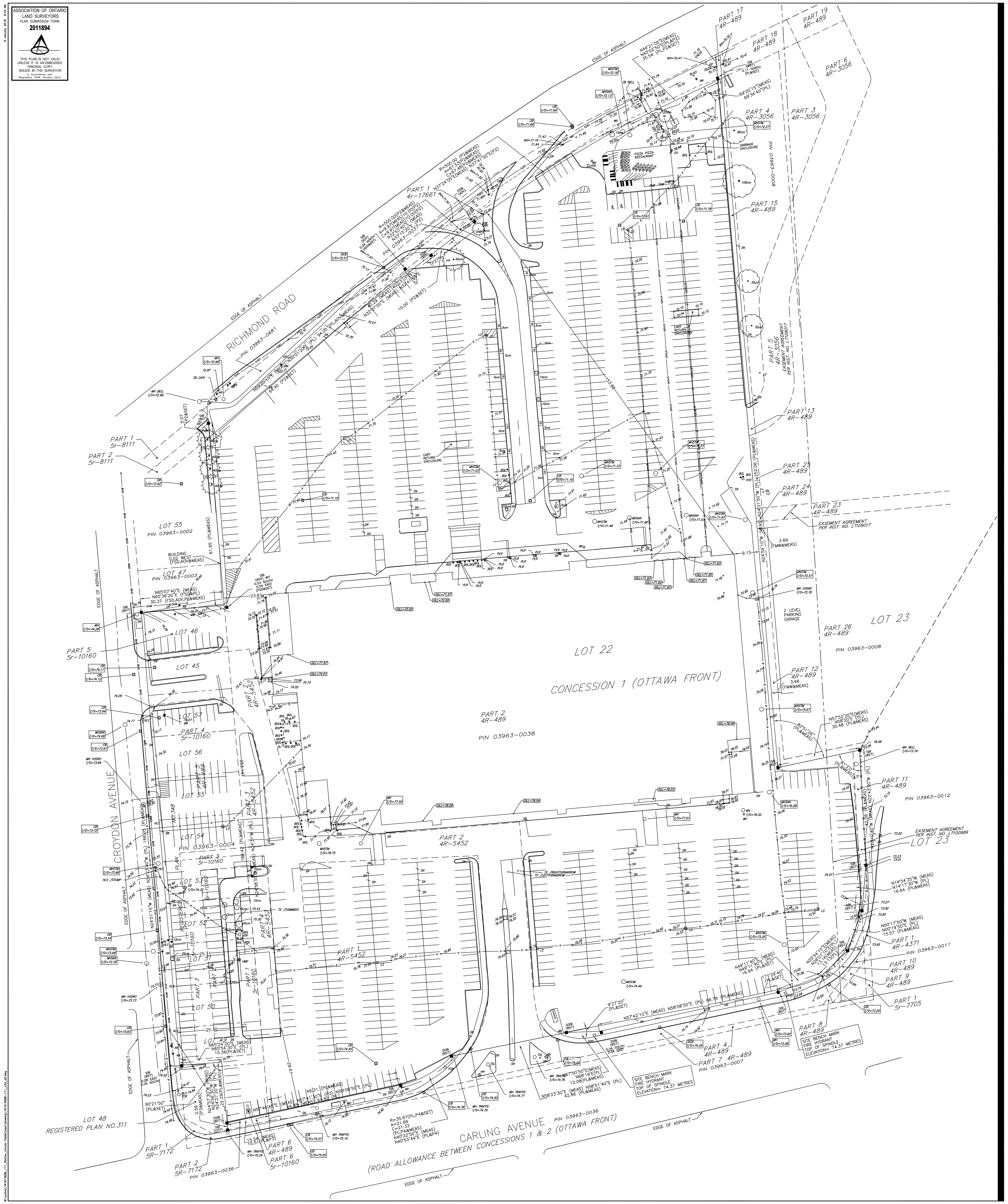
ARCHITECT:
rla/architecture
roderick lahey architect inc.
56 beech street, ottawa, ontario K1S 3J6
t. 613.724.9932 f. 613.724.1209 rlaarchitecture.ca

PROJECT TITLE:
LINCOLN FIELDS
2525 CARLING AVENUE
OTTAWA ONTARIO

SHEET TITLE:
SITE PLAN
PHASE #1

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

D07-12-18-0195



Stantec

Stantec Geomatics Ltd.
400 - 1331 Clyde Avenue
Ottawa ON
Tel. 613.722.4420
www.stantec.com

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

Scale 1:500

10 0 10 20 30 METRES

METRIC CONVERSION

DISTANCES AND COORDINATES SHOWN ON THIS PLAN ARE IN METRES AND CAN BE CONVERTED TO FEET BY DIVIDING BY 0.3048

HORIZONTAL DATUM NOTE

PROJECTION: UNIVERSAL TRANSVERSE MERCATOR (MTM, ZONE 9, CM76°30'W)
DATUM: NAD 83 (ORIGINAL)

DISTANCES ON THIS PLAN MAY BE CONVERTED TO GROUND DISTANCES BY DIVIDING BY A COMBINED SCALE FACTOR OF 0.99994.

VERTICAL DATUM NOTE

ELEVATIONS SHOWN HEREON ARE GEODETIC (CGVD-1928:1978) AND ARE DERIVED FROM THE CAN-NET VRS NETWORK AND CITY OF OTTAWA MONUMENT N-62 HAVING AN ELEVATION OF 69.238 METRES.

SITE BENCH MARK ARE AS SHOWN.

BEARING NOTE

BEARINGS ARE GRID, DERIVED FROM THE CAN-NET VRS NETWORK GPS OBSERVATIONS ON NCC HORIZONTAL CONTROL MONUMENTS 19773035 AND 19680191, CENTRAL MERIDIAN, 76°30' WEST LONGITUDE MTM ZONE 9, NAD83(ORIGINAL).

19773035 N:5006060.42 E:324888.04
19680191 N:5033564.26 E:388064.94

LEGEND

■	DENOTES	FOUND MONUMENTS
□	"	SET MONUMENTS
IB	"	IRON BAR
IBø	"	ROUND IRON BAR
SIB	"	STANDARD IRON BAR
SSIB	"	SHORT STANDARD IRON BAR
CC	"	CUT CROSS
CP	"	CONCRETE PIN
WIT	"	WITNESS
PIN	"	PROPERTY IDENTIFICATION NUMBER
MEAS	"	MEASURED
PROP	"	PROPORTIONED
OU	"	ORIGIN UNKNOWN
SG	"	STANTEC GEOMATICS LTD.
ORP	"	OBSERVED REFERENCE POINT
PL	"	PLAN 4R-489
P2	"	PLAN 4R-17661
P3	"	PLAN 5R-7172
P4	"	PLAN 4R-5452
1303	"	L.V. HARTEN O.L.S.
857	"	FAIRHALL, MOFFATT & WOODLAND LTD.
ACU	"	AIR CONDITIONING UNIT
AN	"	ANCHOR
AP	"	AIR PUMP
ANT	"	ANTENNA
BH	"	BOREHOLE
BIB	"	HOSE BIB
BKR	"	BIKE RACK
BENCH	"	BENCH
BOL	"	BOLLARD
BOUL	"	BOULDER
CB	"	CATCH BASIN
DCB	"	DOUBLE CB
CBMH	"	CB MANHOLE
DCBMH	"	DOUBLE CB MANHOLE
CBSI	"	SIDE INLET CB
CHM	"	CHIMNEY
CSV	"	VALVE CURB STOP
DRN	"	DRAIN
EPOST	"	ELECTRICAL OUTLET
FP	"	FLAG POLE
FL	"	FLOOD LIGHT
FTF	"	FUEL TANK FILLER CAP
GC	"	GARBAGE CAN
GFL	"	PIPE FLANGE (GAS)
GFP	"	GAS FUEL PUMP
GP	"	POLE GUYWIRE
GSR	"	GAS SERVICE REGULATOR
GV	"	GAS VALVE
HIC	"	HICKENBOTTOM
HDS	"	HEADSTONE
HLS	"	LIGHT STANDARD HYDRO
HM	"	HYDRO METER
HTN	"	HYDRO TRANSFORMER
HW	"	HAND WELL
HYD	"	FIRE HYDRANT
JBX	"	JUNCTION BOX
MB	"	MAILBOX
MP	"	MONITORING PIN
MH	"	MAINTENANCE HOLE UNIDENTIFIED
MHB	"	MAINTENANCE HOLE BELL
MHF	"	MAINTENANCE HOLE FIBRE OPTIC
MHH	"	MAINTENANCE HOLE HYDRO
MHI	"	MAINTENANCE HOLE INVERT
MHSA	"	MAINTENANCE HOLE SANITARY
MHST	"	MAINTENANCE HOLE STORM
MHT	"	MAINTENANCE HOLE TRAFFIC
MW	"	MONITORING WELL
NPB	"	NEWS PAPER BOX
OLP	"	LIGHT STANDARD ORNAMENTAL
OW	"	OBSERVATION WELL
PKM	"	PARKING METER
PLBX	"	PULL BOX
PLQ	"	PLAQUE
PLR	"	PILLAR
PZ	"	PIEZIOMETER
RLC	"	RED LIGHT CAMERA
RWSL	"	RAILWAY SIGNAL LIGHT
RWSS	"	RAILWAY SWITCH STAND
SAT	"	SATELLITE DISH
SCLP	"	SCULPTURE
SCP	"	SUMP/CATCH PIT
SCV	"	SPRINKLER CONTROL VALVE
SH	"	SPRINKLER HEAD
SIA	"	SIAMESE CONNECTION
SN	"	SIGN
SPAN	"	SOLAR PANEL
SPT	"	SEPTIC TANK LID
TBL	"	TABLE
TB BELL	"	TERMINAL BOX - BELL
TB CATV	"	TERMINAL BOX - CABLE
TCB	"	TRAFFIC CONTROL BOX
TPIT	"	TEST PIT
TSL	"	TRAFFIC SIGNAL LIGHT
UMB	"	MARKER BELL UNDERGROUND
UMC	"	MARKER CABLE UNDERGROUND
UMG	"	MARKER GAS UNDERGROUND
UMO	"	MARKER OIL UNDERGROUND
UP	"	UTILITY POLE
VB	"	VALVE BOX
VC	"	VALVE CHAMBER
WV	"	WATER VALVE
	"	TREE STUMP
	"	TREE CONIFEROUS
	"	TREE DECIDUOUS

SURVEYOR'S CERTIFICATE

I CERTIFY THAT :

1. THIS SURVEY AND PLAN ARE CORRECT AND IN ACCORDANCE WITH THE SURVEYS ACT, THE SURVEYORS ACT AND THE REGULATIONS MADE UNDER THEM.
2. THE SURVEY WAS COMPLETED ON THE 23rd DAY OF JUNE, 2017 .

DATE

BRIAN J. WEBSTER
ONTARIO LAND SURVEYOR

DRAWN: CT CHECKED: BW PM: BW FIELD: ES/CA PROJECT No.: 161613668-111