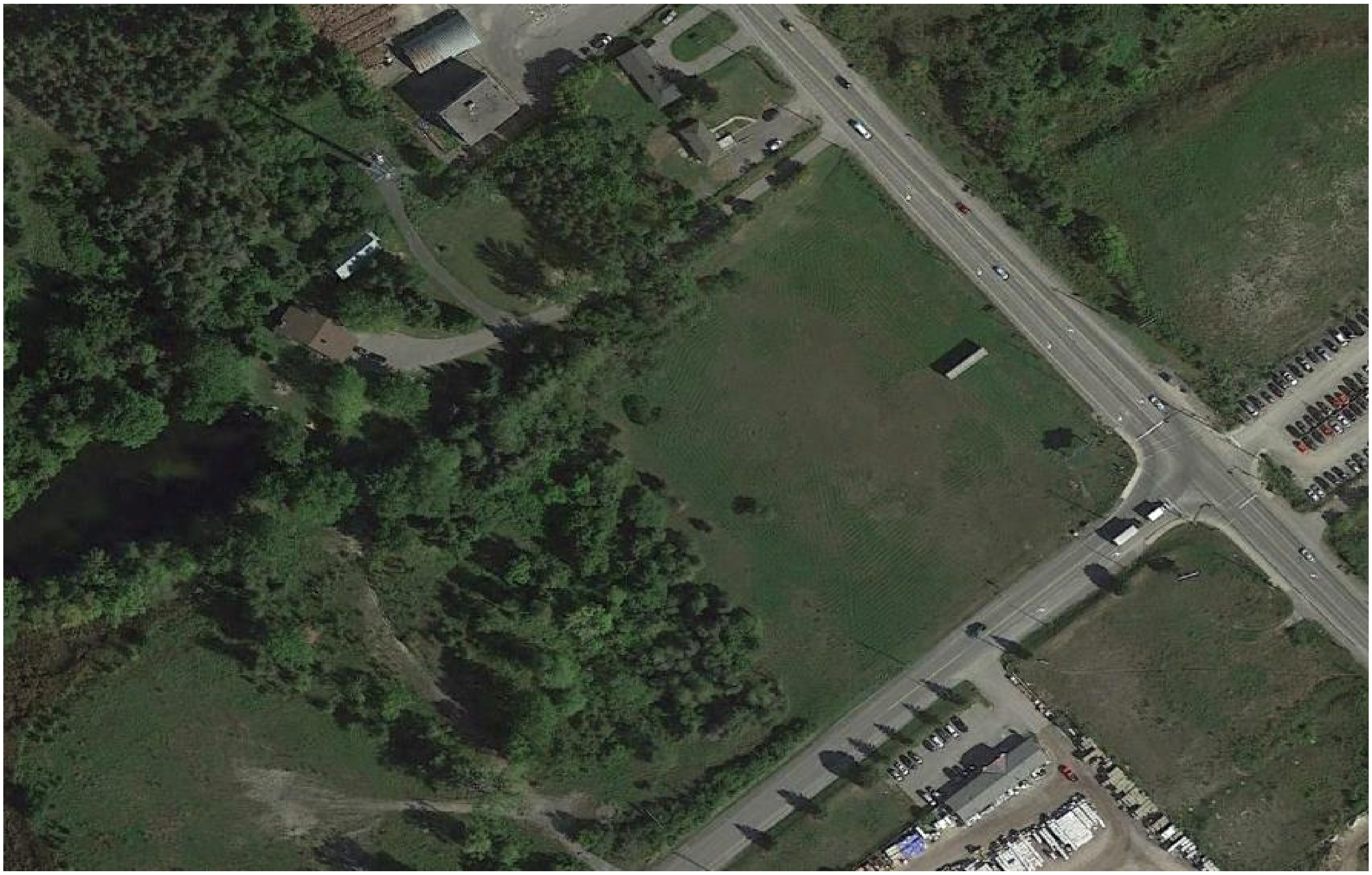
SERVICING AND STORMWATER MANAGEMENT REPORT



Project No.: 0CP-17-0603

Project Name.: Carp Road Body Shop

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Executive Summary

Developing a site within the City of Ottawa requires meeting a predefined set of requirements outlined in the City of Ottawa Sewer Design Guidelines (SDG) - 2012 along with meeting the local conservation authority requirements (Mississippi Valley Conservation Authority- MVCA) and provincial requirements (Ministry of Environment, Conservation and Parks – MECP). This site is also within the Carp River watershed and the Feedmill Creek sub-watershed, therefore additional stormwater management restrictions will apply.

This report describes an innovative and cost-efficient design solution for the site servicing (water, sanitary, and storm) and stormwater management (SWM) requirements in order to develop this site.

Strict SWM criteria were identified by the regulatory agencies, therefore effective engineering solutions were subsequently designed. An evaluation of the proposed site plan, topographic survey, and the geotechnical investigation was complete. Our review identified that parking lot storage, in conjunction with an infiltration trench is the optimal design solution to meet the SWM requirements. The parking lot storage will contain stormwater runoff from the asphalt, gravel, and roof areas within the site until the storm event subsides and flows reduce. This is achieved through the use of a restriction devices placed in storm structures within the site. The restricted runoff from the parking lot will be directed to a quality treatment unit prior to draining to the downstream infiltration trench. The infiltration trench is an excavation lined with geotextile fabric and filled with clean granular stone that receives the upstream flow from a perforated pipe and allows it to soak into the native soils below. The above design elements will ensure that the water quality and quantity concerns are addressed at all stages of development. A septic tank, pumping chamber, and leaching bed have been proposed to address sanitary needs of the new development. A new water connection from Westbrook Road as well as a hydrant are proposed for the site. It is our professional opinion that this site located at 2113 Carp Road is able to be developed and fully serviced for the proposed use.

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1.0 PROJECT DESCRIPTION

1.1 Purpose

This report will address the servicing (water, sanitary, and storm) and stormwater management requirements associated with the proposed development located at 2113 & 2125 Carp Road within the City of Ottawa.

1.2 Site Description

The property is located at 2113 & 2125 Carp Road. It is described as Part of Lot 28, Concession A (Rideau Front), City of Ottawa, Ontario. The land in question covers approximately 4.23 ha and is located northwest of the intersection of Westbrook Road and Carp Road.

The property at 2125 Carp Road is currently developed with a residential dwelling, detached garage and an asphalt driveway extending to Carp Road. The property at 2113 Carp Road is currently developed with gravel parking areas for vehicle storage. The existing site has a private septic system on the 2125 parcel with a domestic water service. The remainder of the site has no sanitary or water services, however there are roadside ditches surrounding the site.

The proposed development consists of a 1552m^2 automotive bodyshop. Parking and drive aisles will be provided throughout the site along with landscaping. There will be two site accesses for the development; the existing entrance from Carp Road will be maintained and a new entrance extending from Westbrook Road is proposed.

Figure 1: Key Map: 2113 and 2125 Carp Road, Ottawa

2.0 BACKGROUND STUDIES

Background studies that have been completed for the site include review of the City of Ottawa as-built drawings, a topographical survey of the site, a geotechnical report, a Phase I and II Environmental Site Assessment (ESA), and the Feedmill Creek Stormwater Management Criteria Study.

As-built drawings of the existing services within the vicinity of the site were reviewed in order to determine proper servicing and stormwater management schemes for the site.

A topographic survey of the site was completed by McIntosh Perry dated December 4, 2017 and can be found under separate cover.

The following reports have previously been completed and are available under separate cover:

- Geotechnical Investigation completed by Paterson Group dated April 25, 2018.
- Phase I ESA completed by Mcintosh Perry dated May 2, 2017.
- Phase I ESA Update completed by Mcintosh Perry dated April 5, 2018.
- Feedmill Creek Stormwater Management Criteria Study by J.F. Sabourin and Associates Inc. dated April 2017.
- Carp River Watershed/Subwatershed Study

3.0 PRE-CONSULTATION SUMMARY

City of Ottawa Staff have been pre-consulted regarding this proposed development in person on April 21, 2017. Specific design parameters to be incorporated within this design include the following:

Stormwater management criteria from the Feedmill Creek Stormwater Management Criteria Study:

- Extended Detention Control: Provide sufficient on-site storage volume to control the peak flow from a 15mm 3-hour Chicago design storm to 0.51 L/s/ha.
- Flood Control: Provide sufficient on-site storage volume and quality control structure to control peak flow from a 100-year storm to 8.0L/s/ha.
- Retention Control: Provide on-site Low Impact Development (LID) controls to retain the entire volume (no runoff) from a 10mm rainfall.

Additional design requirements:

- An enhanced level of protection, 80% TSS removal, is required for quality control as per the Carp River Watershed/Subwatershed Study.

Correspondence with the City can be found in Appendix ‘A’.

4.0 EXISTING SERVICES

The developed property at 2125 Carp Road has a municipal water service connected to the 406 mm watermain within Carp Road. The property also has a private septic system and no known stormwater management features. The existing water service and septic system are to be decommissioned by others.

The undeveloped property at 2113 Carp Road has no exiting services.

4.1 Carp Road

There is an existing 150 mm diameter PVC force main as well as a 100 mm diameter steel gas main located within the western portion of Carp Road.

There is also a 406 mm diameter DI watermain within the eastern portion of Carp Road. The watermain services the fire hydrants located along the west side of Carp Road.

There is an existing storm structure approximately 50m south east of the proposed entrance off Carp Road. The storm structure has two 800mm diameter storm pipes connected to it. One of the pipes runs parallel to Carp Road while the remaining pipe runs across the road and outlets at the northeast side of Carp Road. Runoff is then directed toward Feedmill Creek and eventually to the Carp River.

Hydro, gas, cable and bell services are also available along Carp Road.

4.2 Westbrook Road

There is a 305 mm diameter watermain within the south shoulder of Westbrook Road. The watermain services the fire hydrants located along the south side of Westbrook Road. The 305mm watermain tees into an existing 406mm diameter watermain within Carp Road.

There are no existing storm or sanitary sewers within Carp or Westbrook Road within the vicinity of the site. There is an 800mm diameter CSP culvert crossing Carp Road approximately 100m northwest of the intersection of Carp Road and Westbrook Road. There is an existing maintenance hole at the southwest end of the 800mm diameter culvert with another section of 800mm diameter CSP culvert connected running perpendicular to Carp Road.

5.0 SERVICING PLAN

5.1 Proposed Water Design

A new 150mm PVC diameter water lateral complete with a water valve located at the property line will be connected to the existing 305mm DI watermain within Westbrook Road. A private hydrant will be located on the southwest side of the proposed site entrance off Westbrook Road. A reducer is proposed after the onsite hydrant tee to reduce the water line from a 150mm to a 50mm water service to the building.

The Fire Underwriters Survey 1999 (FUS) method was utilized to determine the required fire flow for the site. The 'C' factor (type of construction) for the FUS calculation was determined to be 0.8 (non-combustible type construction). The total floor area ('A' value) for the FUS calculation is 1,552 m^2. The results of the calculations yielded a required fire flow of 5,000 L/min. A fire flow of 6,300 L/min was calculated using the Ontario Building Code (OBC) requirements. The detailed calculations for the FUS and OBC can be found in Appendix 'B'.

The proposed daily sewage design flow has been used as the water demands for the proposed building and can be found in Appendix 'B'. The total flow is calculated as 7,905L/day.

Boundary conditions have been provided by the City of Ottawa for the current conditions and are available in Appendix 'B'. A water model was completed using Bentley's WaterCAD based on the boundary conditions. The results determined that the proposed 150mm and 50mm watermain can adequately service the proposed development and provide sufficient fire flow and is adequate in accordance with OBC 3.2.5.7. The results are available in Appendix 'B' of this report.

5.2 Proposed Sanitary Design

A new sewage disposal system located between the proposed building and Westbrook Road will be installed and sized to service the development. McIntosh Perry will coordinate with the Ottawa Septic System Office (OSSO) for the required permits and approvals. Currently the sanitary design flow is calculated at a maximum of 9,105 L/day, which takes into consideration the building plumbing as well as the floor drains from the maintenance, service, and wash bay locations within the building. There is a proposed oil and grit separator in the building that will accept flow from the floor drains prior to outletting to the septic system (refer to mechanical plans).

5.3 Proposed Storm Design (Conveyance and Management)

Site runoff within the development area will sheet flow to the new storm network within the parking lot areas. A foundation drain outlet has also been provided and is connected to MH24 and connects to the storm network immediately after MH19. The new storm sewer network will direct controlled runoff from the site to the quality treatment unit within MH22. The runoff will then be directed to the infiltration trench prior to outletting to the existing storm structure and culvert crossing under Carp Road via a restricted outlet. The storm system will be further detailed in Section 6.0.

5.4 Site Utilities

All relevant utility companies (Bell, Gas Hydro, Cable) shall be contacted prior to construction in order to confirm adequate utility servicing for the site. The existing site connections are anticipated to be fed from the existing utilities currently within the right-of-way to the proposed site.

5.5 Service Locations/Cover

The proposed services will be placed under the parking lot and laneway as is typical in an urban development. Hydro, telephone, gas will be primarily placed in a common utility trench connecting to existing infrastructure along Carp or Westbrook Road. It is anticipated that the hydro, water and gas meter will be located at the centre of the building. The minimum cover for the storm and water services will be as follows:

Table 1: Required Cover

Service	Minimum Cover
Storm Sewer	2.0m
Watermain	2.4m

All minimum cover requirements are as per City of Ottawa Standards. Separation distances between the storm, water and sanitary will be maintained as per the Ministry of the Environment, Conservation and Parks requirements.

6.0 PROPOSED STORMWATER MANAGEMENT

6.1 Design Criteria and Methodology

The design criteria for the site has been set forth in the *Feedmill Creek SWM Criteria Study* and the *Carp River Watershed/Subwatershed Study*. The intent of this stormwater management plan is to provide adequate stormwater treatment for both quantity and quality control to meet the requirements of both watershed studies.

Stormwater Best Management Practices (BMPs) will be implemented at "Lot level" and "Conveyance" locations. These concepts will be explained further below. To summarize, most of the parking area runoff will be directed to an internal pipe network that outlets to a SWM facility on the east side of the parking lot. The SWM facility will consist of a quality control manhole and an infiltration trench treating both quality and quantity, with an enhanced level of quality control (80% Total Suspended Solids (TSS) removal). Grassed areas in the northwest and southeast corners of the lot will sheet flow away from the site, similar to pre-development.

In summary, the following design criteria have been employed in developing the stormwater management design for the site as directed by the MVCA and City:

<u>Quality Control</u>

- The site has been designed to achieve an 80% total suspended solids removal (*enhanced* level) using a proposed oil/grit separator as per Section 8.3.1.3 of the Carp River Watershed/Subwatershed Study.

<u>Quantity Control</u>

- Typical pre- to post-development criteria do not apply. The site is to be designed to the following SWM criteria as outlined within the *Feedmill Creek SWM Criteria Study*.
    - Extended Detention Control: Provide sufficient on-site storage volume to control the peak flow from a 15mm 3-hour Chicago design storm to 0.51 L/s/ha.
    - Flood Control: Provide sufficient on-site storage volume and quantity control structure to control peak flow from a 100-yr storm to 8.0L/s/ha; and
    - Retention Control: Provide on-site Low Impact Development (LID) Controls to retain the entire volume (no runoff) from a 10mm rainfall.

6.2 Runoff Calculations

The rational method has been employed for the stormwater management calculations using the following. methodology.

$$Q = 2.78CIA \text{ (L/s)}$$

Where C = Runoff coefficient
I = Rainfall intensity in mm/hr (City of Ottawa IDF curves)
A = Drainage area in hectares

The following coefficients were used to develop an average C for each area:

Roofs/Concrete/Asphalt	0.90
Gravel	0.60
Undeveloped and Grass	0.20

As per the City of Ottawa requirement, the 5-year balanced 'C' value must be increased by 25% for a 100-year storm event to a maximum of 1.00.

Rainfall intensities were derived from the Intensity-Duration-Frequency (IDF) curves from the City of Ottawa Sewer Design Guidelines and Visual OTTHYMO (Version 5.0) where applicable. Please note that while the Feedmill Creek SWM Criteria Study specifies that the site meet a 100-year 12-hour SCS Type II storm event, the 100-year storm used was derived from the City of Ottawa IDF curve to be consistent with the chosen methodology. It is believed that results are comparable. In the storm sewer design sheet an assumed Tc value of 10 minutes was used as per the City of Ottawa design standards. Pre- and Post-Development Runoff Coefficient calculations are summarized below.

(continued on next sheet)

Table 2: Runoff Coefficients

Drainage Area	C (Average) 5-Year	C (Average) 100-Year
Pre-Development		
A1	0.20	0.25
Post-Development		
B1	0.70	0.79
B2	0.89	0.99
B3	0.89	0.99
B4	0.59	0.74
B5	0.59	0.74
B6	0.60	0.75
B7	0.54	0.66
B8	0.64	0.79
B9	0.52	0.65
B10	0.82	0.91
B11	0.59	0.72
B12	0.60	0.75
B13	0.61	0.75
B14	0.60	0.75
B15	0.61	0.75
B16	0.60	0.75
B17	0.68	0.82
B18	0.64	0.77
B19	0.20	0.25
B20	0.22	0.27

6.3 Pre-Development Drainage

Stormwater design criteria for the site is based on allowable discharge rates from the Feedmill Creek SWM Criteria Study. Pre-development drainage patterns and flow rates are listed below for information purposes but have not been considered within the design. Please see Section 6.1 for a summary of design criteria.

6.3.1 Drainage Area A1

Drainage area A1 encompasses the entire area of the site. Runoff from the majority of the site flows east via overland flow toward the Carp Road right-of-way. A relatively small portion of the site in the northwest corner and along the west side of site flows west via overland flow, ultimately reaching the wetland west of the site. The area ranges in elevation from approximately 132 m at west side of the site to 127 m at the east side of the site adjacent to Carp Road. The area is mostly undeveloped consisting of grass and low-lying vegetation. The north section of the site is developed with a residential dwelling, detached garage and an asphalt driveway extending to Carp Road.

The area encompasses approximately 4.21 ha, and has runoff coefficients of 0.20 and 0.25 in the 5- and 100-year events, respectively.

Table 3: Pre-Development Flow

					Peak Flows (L/s)		
Area ID	Drainage Area (ha)	C (5-year)	C (100-year)	T_c (min)	15mm 3hr	2-year	100-year
A1	4.2	0.20	0.25	39.6	49.5	77.5	221.6
Total	4.2				49.5	77.5	221.6

6.4 Post-Development Drainage

Stormwater design criteria for the site is based on allowable discharge rates from the Feedmill Creek SWM Criteria Study. Unrestricted post-development flow rates are listed below for information purposes, but have not been considered within the design. Please see Section 6.1 for a summary of design criteria.

The post-development drainage scheme for the proposed development is comprised of twenty drainage areas. Two vegetated areas are proposed to flow offsite unrestricted to the wetland west of the site and to Carp Road, as in pre-development. The remaining eighteen drain directly to the internal pipe network before entering a quality treatment unit followed by an infiltration trench.

The development will see the addition of a 1,570 m² building with adjacent asphalt parking lot and landscaped areas, as well as a relatively large area north and east of the asphalt lot, consisting of gravel parking areas and drive aisles as well as landscaped areas. The developed areas contain three distinct sections consisting of multiple drainage areas each, separated by curb and/or relatively steeply graded landscaped areas.

Please see Appendix E for detailed calculations and Appendix D for the Post-Development Drainage Plan for more information.

6.4.1 Section 1 – Areas B1-B4 – Building and Asphalt Parking Area

Section 1 is made up of Drainage Areas B1, B2, B3 and B4 and consists of the proposed 1,570 m² building, as well as, the adjacent asphalt parking area, gravel parking area and landscaped areas. The total area of the section is approximately 1.2 ha.

Runoff from this area is directed to four catchbasin structures within the parking areas via overland flow. Runoff from this area will be restricted within the underground infrastructure by a 107 mm diameter orifice plug (Design head of 1.98 m) within the northeast outlet pipe of the manhole in the northeast corner of the section (MH19). Flow from this section will be restricted to 35 and 36 L/s for the 5 and 100-year storm events, respectively. Flow from this structure will continue within the underground stormwater network east through Section 2 to a quality control structure and an infiltration trench at the east limits of the site before ultimately discharging to the Carp Road ROW. The area ranges in elevation from 128.85 m at the building to 128.25 m at each of the catchbasin structures.

6.4.2 Section 2 – Areas B5-B10 - Gravel Parking Area North of Building

Section 2 is made up of Drainage Areas B5, through B10 and consists of the gravel parking area and landscaped areas north and northeast of the proposed building. The total area of the section is approximately 1.0 ha.

Runoff from this area is directed to six catchbasin structures within the parking areas via overland flow. Runoff from this area will be restricted within the underground infrastructure by a 75 mm diameter orifice plug (Design head of 2.64 m) within the southeast outlet pipe of the manhole just south of the southwest corner of the section (CBMH10). Flow from this section will be restricted to 19 and 20 L/s for the 5 and 100-year storm events, respectively. Flow from this structure will continue within the underground stormwater network east through Section 3 to a quality control structure and an infiltration trench at the east limits of the site before ultimately discharging to the Carp Road ROW. The area ranges in elevation from 130.00 m at the north limits of the site to 129.20 m at each of the catchbasin structures.

6.4.3 Section 3 – Areas B11-B18 – Gravel Parking Area East of Building

Section 3 is made up of Drainage Areas B11, through B18 and consists of the gravel parking area and landscaped areas east of the proposed building. The total area of the section is approximately 1.6 ha.

Runoff from this area is directed to eight catchbasin structures within the parking areas via overland flow. Runoff from this area will be restricted within the underground infrastructure by a 75 mm diameter orifice plug (Design head of 1.77 m) within the northwest outlet pipe of the manhole in the northeast corner of the section (CBMH18). Flow from this section will be restricted to 16 and 17 L/s for the 5 and 100-year storm events, respectively. Flow from this structure will continue within the underground stormwater network east to a quality control structure and an infiltration trench at the east limits of the site before ultimately discharging to the Carp Road ROW. The area ranges in elevation from 129.50 m at its north limits to 127.90 m at each of the catchbasin structures.

Table 4: Post-Development Flow (Unrestricted)

Area ID	Drainage Area (ha)	C (5-year)	C (100-year)	T_c (min)	Peak Flows (L/s) 15mm 3hr	Peak Flows (L/s) 2-year	Peak Flows (L/s) 100-year
B1	0.3	0.70	0.79	10.0	32.4	48.4	126.2
B2	0.3	0.89	0.99	10.0	32.2	48.5	125.4
B3	0.3	0.89	0.99	10.0	40.9	61.7	159.4
B4	0.3	0.59	0.74	10.0	30.2	40.6	117.9
B5	0.2	0.59	0.74	10.0	14.7	19.7	57.1
B6	0.1	0.60	0.75	10.0	11.2	15.0	43.7
B7	0.2	0.54	0.66	10.0	20.4	27.9	79.6
B8	0.1	0.64	0.79	10.0	13.6	18.6	52.9
B9	0.2	0.52	0.65	10.0	15.4	20.6	59.9
B10	0.1	0.82	0.91	10.0	15.0	22.5	58.4
B11	0.2	0.59	0.72	10.0	21.6	29.6	84.1
B12	0.2	0.60	0.75	10.0	15.4	20.7	60.2
B13	0.2	0.61	0.75	10.0	18.5	25.3	72.1
B14	0.2	0.60	0.75	10.0	15.6	21.0	60.9
B15	0.2	0.61	0.75	10.0	19.6	26.9	76.5
B16	0.2	0.60	0.75	10.0	15.5	20.8	60.5
B17	0.3	0.68	0.82	10.0	26.3	36.8	102.6
B18	0.2	0.64	0.77	10.0	21.3	29.5	82.8
B19	0.1	0.20	0.25	10.0	3.1	4.2	12.3
B20	0.3	0.22	0.27	10.0	11.5	15.6	44.9
Total	4.2				394.3	553.9	1537.3

6.5 Quantity Control

Detailed stormwater peak flow rates and storage calculations have been provided in Appendix E. As seen in the calculations provided, the post-development flow rates will need to be restricted in order to meet the Feedmill Creek Stormwater Management Criteria (see Section 6.1 for criteria).

Runoff from Post-development Drainage Areas B1-B18 flows overland to catchbasins where runoff enters the underground infrastructure and drains to a quality control structure before entering an infiltration trench which outlets to the Carp Road ROW. Runoff from Post-development Drainage Areas B19 and B20 drains offsite to the northwest and southeast respectively via overland flow over grassed areas. Runoff from Drainage Areas B19 and B20 will be allowed to flow uncontrolled, however; flow from these areas is expected to be similar or lower than flows from similar areas in pre-development due to the proposed land cover.

The proposed underground storage will be restricted by use of flow control structures and the infiltration trench to specific rates to meet the specified criteria for the site. The site is broken up into 3 sections as described in Section 6.4, and will be separately restricted before entering the main conveyance pipe and being conveyed to the quality control structure and infiltration trench. Flows from the 3 sections comprising Post-development Drainage Areas B1-B18 are restricted within their separate areas to maximize the available storage on site, while minimizing outflow to the trench.

(continued on next sheet)

Table 5: Restricted Flow Upstream of Infiltration Trench

Area ID	Restriction Location	Orifice Size (mm)	15mm 3hr Chicago	2-year	5-year	100-year
B1 – B4	MH19	107	Discharge (L/s)			
			29	35	35	36
			Storage Required (m³)			
			41	151	191	468
			Ponding Elevation (m)			
			127.75	128.45	128.45	128.55
			Surface Ponding Depth (m)			
			n/a	0.20	0.20	0.30
B5 – B10	CBMH10	75	Discharge (L/s)			
			19	19	19	20
			Storage Required (m³)			
			50	83	126	329
			Ponding Elevation (m)			
			129.30	129.35	129.35	129.45
			Surface Ponding Depth (m)			
			0.10	0.15	0.15	0.25
B11 – B18	CBMH18	75	Discharge (L/s)			
			16	16	16	17
			Storage Required (m³)			
			54	185	273	656
			Ponding Elevation (m)			
			127.95	128.05	128.10	128.20
			Surface Ponding Depth (m)			
			0.05	0.15	0.20	0.30

Table 6: Flow to Infiltration Trench - Summary

		15mm 3hr	100-Year	2-Year
Areas	Structure	Outflow (L/s)		
B1 - B4	MH19	29	35	35
B5 - B10	CBMH10	19	20	19
B11 - B18	CBMH18	16	17	16
Flow to Infiltration Trench (L/s)		64	71	70

Runoff to the infiltration trench was determined by combining the allowable outflow from each section into a single sewer. Allowable outflow from the infiltration trench is made up a combination of infiltration into the ground based on the bottom area of the trench for the design infiltration rate, and the allowable discharge rates for each storm event based on the Feedmill Creek Stormwater Management Criteria. Further design information for the infiltration trench is given in Sections 6.5.1 – 6.5.3 below. A flow chart has been provided in Appendix E to represent visually the flows, restrictions and outflows, in addition to detailed calculations.

Table 7: Outflow from Infiltration Trench

Area ID	Restriction Location	Orifice Size (mm)	15mm 3hr Chicago	2-year	100-year
			Discharge (L/s)		
Infiltration Trench	Outlet Pipe	120	0	5	32
			Discharge (L/s/ha)*		
			0	1	8
			Storage Required (m^3)		
			296	530	925
			Elevation (in trench) (m)		
			125.09	125.74	126.85

*L/s/ha values have been calculated by dividing the discharge rate at each given storm event by the total site area and are given in order to demonstrate that outflows from the site meet Feedmill Creek Stormwater Management Criteria as follows:

- Extended Detention Control: Provide sufficient on-site storage volume to control the peak flow from a 15mm 3-hour Chicago design storm to 0.51 L/s/ha.

- Flood Control: Provide sufficient on-site storage volume and quality control structure to control peak flow from a 100-year storm to 8.0L/s/ha.

The Feedmill Creek Stormwater Management Criteria also includes the following requirement:

- Retention Control: Provide on-site Low Impact Development (LID) controls to retain the entire volume (no runoff) from a 10mm rainfall.

Table 8 below demonstrates that the infiltration trench is able to retain a 10mm rainfall without runoff from the site, by calculating the total volume of a 10mm rainfall (259 m^3) using the post-development drainage areas and calculated Runoff Coefficients for each area, and demonstrating that volume exceeding that amount is available within the infiltration trench, below the outlet from the site.

Table 8: 10mm Rainfall Storage

Area ID	Area	C	10mm Rainfall Volume (m^3)
B1	3221	0.70	23
B2	2552	0.89	23
B3	3240	0.89	29
B4	3212	0.59	19
B5	1564	0.59	9
B6	1173	0.60	7
B7	2416	0.54	13
B8	1355	0.64	9
B9	1859	0.52	10
B10	1292	0.82	11
B11	2346	0.59	14
B12	1616	0.60	10
B13	1936	0.61	12
B14	1637	0.60	10
B15	2054	0.61	13
B16	1624	0.60	10
B17	2535	0.68	17
B18	2169	0.64	14
B19	989	0.20	2
B20	3349	0.22	7
	42140	0.00	259
Volume Available in Infiltration Trench Below Outlet Pipe (m^3)			498

A design infiltration rate of 75 mm/hr was selected based on a review of the provided geotechnical report by Paterson Group dated April 25, 2018, as well as, direct recommendation from the geotechnical engineer. The geotechnical engineer anticipates an infiltration rate of 75 to 150 mm/hr, from which the most conservative result was selected. A safety factor of 2.5 was applied based on the geotechnical engineer's recommendation.

In the 100-year event, the restriction will cause runoff to back up into the upstream conveyance pipes and structures and above the level of the parking lot surface and structure grates to a maximum allowable depth of 0.3m, which will provide the necessary additional storage due to the grading of the area.

The specified 15 mm Chicago Storm is contained within the underground infrastructure and ultimately causes no outflow from the site based on the available volume in the infiltration trench and the design infiltration rate. Similarly, a 10 mm rainfall requires less storage than is available in the portion of the infiltration trench located below the outlet and thus will have no outflow from the site.

The City of Ottawa Sewer Design Guidelines Technical Bulletin PIEDTB-2016-01 notes that one item that must be considered when using storage within parking lots is that there is no surface ponding in the 2-year event. While every effort was made to minimize surface ponding in the 2-year event, the relatively restrictive specifications from the Feedmill Creek Stormwater Management Criteria required that runoff be heavily restricted such that temporary ponding does occur within the private property in the 2-year event to a level of 5-15 cm above the elevation of the catchbasins within the parking lot. Based on analysis of the available storage within pipes and structures of different sizes, it was determined that to contain runoff from the 2-year storm would require significant upsizing of onsite pipes and/or structures, and would be an inefficient use of materials for a site of this nature at an unreasonable cost to the client. It should be noted that the outflow from the 2-year leaving the site is considered negligible given the volume and infiltration rate within the infiltration trench.

Please see Appendix E for a schematic detailing the drainage and restriction and detailed calculations showing how flow rates are restricted to meet Feedmill Creek Stormwater Management Criteria and how the necessary storage is achieved.

6.6 Quality Control

The development of this lot will employ Best Management Practices (BMP's) wherever possible. The intent of implementing stormwater BMP's is to ensure that water quality and quantity concerns are addressed at all stages of development. Lot level BMP's typically include temporary retention of the parking lot runoff, minimizing ground slopes and maximizing landscaped areas. Some of these BMP's cannot be provided for this site due to site constraints and development requirements. As per the Carp River Watershed/ Subwatershed Study, an enhanced level of water quality control is required for the site (80% TSS removal). A Stormceptor EFO12 is proposed at MH22 to provide the required water quality treatment (see Appendix 'F' for unit details).

Outflow from the site as detailed in Sections 6.4 and 6.5 above will be controlled through the use of flow control structures within the underground infrastructure, causing temporary ponding in the pipes, structures and on the surface of the parking lot. Runoff from the underground infrastructure will be directed to a quality treatment unit (Stormceptor EFO12 at MH22) before reaching the infiltration trench along the eastern side of the site (see Appendix F for sizing details). There will be an opportunity for particle settlement during this process. Uncontrolled runoff will be directed to grassed areas, which will provide an opportunity for initial filtration of any sediment, absorption and ground water recharge.

As per Table 3.2 of the MECP Stormwater Planning and Design Manual, the required storage volume for infiltration is 40 m^3/ha for areas representing 85% imperviousness. As the contributing areas have a weighted imperviousness of 93%, a required storage volume of 43 m^3/ha has been interpolated from the chart. Given the approximately 3.8 ha contributing area at 43 m^3/ha, an infiltration volume of a minimum of 163 m^3 is required to meet the quality requirements. A large infiltration trench has been proposed at the east side of the side adjacent to Carp Road providing 498 m^3 available quality volume (below the gravity outlet of the trench to the municipal ditch, in addition to the quality treatment unit.

6.6.1 Infiltration Trench Design

As per the Feedmill Creek Stormwater Management Criteria Study, a LID feature is required on the site to retain the entire volume from a 10mm rainfall.

As noted above, a design infiltration rate of 75 mm/hr was selected based on a review of the provided geotechnical report by Paterson Group dated April 25, 2018, as well as, direct recommendation from the geotechnical engineer. The geotechnical engineer anticipates an infiltration rate of 75 to 150 mm/hr, from which the most conservative result was selected. A safety factor of 2.5 was applied based on the geotechnical engineer's recommendation resulting in a 30 mm/hr infiltration rate.

A 750mm diameter header pipe is proposed following the Stormceptor treatment unit within MH22. Perforated 150mm diameter conveyance pipes will be tee'd perpendicularly into the header pipe and will run parallel with the length of the trench through the entire length. The pipes are to be spaced at 1.2m.

The infiltration trench has been designed for the site as per the MECP Stormwater Planning and Design Manual. The infiltration trench will be constructed at the north east side of the site adjacent to the parking area. The trench has been designed to meet the criteria noted in the following table:

Table 9: Infiltration Trench - MECP Requirements

No.	Design Element	Criteria	Proposed Works
1	Water Table Depth	The seasonally high water depth should be greater than 1m below the bottom of the trench	The water table depth is greater than 1m below the bottom of the trench as per the geotechnical report. (4-5m below existing ground)

2	Depth to Bedrock	The depth to bedrock should be greater than 1m below the bottom of the trench	Depth of bedrock is greater than 1m below the bottom of the trench
3	Soils	Soil percolation rate should be greater than 15mm/hr	As per the correspondence with the Geotechnical Engineer the percolation time of the soil is 30 mm/hr
4	Location	>4m from the building	Trench is >4m from the building
5	Storage Media	Trench is comprised of clear stone (50 mm dimeter) with non-woven filter cloth lining the trench	Trench is specified to have 50mm clear stone and to be lined with geotextile.
6	Conveyance Pipe	Perforated pipes should be >100mm diameter and traverse the entire length of the trench. Pipes should be spaced at maximum 1.2m apart. Pipes should be located 75 – 150mm from top of storage layer.	Perforated pipes specified in the trench are 150mm diameter and spaced at 1.2m apart. Pipes are placed at 1.55m above the bottom of trench (150mm above outlet pipe invert).
7	Filter Layer	A filter layer is constructed underneath the storage layer to provide quality enhancement of the stormwater before it infiltrates the native soil. The most common filter medium is sand and should be 0.15 to 0.30m thick.	Trench is specified to have a 0.30m sand filter.

6.6.2 Storage Configuration

The maximum allowable depth of trench below the perforated pipe was determined using Equation 4.2 of the MECP Stormwater Planning and Design Manual as shown below.

- Maximum Allowable Soakaway Pit Depth

$$d = \frac{P(t)}{1000}$$

d = maximum allowable depth of the soakaway pit (m)

P = percolation rate (mm/h)

t = drawdown time (hr)

See Appendix 'G' for calculations.

It is noted that the above equation is applicable to soakaway pits, which typically do not posses a pipe outlet, and has been used to determine the maximum allowable depth of the pit below the outlet. A comparable depth guideline from the *TRCA/CVC LID Planning and Design Guide (2010)* notes that "for designs that include an underdrain, the above equation can be used to determine the maximum depth of the stone reservoir below the invert of the underdrain pipe." The maximum depth of the trench under the outlet has been calculated at 1.4 m, which matches the design depth.

The detention time of the infiltration trench below the outlet was determined using Equation 4.3 of the MECP Stormwater Planning and Design Manual, as shown below.

- Infiltration Trench Bottom Area

$$A = \frac{1000V}{Pnt}$$

A = bottom area of the trench (m^2)
V = runoff volume to be infiltrated (m^3)
P = percolation rate of surrounding native soil (mm/h)
n = porosity of the storage media
t = retention time (hr)

The equation can be rearranged to solve for retention time as shown below.

$$t = \frac{1000V\,/\,A}{Pn}$$

It is noted that since the infiltration trench receives runoff that has passed through the proposed quality treatment unit, the actual runoff volume to be infiltrated for various storm events has been used instead of required quality storage volumes from Table 3.2 from the MECP Stormwater Planning and Design Manual. In addition, the actual bottom area of the trench has been used. For a 15mm 3-hour Chicago design storm, the retention time has been calculated at 28 hours. Calculations have also been provided to demonstrate the retention time for the trench when full below the level of the outlet, which has been calculated at 47 hours.

In addition, further drawdown calculations have been determined for the pipe outlet using Equation 4.11 of the MECP Stormwater Planning and Design Manual, for storm events that have been determined to exceed the storage of the trench below the outlet. This calculation has been provided in order to demonstrate that the detention time for runoff below the outlet will be the determining factor in the ultimate retention time.

See Appendix 'G' for calculations.

6.6.3 Filter Layer

A filter layer is constructed underneath the storage layer to provide quality enhancement of the stormwater before it infiltrates the native soil. The most common filter medium used in infiltration trenches is sand. The sand layer should be approximately 0.3 m thick (0.15 m - 0.30 m).

Peat may be mixed with the sand to enhance the pollutant removal characteristics of the trench. Peat has a high affinity for metals, hydrocarbons, and nutrients (Galli, 1990). Fibric or hemic peat should be utilized to achieve the desired percolation rates.

6.6.4 Maintenance

Maintenance and monitoring are required to ensure effective operation, longevity, and function of the quality treatment unit, infiltration trench, and restriction devices and will include: sediment removal, trash removal, and inspection of inlet and outlets.

In addition, as per Section 6 of the MECP 'SWM Planning and Design Manual' the infiltration trench shall also be monitored to ensure the facility drains within the allowed time (18 hours for a 100-year storm event). ECB23 may be used to monitor the water levels in the trench. If the trench has not drained within 24 hours, the pre treatment unit and inlet pipes should be cleaned. If the trench has not drained within 48 hours, further investigation should be complete. To improve performance of the trench reconstruction may be required. In the event the trench is relatively dry following a storm event, the inlet pipe should be investigated and cleaned to ensure water is flowing into the trench.

7.0 SEDIMENT EROSION CONTROL

7.1 Temporary Measures

Before construction begins, temporary silt fence, straw bale or rock flow check dams will be installed at all-natural runoff outlets from the property. For this Project, areas of concern include the existing roadside ditch along Carp Road where most of the runoff from the site is ultimately directed, as well as the wetland northeast of the site. It is crucial that these controls be maintained throughout construction and inspection of sediment and erosion control will be facilitated by the Contractor or Contract Administration staff throughout the construction period.

Silt fences will be installed where shown on the final engineering plans, specifically along the downstream property limits. The Contractor, at their discretion or at the instruction of the City of Ottawa, MVCA or the Contract Administrator shall increase the quantity of sediment and erosion controls on-site to ensure that the site is operating as intended and no additional sediment finds its way off site. The rock flow, straw bale & silt fence check dams and barriers shall be inspected weekly and after rainfall events. Care shall be taken to properly remove sediment from the fences and check dams as required. Geosock is to be installed under the grates of all existing structures along the frontage of the site and any new structures immediately upon installation. The Geosock is to be removed only after all areas have been paved. Care shall be taken at the removal stage to ensure that any silt that has accumulated is properly handled and disposed of. Removal of silt fences without prior removal of the sediments shall not be permitted.

Although not anticipated, work through winter months shall be closely monitored for erosion along sloped areas. Should erosion be noted, the Contractor shall be alerted and shall take all necessary steps to rectify the situation. Should the Contractor's efforts fail at remediating the eroded areas, the Contractor shall contact the MVCA to review the site conditions and determine the appropriate course of action. As the ground begins to thaw, the Contractor shall place silt fencing at all required locations as soon as ground conditions both warrant and permit. Please see the Site Grading and Drainage Plan for additional details regarding the temporary measures to be installed and their appropriate OPSD references.

7.2 Permanent Measures

Rip-rap will be placed at all locations that have the potential for concentrated flow. It is crucial that the Contractor ensure that the geotextile is keyed in properly to ensure runoff does not undermine the rip rapped area. Additional rip rap is to be placed at erosion prone locations as identified by the Contractor / Contract Administrator / City of Ottawa or MVCA.

It is expected that the Contractor will promptly ensure that all disturbed areas receive topsoil and seed/sod and that grass be established as soon as possible. Any areas of excess fill shall be removed or levelled as soon as possible and must be located a sufficient distance from any watercourse to ensure that no sediment is washed out into the watercourse. As the vegetation growth within the site provides a key component to the control of sediment for the site, it must be properly maintained once established. Once the construction is complete, it will be up to the landowner to maintain the vegetation and ensure that the vegetation is not overgrown or impeded by foreign objects.

8.0 SUMMARY

- A new 1552m^2 automotive bodyshop will be constructed on the site located the northwest corner of Carp Road and Westbrook Road.
- A new sewage disposal system located onsite between the proposed building and Westbrook Road will be installed and sized to service the development.
- A new 150 mm diameter water service will be extended from the existing 305mm diameter main within Westbrook Road. The water service will be reduced to 75mm past the onsite private hydrant connection.
- A new storm network will be installed onsite and will drain via a quality treatment unit and infiltration trench providing quantity and quality treatment to the Carp Road ROW.
- As discussed with the City of Ottawa staff, the stormwater management design will ensure the Feedmill Creek Stormwater Management Criteria has been implemented. Storage to meet the specified criteria will be provided within the infiltration trench as well as the pipes, structures and parking lot surface above the storm structures.
- As per the Carp River Wateshed/Subwatershed Study, 80% TSS removal will be achieved through the use of a Stormceptor EFO12 on the site.

9.0 RECOMMENDATIONS

Based on the information presented in this report, we recommend that City of Ottawa approve this Servicing and Stormwater Management Report in support of the proposed development at 2113 Carp Road.

The sediment and erosion control plan outlined in Section 7.0 and detailed in the Grading and Drainage Plan notes are to be implemented by the contractor.

This report is respectfully being submitted for approval.

Ryan Kennedy, P.Eng.
Practice Area Lead, Land Development
McIntosh Perry Consulting Engineers
T: 613.903.5766
E: r.kennedy@mcintoshperry.com

Charissa Hampel
Engineering Intern, Land Development
McIntosh Perry Consulting Engineers
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E: c.hampel@mcintoshperry.com

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10.0 STATEMENT OF LIMITATIONS

This report was produced for the exclusive use of BBS Construction Ltd. The purpose of the report is to assess the existing stormwater management system and provide recommendations and designs for the post-construction scenario that are in compliance with the guidelines and standards from the Ministry of Environment, Conservation and Parks, City of Ottawa and local approval agencies. McIntosh Perry reviewed the site information and background documents listed in Section 2.0 of this report. While the previous data was reviewed by McIntosh Perry and site visits were performed, no field verification/measures of any information were conducted.

Any use of this review by a third party, or any reliance on decisions made based on it, without a reliance report is the responsibility of such third parties. McIntosh Perry accepts no responsibility for damages, if any, suffered by any third party as a result of decisions or actions made based on this review.

The findings, conclusions and/or recommendations of this report are only valid as of the date of this report. No assurance is made regarding any changes in conditions subsequent to this date. If additional information is discovered or becomes available at a future date, McIntosh Perry should be requested to re-evaluate the conclusions presented in this report, and provide amendments, if required.

APPENDIX A

CITY OF OTTAWA PRE-CONSULTATION NOTES

Pre-Application Consultation Notes

Date: April 21, 2017

Subject Address: 2113 Carp Road

Attendees: Natalie Persaud, City, Planner

Existing Use: Vacant lands

Existing Policies:

Zoning: Rural General Industrial, Subzone 1, exception 774r

Permits for storage yard and automobile dealership
Exception 774r limits type of retail uses, and adds additional permitted uses of Office and Research and Development.

Official Plan: Carp Road Corridor Rural Employment Area

Proposed Use:

Storage site for new vehicles to be sold at another location. Future intention could be sell vehicles at this location.
Storage of vehicles may also include display.

Comments:

Planning
Natalie.Persaud@ottawa.ca
(613) 580-2424 Ext. 12681

Application required for storage yard, where no buildings are proposed is Site Plan Control – No Public Consultation – Rural Based.

The consultation fee you have paid will be refunded following the site plan application.

The use proposed is considered to be a storage yard. The provisions related to outdoor storage are to be followed. This means no storage in required front or corner side yards and requires opaque screening at a minim of 1.8 metres in height (max. 3m). This also means no displaying of vehicles within the front and corner side yards as well. Should the use of the site change to a dealership, display of goods would be permitted, also ensuring any related storage be screened.

Engineering **Kevin.Hall@ottawa.ca** **(613) 580-2424 Ext. 27824**	*Stormwater Management:* SWM criteria for the Feedmill Creek - • Control (detain) peak runoff from a 15 mm 3-hour Chicago design storm to 0.51 L/s/ha. Due to orifice size limitation for small sites, a maximum release rate of 6 l/s can be used for the site plan located at 2113 Carp Road. • Control (detail) peak runoff from a 100-year 12-hour SCS Type II storm to 8.0 L/s/ha. • Control (retain) runoff from a 10 mm rainfall on-site through implementation of Low Impact Development (LID) controls. • Cost contribution for the in-stream works on Feedmill Creek. An Area Specific Development Charge background study is currently under preparation (more details will follow). In addition, an enhanced level of protection (80% TSS removal) is required for quality control, as per Section 8.3.1.3 of the Carp River Watershed/Subwatershed Study. There may be a financial contribution for Feedmill creek improvements. A watermain is available for connection, however sanitary services must be provided privately on-site.
Environment **Matthew.Hayley@ottawa.ca** **(613) 580-2424 Ext. 23358**	Possibility of Blanding's Turtle and habitat near site as well as Butternut Tree Development may require approval from the Ministry of Natural Resources and Forestry. Depending on the presence of Butternuts a permit for removal would also be required from the MNRF Contact Aaron Foss at the MNRF to discuss Species at Risk. MNRF may say no ministry approval is required, please provide correspondence. A combined tree conservation report and Environmental Impact Statement will be required as part of the application.
Traffic **Amira.Shehata@ottawa.ca** **(613) 580-2424 Ext. 27737**	Access to Carp Road from this site will not be permitted. A new access at this location would affect the right-turn storage capacity, potentially causing delays, and be unsafe for vehicles moving close to the intersection. Carp Road is an arterial road with high traffic volumes at high speeds. As such, we need to maintain a high level of service for traffic operation in the area.

The ROW protection at this segment is 37.5 metres. Do ensure the survey submitted identifies the measurement 18.75 metres from the centreline of the road.

Other Agencies

Consult the Rideau Valley Conservation Authority for with respect to stormwater runoff and requirements for quality and quantity.

Submission Requirements

5 - Combined Site Plan and Landscape Plan
5 – Grading and Drainage Plan
5 – Erosion and Sediment Control
5 – Stormwater Management Report
5 – Combined Environmental Impact Statement and Tree Conservation Report
3 – Geotechnical Investigation Reports
3 – Planning brief, a simple discussion of the site details and what is proposed
1 - Digital copies of all plans and studies, either USB or CD

APPENDIX B

FIRE PROTECTION CALCULATIONS

Proposed Daily Sewage Design Flow - 2113 Carp Road

Office		
Q (OBC - Office/Floor Area)	75	L/ 9.3 m^2
Proposed Office Floor Area=	109	m^2
Q (OBC - Office/Floor Area)	900	L/day
Factory		
Q (OBC - Factory Employee)	75	L/ employee per 8-hr shift
Employees/8-hr shift =	2	employees (in parts)
Q (OBC -Factory/Employee)	150	L/day
AND		
Q (OBC - Factory Employee)	125	L/ employee per 8-hr shift with shower
Employees/8-hr shift =	21	employees in shop (service area, paint booths, wash bays, prep area, appraisal bays)
Q (OBC - Factory/Employee)	2625	L/day
Pressure Washer		
Q (Pressure washer in wash bay)	150	L/wash (10 L/min for industrial pressure washer @ 15min./car)
# washes per day =	16	cars/day
Q (Pressure washer)	2400	L/day
Floor Drains		
Q (Floor Drains)	600	L/hr (10 L/min for industrial pressure washer)
# hrs pressure washsing per day =	1	hr/day (pressure washing for cleaning, not including wash bays)
Q (Floor Drains)	600	L/day
Customers		
Q (OBC - Store Watercloset)	1230	L/ water closet
# Water Closets =	1	water closets
Q (OBC - Store WC)	1230	L/day
Q (Office)	900	L/day
Q (Factory)	2775	L/day
Q (Pressure Washer)	2400	L/day
Q (Floor Drains)	600	L/day
Q (Customers)	1230	L/day
Q (total, calculated)	**7905**	**L/day**

CP-17-0603 - 2113 Carp Road - OBC Fire Calculations

Project:	2113 Carp Road
Project No.:	CP-17-0603
Designed By:	C.D.H.
Checked By:	R.P.K.
Date:	2018/11/05

Ontario 2006 Building Code Compendium (Div. B - Part 3)

Water Supply for Fire-Fighting - Store/Office & Warhouse Building

Building is classified as Group : F2 (from table 3.2.2.67)
Building is of noncombustable construction with fire separations and fire-resistance ratings provided in accordance with Subsection 3.2.2, including loadbearging walls, columns and arches.

From Div. B A-3.2.5.7. of the Ontario Building Code - 3. Building On-Site Water Supply:

(a) Q = K x V x Stot

where:

Q = minimum supply of water in litres

K = water supply coefficient from Table 1

V = total building volume in cubic metres

Stot = total of spatial coefficient values from the property line exposures on all sides as obtained from the formula:

Stot = 1.0 + [Sside1+Sside2+Sside3+...etc.]

K	17	(from Table 1 pg A-31) (Worst case occupancy {E / F2} 'K' value used)
V	392,786	(Total building volume in m³.)
Stot	1.0	(From figure 1 pg A-32)
Q =	6,677,362.00 L	

			From Figure 1 (A-32)
Snorth	134	m	0.0
Seast		m	0.0
Ssouth	75	m	0.0
Swest		m	0.0

*approximate distances

From Table 2: Required Minimum Water Supply Flow Rate (L/s)

9000 L/min (if Q >270,000 L)
2378 gpm

MCINTOSH PERRY

CP-17-0603 - 2113 Carp Road - Fire Underwriters Survey (FUS) Fire Calculations

Project:	2113 Carp Road
Project No.:	CP-17-0603
Designed By:	C.D.H.
Checked By:	R.P.K.
Date:	2018/11/05

From the Fire Underwriters Survey (1999)

From Part II – Guide for Determination of Required Fire Flow Copyright I.S.O.:

F = 220 x C x √A Where:

F = Required fire flow in liters per minute

C = Coefficient related to the type of construction.

A = The total floor area in square meters (including all storey's, but excluding basements at least 50 percent below grade) in the building being considered.

A. Determine The Coefficient Related To The Type Of Construction

The building is considered to be non-combustable construction. Therefore,

C = 0.80

B. Determine Ground Floor Area

As provided by the Architect:

Floor Area (One Floor) = 1,592.00 m²

A = 1,592.00 m²

This floor area represents the final build-out of the development; as outlined on the Site Plan drawing.

C. Determine Height in Storeys

From Architectural Drawings:

Number of Storeys = 1.00

D. Calculate Required Fire Flow

F = 220 x C x √A

F = 220.00 X 0.80 X √ 1592.00

F = 7,022.38 L/min.

F = 7,000.00 L/min.

E. Determine Increase or Decrease Based on Occupancy

From note 2, Page 18 of the Fire Underwriter Survey:

Non-combustible

-25% Charge

Occupancy Decrease = 1,750.00 L/min.

F = 5,250.00 L/min.

F. Determine the Decrease, if any for Sprinkler Protection

From note 3, Page 18 of the Fire Underwriter Survey:

- The flow requirement may be reduced by up to 50% for complete automatic sprinkler protection depending upon adequacy of the system.
- The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.
- Additional credit of 10% if water supply is standard for both the system and fire department hose lines
- If sprinkler system is fully supervised system, an additional 10% credit is granted
- The entire building will be installed with a fully automated, standardized with the City of Ottawa Fire Department and fully supervised.
- Therefore no reduction is granted.

Reduction = 5,250.00 L/min. X 0%

Reduction = 0.00 L/min.

G. Determine the Total Increase for Exposures

From note 4, Page 18 of the Fire Underwriter Survey:

- There are no existing buildings surrounding the site that are within 45m.
- Therefore the charge for exposure is 0% of the value obtained in Step E.

= 5,250.00 L/min. X 0%

Increase = 0.00 L/min.

H. Determine the Total Fire Demand

- To the answer obtained in E, substract the value obtained in F and add the value obtained in G
- Fire flow should be no less than 2,000L/min. and the maximum value shoul not exceed 45,000L/min.

F = 5,250.00 L/min. - 0.00 L/min. + 0.00 L/min.

F = 5,250.00 L/min.

Therefore, after rounding to the nearest 1,000 L/min, the total required fire flow for the development is 5000 L/min (1321 GPM).

From: Tyler Ferguson
Sent: November 21, 2018 1:29 PM
To: Sean Leflar
Subject: FW: Request For Boundary Conditions - 2113 Carp Road
Attachments: 2113 Carp Road BC.docx

Follow Up Flag: Follow up
Flag Status: Flagged

Hey Sean,

When you have some time later today/this week in between Microtel report/drawing updates. Water model can be done for CP-17-0603. We can chat before you get started.

Thanks,

Tyler Ferguson, EIT
Engineering Intern
T. 613.836.2184 (ext 2242) | **F.** 613.836.3742

From: Charissa Hampel
Sent: November-21-18 9:31 AM
To: Tyler Ferguson <t.ferguson@mcintoshperry.com>
Subject: FW: Request For Boundary Conditions - 2113 Carp Road

Can we have someone run the water model.

Charissa Hampel, EIT
Engineering Intern
T. 613.836.2184 (ext 2268) | **F.** 613.836.3742 | **C.** 613.791.0505

From: Hall, Kevin <Kevin.Hall@ottawa.ca>
Sent: November 21, 2018 9:15 AM
To: Charissa Hampel <c.hampel@mcintoshperry.com>
Subject: RE: Request For Boundary Conditions - 2113 Carp Road

Charissa

Attached is the boundary conditions for your site.

Kevin Hall, C.E.T.
Project Manager, Infrastructure Approvals
Development Review - Rural Services
Gestionnaire de projet, Approbation des demandes d'infrastructure
Examen des demandes d'aménagement (Services ruraux)
City of Ottawa | Ville d'Ottawa
613.580.2424 ext./poste 27824
Fax 613.580.2576
ottawa.ca/planning / ottawa.ca/urbanisme

From: Charissa Hampel <c.hampel@mcintoshperry.com>
Sent: Friday, November 16, 2018 10:58 AM
To: Whittaker, Damien <Damien.Whittaker@ottawa.ca>
Cc: Hall, Kevin <Kevin.Hall@ottawa.ca>
Subject: RE: Request For Boundary Conditions - 2113 Carp Road

Please see attached sheets.

Charissa Hampel, EIT
Engineering Intern
115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0
T. 613.836.2184 (ext 2268) | **F.** 613.836.3742 | **C.** 613.791.0505
c.hampel@mcintoshperry.com | www.mcintoshperry.com

From: Whittaker, Damien <Damien.Whittaker@ottawa.ca>
Sent: November 16, 2018 10:52 AM
To: Charissa Hampel <c.hampel@mcintoshperry.com>
Cc: Hall, Kevin <Kevin.Hall@ottawa.ca>

Subject: RE: Request For Boundary Conditions - 2113 Carp Road

Hello Charissa,

Can you please send the fire demand calculation?

Thank you,

Damien Whittaker, P.Eng
Senior Engineer - Infrastructure Applications § Ingénieur principal - applications d'infrastructure
Development Review, Rural Services Unit § Examen des projets d'eménagement, Unité des services ruraux
Planning, Infrastructure and Economic Development Department | Services de la planification, de l'infrastructure et du développement économique
City of Ottawa | ville d'Ottawa § (613-580-2424 x16968 § 8 damien.whittaker@ottawa.ca § + 01-14

From: Charissa Hampel <c.hampel@mcintoshperry.com>
Sent: Friday, November 16, 2018 10:43 AM
To: Whittaker, Damien <Damien.Whittaker@ottawa.ca>
Cc: Hall, Kevin <Kevin.Hall@ottawa.ca>
Subject: RE: Request For Boundary Conditions - 2113 Carp Road

Hi Damien,
Please see below for parameters. Site Plan is attached as well.

1. Type of development: Automotive Bodyshop
2. Location of service: 2113 Carp Road
3. Amount of fire flow required: 5,000 L/min (FUS)
4. Average daily demand: 1.71 L/s.
5. Maximum daily demand: 2.56 L/s.
6. Maximum hourly daily demand: 4.60 L/s.

We will also need flow data from hydrants within the vicinity.

Thank you,

Charissa Hampel, EIT
Engineering Intern
115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0
T. 613.836.2184 (ext 2268) | **F.** 613.836.3742 | **C.** 613.791.0505
c.hampel@mcintoshperry.com | www.mcintoshperry.com

From: Whittaker, Damien <Damien.Whittaker@ottawa.ca>
Sent: November 16, 2018 10:31 AM
To: Charissa Hampel <c.hampel@mcintoshperry.com>
Cc: Hall, Kevin <Kevin.Hall@ottawa.ca>
Subject: RE: Request For Boundary Conditions - 2113 Carp Road

Hello Charissa,

I am not sure if it was provided to Kevin, but I did not receive a calculation of the fire demand, together with a plan to verify parameters. Can you please provide a plan showing the parameters in the fire demand calculation and the entire calculation to facilitate the processing of the boundary condition request.

Thank you,

Damien Whittaker, P.Eng
Senior Engineer - Infrastructure Applications § Ingénieur principal - applications d'infrastructure
Development Review, Rural Services Unit § Examen des projets d'eménagement, Unité des services ruraux
Planning, Infrastructure and Economic Development Department | Services de la planification, de l'infrastructure et du développement économique
City of Ottawa | ville d'Ottawa § (613-580-2424 x16968 § 8 damien.whittaker@ottawa.ca § + 01-14

From: Charissa Hampel <c.hampel@mcintoshperry.com>
Sent: Friday, November 16, 2018 9:36 AM
To: Hall, Kevin <Kevin.Hall@ottawa.ca>; Whittaker, Damien <Damien.Whittaker@ottawa.ca>
Subject: RE: Request For Boundary Conditions - 2113 Carp Road

Charissa Hampel, EIT
Engineering Intern
115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0
T. 613.836.2184 (ext 2268) | **F.** 613.836.3742 | **C.** 613.791.0505
c.hampel@mcintoshperry.com | www.mcintoshperry.com

From: Charissa Hampel <c.hampel@mcintoshperry.com>

Sent: November 16, 2018 9:35 AM
To: Kevin.Hall@ottawa.ca
Subject: Request For Boundary Conditions - 2113 Carp Road

Good morning,

Below are the anticipated water demands for the site to obtain the boundary conditions. See attached site plan attached for reference.

1. Type of development: Automotive Bodyshop
2. Location of service: 2113 Carp Road
3. Amount of fire flow required: 5,000 L/min (FUS)
4. Average daily demand: 1.71 L/s.
5. Maximum daily demand: 2.56 L/s.
6. Maximum hourly daily demand: 4.60 L/s.

We will need boundary conditions for Westbrook Road as that is where the water is anticipated to be connected. We will also need flow data from hydrants within the vicinity.

Thanks,

Charissa Hampel, EIT

Engineering Intern
115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0
T. 613.836.2184 (ext 2268) | **F.** 613.836.3742 | **C.** 613.791.0505
c.hampel@mcintoshperry.com | www.mcintoshperry.com

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BOUNDARY CONDITIONS

Boundary Conditions For: 2113 Carp Road

Date of Boundary Conditions: 2018-Nov-20

Provided Information:

Scenario	Demand	
	L/min	L/s
Average Daily Demand	102.6	1.7
Maximum Daily Demand	153.6	2.6
Peak Hour	276.0	4.6
Fire Flow #1 Demand	5,000	83.3

Number Of Connections: 1

Location:

BOUNDARY CONDITIONS

Results:

Connection #: 1

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	160.6	47.7
Peak Hour	157.1	42.7
Max Day Plus Fire (5,000) L/min	156.2	41.4

[1]Elevation: **127.07 m**

Notes:

1) As per the Ontario Building Code in areas that may be occupied, the static pressure at any fixture shall not exceed 552 kPa (80 psi.) Pressure control measures to be considered are as follows, in order of preference:

a) If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.

b) Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

2) Click or tap here to enter text.

3) Click or tap here to enter text.

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. Fire Flow analysis is a reflection of available flow in the watermain; there may be additional restrictions that occur between the watermain and the hydrant that the model cannot take into account.

Avg. Day

Label	Elevation (m)	Demand (L/min)	Pressure (psi)	Hydraulic Grade (m)
J-1 (Connection)	126.39	0.00	48.56	160.60
J-2 (BLDG)	126.45	54.86	47.58	159.97

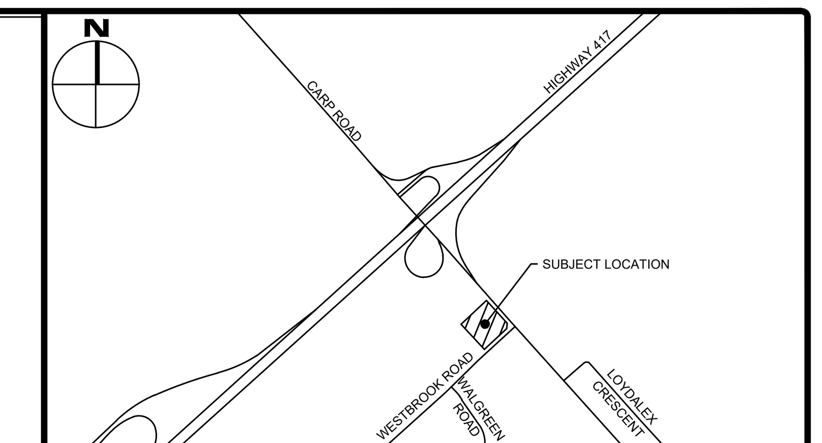
Peak Hourly

Label	Elevation (m)	Demand (L/min)	Pressure (psi)	Hydraulic Grade (m)
J-1 (Connection)	126.39	0.00	43.59	157.10
J-2 (BLDG)	126.45	54.86	42.61	156.47

Max. Day + Fire Flow

Label	Is Fire Flow Run Balanced?	Satisfies Fire Flow Constraints?	Fire Flow (Needed) (L/min)	Fire Flow (Available) (L/min)	Pressure (psi)	Elevation (m)
H-1	True	True	5,000.00	9,098.17	42.30	126.40
J-1 (Connection)	False	False	5,000.00	(N/A)	42.31	126.39
J-2 (BLDG)	False	False	5,000.00	(N/A)	41.34	126.45

APPENDIX C
PRE-DEVELOPMENT DRAINAGE PLAN



LOCATION PLAN

LEGEND

AREA NAME
AREA (Ha)
A1 0.25
0.90
1.00
5yr & 100yr COEFFICIENT

OVERLAND DRAINAGE FLOW

FOR REVIEW ONLY
NOT FOR CONSTRUCTION

No.	Revisions	Date
1	ISSUED FOR SITE PLAN CONTROL	NOV. 28, 2018

Check and verify all dimensions before proceeding with the work

Do not scale drawings

SCALE 1 : 500
0 10 20 30 40 50 Metres

McINTOSH PERRY
115 Walgreen Road, RR3, Carp, ON K0A 1L0
Tel: 613-836-2184 Fax: 613-836-3742
www.mcintoshperry.com

Stamp:

Client:
BBS CONSTRUCTION LTD.
1805 WOODWARD DRIVE
OTTAWA, ON K2C 0P9

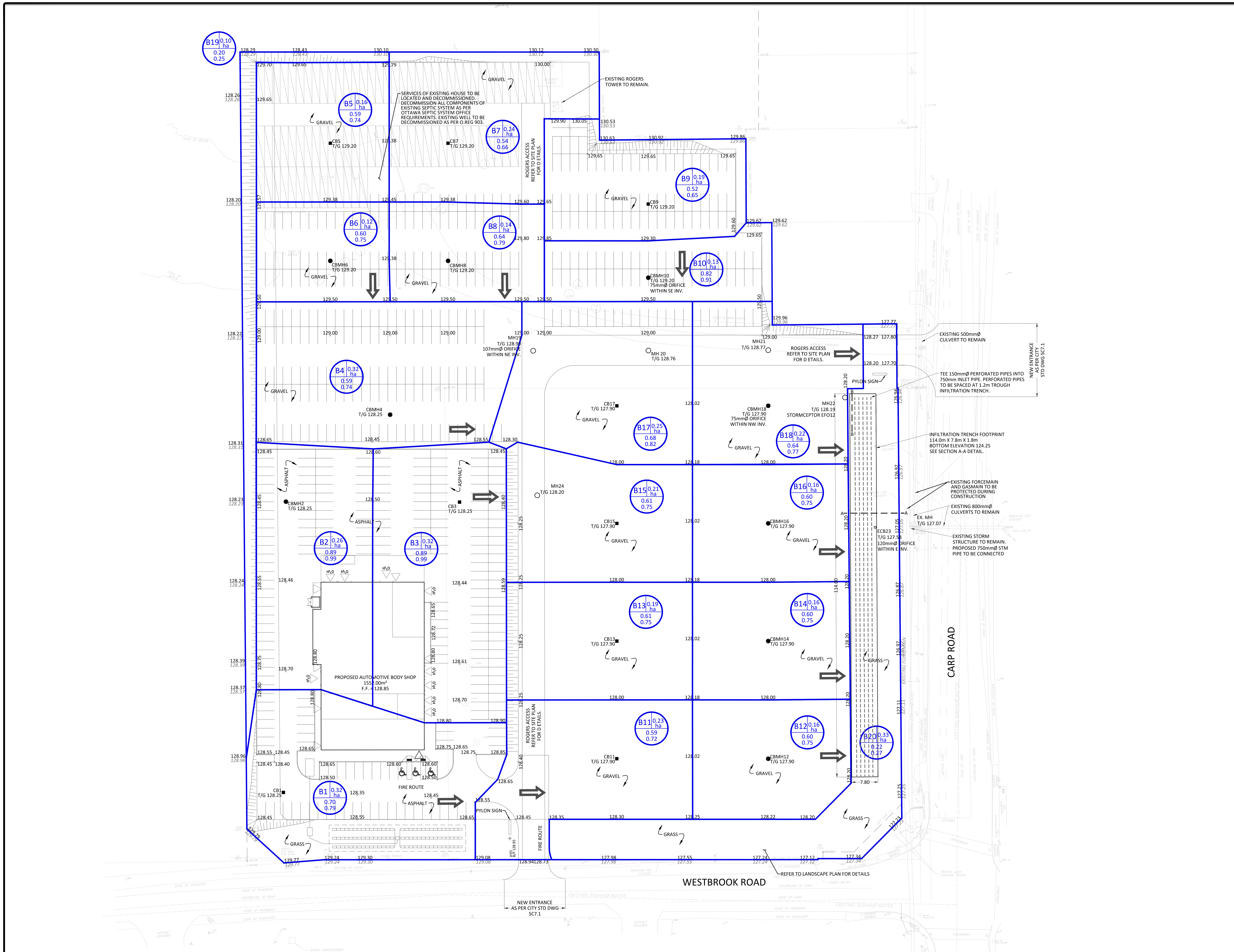
Project:
CARP ROAD BODY SHOP
2113 & 2125 CARP ROAD

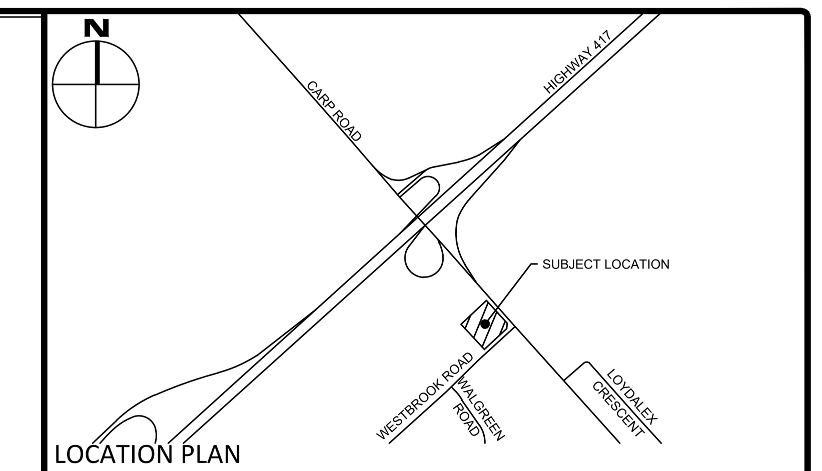
Drawing Title:
PRE-DEVELOPMENT DRAINAGE AREA PLAN

Scale: 1:500	Project Number: CP-17-0603
Drawn By: C.D.H.	
Checked By: R.P.K.	Drawing Number: PRE
Designed By: C.D.H.	

APPENDIX D

POST-DEVELOPMENT DRAINAGE PLAN





LEGEND

AREA NAME — AREA (Ha) — 5yr & 100yr COEFFICIENT (B1, 0.25 ha, 0.90, 1.00)

FOR REVIEW ONLY
NOT FOR CONSTRUCTION

No.	Revisions	Date
3	REVISED AS PER COMMENTS	JULY 8, 2019
2	REVISED AS PER COMMENTS	MAR. 7, 2019
1	ISSUED FOR SITE PLAN CONTROL	NOV. 28, 2018

Check and verify all dimensions before proceeding with the work — Do not scale drawings

SCALE 1 : 500 (0, 10, 20, 30, 40, 50 Metres)

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Tel: 613-836-2184 Fax: 613-836-3742
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Client:
BBS CONSTRUCTION LTD.
1805 WOODWARD DRIVE
OTTAWA, ON K2C 0P9

Project:
CARP ROAD BODY SHOP
2113 & 2125 CARP ROAD

Drawing Title:
POST-DEVELOPMENT DRAINAGE AREA PLAN

Scale: 1:500	Project Number: CP-17-0603
Drawn By: C.D.H.	
Checked By: R.P.K.	Drawing Number: POST
Designed By: C.D.H.	

FILENAME: \\192.168.1.3\mpdocument\01 Project - Proposals\2017 Jobs\CP\0CP-17-0603 BBS_Body Shop_2113 Carp Road\Civil\15 - Drawings\OCP-17-0603 - Presentation.dwg
LAST SAVED: Monday, July 08, 2019 LAST SAVED BY: c.hampel
LAST PLOTTED: Monday, July 08, 2019

APPENDIX E

STORMWATER MANAGEMENT CALCULATIONS

From: Nathan Christie <nchristie@Patersongroup.ca>
Sent: July 16, 2018 3:44 PM
To: Charissa Hampel
Cc: Frits Bosman; Richard Groniger; David Gilbert
Subject: RE: Carp Road and Westbrook Road - Geotechnical Report

Hi Charissa,

Based on our observations, the native subgrade soil underlying the fill layer at the site consists primarily of a compact to very dense silty sand. We have not carried out any grain size analysis or permeameter testing at the site. However, based on the site coverage, our groundwater observations at the test hole locations and our experience with soils of this type, we anticipate an infiltration rate of 75 to 150 mm/hr. A factor of safety of 2.5 should be used when calculating the design infiltration rate.

I'm also assuming with this that you have an overflow valve to outlet to the storm sewer? This provides an additional safety check in the event of a high-intensity rain event that the system can't handle.

Please advise us if an update to our report is required.

Best regards,

Nathan Christie, P.Eng.
Geotechnical Engineer

From: Charissa Hampel <c.hampel@mcintoshperry.com>
Sent: Monday, July 16, 2018 10:38 AM
To: Nathan Christie <nchristie@Patersongroup.ca>
Cc: Richard Groniger <RGroniger@Patersongroup.ca>; David Gilbert <DGilbert@Patersongroup.ca>
Subject: RE: Carp Road and Westbrook Road - Geotechnical Report

Good Morning,
I am following up on the email below. When can I expect to receive the infiltration rate?

Thanks,

From: Charissa Hampel
Sent: July 11, 2018 10:07 AM
To: Nathan Christie <nchristie@Patersongroup.ca>
Cc: Richard Groniger <RGroniger@Patersongroup.ca>; David Gilbert <DGilbert@Patersongroup.ca>
Subject: RE: Carp Road and Westbrook Road - Geotechnical Report

Good Morning,
To meet the SWM criteria for the site we are look at putting in an infiltration gallery on the site. We will need the infiltration rate (mm/hr) of the native soils.

Let me know if you need any additional information.

Thanks,

Charissa Hampel, EIT
Engineering Intern
115 Walgreen Road, R.R. 3, Carp, ON K0A 1L0
T. 613.836.2184 (ext 2268) | **F.** 613.836.3742 | **C.** 613.791.0505
c.hampel@mcintoshperry.com | www.mcintoshperry.com

McINTOSH PERRY

From: Nathan Christie <nchristie@Patersongroup.ca>
Sent: April 25, 2018 12:31 PM
To: frits@bbsconstruction.ca
Cc: Benjamin Clare <b.clare@mcintoshperry.com>; Richard Groniger <RGroniger@Patersongroup.ca>; David Gilbert <DGilbert@Patersongroup.ca>
Subject: Carp Road and Westbrook Road - Geotechnical Report

Hello Frits,

Please find attached our geotechnical report and invoice for the work completed for the above noted site.

Best regards,

Nathan Christie, P.Eng.
Geotechnical Engineer

patersongroup
Solution Oriented Engineering

T: (613) 226-7381 ext. 249
154 Colonnade Road South
Ottaw a, Ontario
K2E 7J5

FAA METHOD OF CALCULATING Tc

PRE-DEVELOPMENT

FAA equation: $t = G\,(1.1 - c)\,L^{0.5} / (100\,S)^{1/3}$

t = 39.6327

t= Time of Travel (min)
C= Runoff Coefficient (dimensionless)
Lo= Overland Flow Length (ft)
So= Overland Slope (%)

Tc = 39.6327

Tc = 39.63

G=	1.8
C=	0.28
Lo=	721
So=	1

POST-DEVELOPMENT

FAA equation: $t = G\,(1.1 - c)\,L^{0.5} / (100\,S)^{1/3}$

t = 2.84605

t= Time of Travel(min)
C= Runoff Coefficient (dimensionless)
Lo= Overland Flow Length (ft)
So= Overland Slope (%)

Tc = 2.84605 + 0

Tc = 2.85

G=	1.8
C=	1.00
Lo=	250
So=	1

CP-17-0603 - BBS, SWM CALCULATIONS - RUNOFF

Time of concentration (min.)	
39.63	Pre-Development
10.00	Post-Development

Drainage Area	Area (m^2)	Impervious (m^2)	C (5-Year)	C (100-Year)	Gravel (m^2)	C (5-Year)	C (100-Year)	Pervious (m^2)	C (5-Year)	C (100-Year)	C_{AVG} 2&5-Year	C_{AVG} 100-Year
A1	42144	0	0.90	1.00	0	0.60	0.75	42144	0.20	0.25	0.20	0.25
Drainage Area	**Area (m^2)**	**Impervious (m^2)**	**C (5-Year)**	**C (100-Year)**	**Gravel (m^2)**	**C (5-Year)**	**C (100-Year)**	**Grass (m^2)**	**C (5-Year)**	**C (100-Year)**	**C_{AVG} 2&5-Year**	**C_{AVG} 100-Year**
B1	3221	2,316	0.90	1.00	0	0.60	0.75	905	0.20	0.25	0.70	0.79
B2	2552	2,517	0.90	1.00	0	0.60	0.75	34	0.20	0.25	0.89	0.99
B3	3240	3,201	0.90	1.00	0	0.60	0.75	39	0.20	0.25	0.89	0.99
B4	3212	0	0.90	1.00	3,143	0.60	0.75	69	0.20	0.25	0.59	0.74
B5	1564	0	0.90	1.00	1,520	0.60	0.75	44	0.20	0.25	0.59	0.74
B6	1173	0	0.90	1.00	1,173	0.60	0.75	0	0.20	0.25	0.60	0.75
B7	2416	213	0.90	1.00	1,680	0.60	0.75	523	0.20	0.25	0.54	0.66
B8	1355	194	0.90	1.00	1,161	0.60	0.75	0	0.20	0.25	0.64	0.79
B9	1859	0	0.90	1.00	1,483	0.60	0.75	376	0.20	0.25	0.52	0.65
B10	1292	1,139	0.90	1.00	0	0.60	0.75	153	0.20	0.25	0.82	0.91
B11	2346	319	0.90	1.00	1,737	0.60	0.75	290	0.20	0.25	0.59	0.72
B12	1616	0	0.90	1.00	1,616	0.60	0.75	0	0.20	0.25	0.60	0.75
B13	1936	235	0.90	1.00	1,584	0.60	0.75	117	0.20	0.25	0.61	0.75
B14	1637	0	0.90	1.00	1,637	0.60	0.75	0	0.20	0.25	0.60	0.75
B15	2054	272	0.90	1.00	1,645	0.60	0.75	136	0.20	0.25	0.61	0.75
B16	1624	0	0.90	1.00	1,624	0.60	0.75	0	0.20	0.25	0.60	0.75
B17	2535	682	0.90	1.00	1,844	0.60	0.75	8	0.20	0.25	0.68	0.82
B18	2169	456	0.90	1.00	1,569	0.60	0.75	144	0.20	0.25	0.64	0.77
B19	989	0	0.90	1.00	0	0.60	0.75	989	0.20	0.25	0.20	0.25
B20	3349	90	0.90	1.00	0	0.60	0.75	3,259	0.20	0.25	0.22	0.27

Uncontrolled Runoff Calculations (for information only)				T_c (min)	I (mm/hr)			Q (L/s)		
Drainage Area	**Area (ha)**	**C - 2&5**	**C - 100**		**15mm 3hr**	**2-year**	**100-year**	**15mm 3hr**	**2-year**	**100-year**
A1	4.2	0.20	0.25	39.6	16.9	33.1	75.6	49.5	77.5	221.6
Drainage Area	**Area (ha)**	**C - 2&5**	**C - 100**	**Tc (min)**	**15mm 3hr**	**2-year**	**100-year**	**15mm 3hr**	**2-year**	**100-year**
B1	0.3	0.70	0.79	10.0	45.8	76.8	178.6	32.4	48.4	126.2
B2	0.3	0.89	0.99	10.0	45.8	76.8	178.6	32.2	48.5	125.4
B3	0.3	0.89	0.99	10.0	45.8	76.8	178.6	40.9	61.7	159.4
B4	0.3	0.59	0.74	10.0	45.8	76.8	178.6	30.2	40.6	117.9
B5	0.2	0.59	0.74	10.0	45.8	76.8	178.6	14.7	19.7	57.1
B6	0.1	0.60	0.75	10.0	45.8	76.8	178.6	11.2	15.0	43.7
B7	0.2	0.54	0.66	10.0	45.8	76.8	178.6	20.4	27.9	79.6
B8	0.1	0.64	0.79	10.0	45.8	76.8	178.6	13.6	18.6	52.9
B9	0.2	0.52	0.65	10.0	45.8	76.8	178.6	15.4	20.6	59.9
B10	0.1	0.82	0.91	10.0	45.8	76.8	178.6	15.0	22.5	58.4
B11	0.2	0.59	0.72	10.0	45.8	76.8	178.6	21.6	29.6	84.1
B12	0.2	0.60	0.75	10.0	45.8	76.8	178.6	15.4	20.7	60.2
B13	0.2	0.61	0.75	10.0	45.8	76.8	178.6	18.5	25.3	72.1
B14	0.2	0.60	0.75	10.0	45.8	76.8	178.6	15.6	21.0	60.9
B15	0.2	0.61	0.75	10.0	45.8	76.8	178.6	19.6	26.9	76.5
B16	0.2	0.60	0.75	10.0	45.8	76.8	178.6	15.5	20.8	60.5
B17	0.3	0.68	0.82	10.0	45.8	76.8	178.6	26.3	36.8	102.6
B18	0.2	0.64	0.77	10.0	45.8	76.8	178.6	21.3	29.5	82.8
B19	0.1	0.20	0.25	10.0	45.8	76.8	178.6	3.1	4.2	12.3
B20	0.3	0.22	0.27	10.0	45.8	76.8	178.6	11.5	15.6	44.9
Total	**4.2**							**394.3**	**553.9**	**1537.3**

Storage Required

The tables below determine the volume required in areas B1, B2, B3 and B4 (combined) to store various storm events. Allowable outflows have been determined through an iterative process. The restriction necessary to achieve these outflows is detailed in the Discharge table (Pg 3 of 3). These outflows will be combined with restricted outflow from other areas to determine the flow entering the infiltration trench.

Storage Requirements for Area B1 - B4
5 Year Storm Event

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	141	366	35	331	99
10	104	270	35	235	141
15	84	217	35	182	163
20	70	182	35	147	177
25	61	158	35	123	184
30	54	140	35	105	189
35	49	126	35	91	191
40	44	115	35	80	191
45	41	105	35	70	190
50	38	98	35	63	188
55	35	91	35	56	185
60	33	85	35	50	181
	Maximum Storage Required 5-year			**191**	m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B1 - B4
2 Year Storm Event

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
10	77	227	35	192	115
15	62	183	35	148	133
20	52	154	35	119	143
25	45	134	35	99	148
30	40	119	35	84	150
35	36	107	35	72	151
40	33	97	35	62	150
45	30	90	35	55	147
50	28	83	35	48	144
55	26	78	35	43	140
60	25	73	35	38	136
65	23	69	35	34	131
	Maximum Storage Required 2-year			**151**	m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B1 - B4
100 Year Storm Event

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
40	75	223	36	187	448
45	69	205	36	169	455
50	64	189	36	153	460
55	60	177	36	141	464
60	56	166	36	130	466
65	53	156	36	120	468
70	50	147	36	111	468
75	47	140	36	104	468
80	45	133	36	97	467
85	43	127	36	91	465
90	41	122	36	86	463
95	39	117	36	81	461
	Maximum Storage Required 100-year			**468**	m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B1 - B4
15mm 3hr 10min. Chicago

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	69	147	29	118	36
10	46	98	29	69	41
15	35	75	29	46	41
20	28	61	29	32	38
25	24	51	29	22	34
30	21	45	29	16	28
35	19	40	29	11	23
40	17	36	29	7	17
45	15	33	29	4	10
50	14	30	29	1	3
55	13	28	29	-1	-4
60	12	26	29	-3	-11
	Maximum Storage Required 15mm 3hr			**41**	m^3

*Intensity equation derived from V05 Climate Library

Storage Proposed

Required storage within each section of the site will be achieved through a mix of underground infrastructure and via surface ponding. In a storm event, runoff will back up into the upstream pipes and structures before ponding above each catchbasin. The site has been graded such that runoff ponding on the surface of the lot does not spill over into adjacent areas prior to achieving the required storage.

Surface Storage

B1		B2		B3		B4	
Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)
128.25	0	128.25	0	128.25	0	128.25	0
128.30	1	128.30	1	128.30	1	128.30	0
128.35	4	128.35	5	128.35	7	128.35	3
128.40	12	128.40	17	128.40	24	128.40	9
128.45	28	128.45	40	128.45	56	128.45	22
128.50	44	128.50	76	128.50	102	128.50	43
128.55	75	128.55	118	128.55	160	128.55	71

*Storage volumes have been calculated in Civil 3D

Underground Infrastructure Storage

Structures

	Size (mm)	Depth (m)	Area (m^2)	Volume (m^3)	T/G	Bottom Elev
CB1	600x600	1.98	0.372	1	128.25	126.27
CBMH2	1200	2.15	1.167	3	128.25	126.10
CB3	600x600	1.98	0.372	1	128.25	126.27
CBMH4	1500	2.38	1.824	4	128.25	125.87
MH19	1800	3.19	2.545	8	128.90	125.71

Pipes

	Diameter (mm)	Length (m)	Area (m^2)	Volume (m^3)	Invert Elev	Obvert Elev
CB1-CBMH2	375	86.48	0.110	10	127.00	127.38
CBMH2-CBMH4	450	40.37	0.159	6	126.71	127.16
CB3 - CBMH4	300	33.20	0.071	2	126.69	126.99
CBMH4-MH19	600	46.58	0.283	13	126.48	127.08

*See drawing C102 for structure data

*Sump depths as per OPSD 705.010, 701.010, 701.012

3

Stage Storage Discharge Table B1-B4

This table combines the storage values calculated above and displays them next to discharge values at applicable elevations, taken from the Discharge table on Pg 3 of 3. Storm event elevations have been highlighted where discharge values match the Allowable Outflow values from the tables on Pg 1.

Stage	Storage CB1	Storage CBMH2	Storage CB3	Storage CBMH4	Storage MH19	Storage Pipe CB1 - CBMH2	Storage Pipe CBMH2 - CBMH4	Storage Pipe CB3 - CBMH4	Storage Pipe CB3 - CBMH5	Surface Storage B1	Surface Storage B2	Surface Storage B3	Surface Storage B4	Storage Total (m³)	Discharge (L/s)	
126.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
126.10	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
126.20	0	0	0	1	1	0	0	0	0	0	0	0	0	2		
126.30	0	0	0	1	2	0	0	0	0	0	0	0	0	2		
126.40	0	0	0	1	2	0	0	0	0	0	0	0	0	3		
126.50	0	0	0	1	2	0	0	0	0	0	0	0	0	4		
126.75	0	1	0	2	3	0	0	0	7	0	0	0	0	12	16	
127.00	0	1	0	2	3	0	3	1	13	0	0	0	0	24	20	
127.20	0	1	0	2	4	5	6	2	13	0	0	0	0	35	22	
127.25	0	1	0	3	4	5	6	2	13	0	0	0	0	35	23	
127.40	0	2	0	3	4	10	6	2	13	0	0	0	0	41	25	
127.75	1	2	1	3	5	10	6	2	13	0	0	0	0	43	29	15mm
128.00	1	2	1	4	6	10	6	2	13	0	0	0	0	45	31	
128.25	1	3	1	4	6	10	6	2	13	0	0	0	0	46	33	
128.30	1	3	1	4	7	10	6	2	13	1	1	1	0	49	34	
128.35	1	3	1	4	7	10	6	2	13	4	5	7	3	66	34	
128.40	1	3	1	4	7	10	6	2	13	12	17	24	9	109	34	
128.45	1	3	1	4	7	10	6	2	13	28	40	56	22	193	35	2-Year, 5-Year
128.50	1	3	1	4	7	10	6	2	13	44	76	102	43	312	35	
128.55	1	3	1	4	7	10	6	2	13	75	118	160	71	471	36	100-Year

Discharge

The table below demonstrates the selection of an orifice size that allows discharge values at elevations where the available storage matches or exceeds the Maximum Storage Required for each storm event as calculated on the Storage Required sheet (Pg 1 of 3)

Stage Storage Discharge Table

	Pipe Outlet
Invert Elevation	126.27
Centroid Elevation	126.32
Orifice Width	107 mm
Top of Grate Elevation	128.25
Maximum Ponding	128.55
Orifice Area (m^2)	0.009

For Orifice Flow, C = 0.60

Elevation	Orifice 1		Total Flow	Storage	
	H [m]	Q [l/s]	Q [l/s]	m^3	
126.32	x	x	x	x	
126.50	0.18	10	10	4	
126.75	0.43	16	16	12	
127.00	0.68	20	20	24	
127.20	0.88	22	22	35	
127.25	0.93	23	23	35	
127.40	1.08	25	25	41	
127.75	1.43	29	29	43	15mm
128.00	1.68	31	31	45	
128.25	1.93	33	33	46	
Ponding on Surface					
128.30	1.98	34	34	49	
128.35	2.03	34	34	66	
128.40	2.08	34	34	109	
128.45	2.13	35	35	193	2-Year, 5-Year
128.50	2.18	35	35	312	
128.55	2.23	36	36	471	100-Year

Storage Required

The tables below determine the volume required in areas B5, B6, B7, B8, B9 and B10 (combined) to store various storm events. Allowable outflows have been determined through an iterative process. The restriction necessary to achieve these outflows is detailed in the Discharge table (Pg 3 of 3). These outflows will be combined with restricted outflow from other areas to determine the flow entering the infiltration trench.

Storage Requirements for Area B5 - B10
5 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
30	54	87	19	68	123
35	49	79	19	60	125
40	44	72	19	53	126
45	41	66	19	47	126
50	38	61	19	42	126
55	35	57	19	38	125
60	33	53	19	34	124
65	31	50	19	31	122
70	29	48	19	29	120
75	28	45	19	26	118
80	27	43	19	24	115
85	25	41	19	22	112

Maximum Storage Required 5-year 126 m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B5 - B10
2 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
10	77	124	19	105	63
15	62	100	19	81	73
20	52	84	19	65	78
25	45	73	19	54	81
30	40	65	19	46	82
35	36	58	19	39	83
40	33	53	19	34	82
45	30	49	19	30	81
50	28	45	19	26	79
55	26	42	19	23	77
60	25	40	19	21	75
65	23	37	19	18	72

Maximum Storage Required 2-year 83 m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B5 - B10
100 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
60	56	110	20	90	324
65	53	104	20	84	326
70	50	98	20	78	328
75	47	93	20	73	329
80	45	89	20	69	329
85	43	85	20	65	329
90	41	81	20	61	329
95	39	78	20	58	329
100	38	75	20	55	328
105	36	72	20	52	327
110	35	69	20	49	325
115	34	67	20	47	324

Maximum Storage Required 100-year 329 m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B1 - B4
15mm 3hr 10min. Chicago

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	69	147	19	128	39
10	46	98	19	79	47
15	35	75	19	56	50
20	28	61	19	42	50
25	24	51	19	32	49
30	21	45	19	26	46
35	19	40	19	21	44
40	17	36	19	17	41
45	15	33	19	14	37
50	14	30	19	11	33
55	13	28	19	9	29
60	12	26	19	7	25

Maximum Storage Required 15mm 3hr 50 m^3

*Intensity equation derived from V05 Climate Library

Storage Proposed

Required storage within each section of the site will be achieved through a mix of underground infrastructure and via surface ponding. In a storm event, runoff will back up into the upstream pipes and structures before ponding above each catchbasin. The site has been graded such that runoff ponding on the surface of the lot does not spill over into adjacent areas prior to achieving the required storage.

Surface Storage

B5		B6		B7		B8		B9		B10	
Elevation	Available	Elevation	Available	Elevation (m)	Available	Elevation	Available	Elevation	Available	Elevation (m)	Available
129.20	0	129.20	0	129.20	0	129.20	0	129.20	0	129.20	0
129.25	1	129.25	1	129.25	1	129.25	1	129.25	1	129.25	1
129.30	5	129.30	6	129.30	4	129.30	6	129.30	5	129.30	5
129.35	18	129.35	21	129.35	15	129.35	19	129.35	15	129.35	15
129.38	29	129.38	36	129.38	26	129.38	32	129.40	32	129.40	33
129.40	36	129.40	36	129.40	30	129.40	37	129.45	58	129.45	61
129.45	48	129.45	36	129.45	42	129.45	50	129.50	93	129.50	78
129.50	75	129.50	36	129.50	67	129.50	74	129.55	138	129.55	80

Underground Infrastructure Storage

Structures	Size (mm)	Depth (m)	Area (m²)	Volume (m³)	T/G	Bottom Elev
CB5	600x600	2.770	0.372	1	129.20	126.43
CBMH6	1200	2.770	1.167	3	129.20	126.43
CB7	600x600	2.960	0.372	1	129.20	126.24
CBMH8	1500	3.010	1.824	5	129.20	126.19
CB9	600x600	2.820	0.372	1	129.20	126.08
CBMH10	1500	3.200	1.824	6	129.20	126.00
Pipes	**Diameter**	**Length (m)**	**Area (m²)**	**Volume (m³)**	**Invert Elev**	**Obvert Elev**
CB5-CBMH6	200	35.000	0.031	1	127.03	127.23
CB7-CBMH8	250	35.000	0.049	2	126.84	127.09
CBMH6 - CBMH8	300	35.000	0.071	2	126.73	127.03
CB9- CBMH10	200	21.900	0.031	1	126.68	126.88
CBMH8 - CBMH10	450	59.750	0.159	10	126.49	126.94

*See Drawing C102 for structure data
*Sump depths as per OPSD 705.010, 701.010, 701.012

Stage Storage Discharge Table B5-B10

This table combines the storage values calculated above and displays them next to discharge values at applicable elevations, taken from the Discharge table on Pg 3 of 3. Storm event elevations have been highlighted where discharge values match the Allowable Outflow values from the tables on Pg 1.

Stage	Storage CB5	Storage CBMH6	Storage CB7	Storage CBMH8	Storage CB9	Storage CBMH10	Storage Pipe CB5 - CBMH6	Storage Pipe CB7 - CBMH8	Storage Pipe CBMH6 - CBMH8	Storage Pipe CB9- CBMH10	Storage Pipe CBMH8 - CBMH10	Surface Storage B5	Surface Storage B6	Surface Storage B7	Surface Storage B8	Surface Storage B9	Surface Storage B10	Storage Total	Discharge	
126.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
126.50	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	
126.60	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	
126.70	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	3	0	
126.80	0	0	0	1	0	1	0	0	0	0	5	0	0	0	0	0	0	9	0	
126.90	0	1	0	1	0	2	0	0	1	0	5	0	0	0	0	0	0	11	6	
127.00	0	1	0	1	0	2	0	1	1	1	10	0	0	0	0	0	0	17	7	
127.10	0	1	0	2	0	2	0	1	2	1	10	0	0	0	0	0	0	19	8	
127.20	0	1	0	2	0	2	1	2	2	1	10	0	0	0	0	0	0	21	9	
128.00	1	2	1	3	1	4	1	2	2	1	10	0	0	0	0	0	0	26	14	
129.20	1	3	1	5	1	6	1	2	2	1	10	0	0	0	0	0	0	33	19	
129.25	1	3	1	5	1	6	1	2	2	1	10	1	1	1	1	1	1	39	19	
129.30	1	3	1	5	1	6	1	2	2	1	10	5	6	4	6	5	5	64	19	15mm
129.35	1	3	1	5	1	6	1	2	2	1	10	18	21	15	19	15	15	136	19	2-Year, 5-Year
129.38	1	3	1	5	1	6	1	2	2	1	10	29	36	26	32	32	33	221	20	
129.40	1	3	1	5	1	6	1	2	2	1	10	36	36	30	37	58	61	291	20	
129.45	1	3	1	5	1	6	1	2	2	1	10	48	36	42	50	93	78	380	20	100-Year
129.50	1	3	1	5	1	6	1	2	2	1	10	75	36	67	74	138	80	503	20	

Discharge

The table below demonstrates the selection of an orifice size that allows discharge values at elevations where the available storage matches or exceeds the Maximum Storage Required for each storm event as calculated on the Storage Required sheet (Pg 1 of 3)

Stage Storage Discharge Table

	Pipe Outlet
Invert Elevation	126.56
Centroid Elevation	126.60
Orifice Width/Weir Length	75 mm
Top of Grate Elevation	129.20
Maximum Ponding Elevation	129.50
Orifice Area (m^2)	0.004

For Orifice Flow, C =	0.60

Elevation (from centroid)	Orifice		Total Flow	Storage	
	H [m]	Q [l/s]	Q [l/s]	m^3	
126.60	x	x	x	x	
126.90	0.30	6	6	11	
127.00	0.40	7	7	17	
127.10	0.50	8	8	19	
127.20	0.60	9	9	21	
128.00	1.40	14	14	26	
129.20	2.60	19	19	33	
Ponding on Surface					
129.25	2.65	19	19	39	
129.30	2.70	19	19	64	15mm
129.35	2.75	19	19	136	2-Year, 5-Year
129.38	2.78	20	20	221	
129.40	2.80	20	20	291	
129.45	2.85	20	20	380	100-Year
129.50	2.90	20	20	503	

Storage Required

The tables below determine the volume required in areas B11, B12, B13, B14, B15, B16, B17 and B18 (combined) to store various storm events. Allowable outflows have been determined through an iterative process. The restriction necessary to achieve these outflows is detailed in the Discharge table (Pg 3 of 3). These outflows will be combined with restricted outflow from other areas to determine the flow entering the infiltration trench.

Storage Requirements for Area B11-B18
5 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
60	33	90	16	74	268
65	31	85	16	69	270
70	29	81	16	65	271
75	28	76	16	60	272
80	27	73	16	57	273
85	25	70	16	54	273
90	24	67	16	51	273
95	23	64	16	48	273
100	22	61	16	45	273
105	22	59	16	43	272
110	21	57	16	41	271
115	20	55	16	39	270

Maximum Storage Required 5-year	273	m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B11-B18
2 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
30	40	110	16	94	169
35	36	99	16	83	174
40	33	90	16	74	178
45	30	83	16	67	181
50	28	77	16	61	183
55	26	72	16	56	184
60	25	67	16	51	185
65	23	63	16	47	185
70	22	60	16	44	185
75	21	57	16	41	185
80	20	54	16	38	184
85	19	52	16	36	183

Maximum Storage Required 2-year	185	m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B11-B18
100 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
60	56	188	17	171	615
65	53	177	17	160	623
70	50	167	17	150	631
75	47	159	17	142	638
80	45	151	17	134	644
85	43	146	17	129	656
90	41	138	17	121	656
95	39	124	17	107	608
100	38	119	17	102	613
105	36	110	17	93	588
110	35	106	17	89	590

Maximum Storage Required 100-year	656	m^3

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B11 - B18
15mm 3hr 10min. Chicago

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	69	147	16	131	39
10	46	98	16	82	49
15	35	75	16	59	53
20	28	61	16	45	54
25	24	51	16	35	53
30	21	45	16	29	52
35	19	40	16	24	50
40	17	36	16	20	48
45	15	33	16	17	45
50	14	30	16	14	42
55	13	28	16	12	39

Maximum Storage Required 15mm 3hr	54	m^3

*Intensity equation derived from V05 Climate Library

Storage Proposed

Required storage within each section of the site will be achieved through a mix of underground infrastructure and via surface ponding. In a storm event, runoff will back up into the upstream pipes and structures before ponding above each catchbasin. The site has been graded such that runoff ponding on the surface of the lot does not spill over into adjacent areas prior to achieving the required storage.

Surface Storage

B11		B12		B13		B14	
Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)
127.90	0	127.90	0	127.90	0	127.90	0
127.95	1	127.95	1	127.95	2	127.95	2
128.00	11	128.00	12	128.00	15	128.00	16
128.05	24	128.05	28	128.05	25	128.05	24
128.10	37	128.10	39	128.10	27	128.10	27
128.15	53	128.15	59	128.15	30	128.15	28
128.20	73	128.20	86	128.20	32	128.20	29
B15		**B16**		**B17**		**B18**	
Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)	Elevation (m)	Available Storage (m^3)
127.90	0	127.90	0	127.90	0	127.90	0
127.95	2	127.95	2	127.95	1	127.95	1
128.00	15	128.00	15	128.00	8	128.00	9
128.05	22	128.05	23	128.05	20	128.05	21
128.10	26	128.10	26	128.10	27	128.10	33
128.15	27	128.15	27	128.15	35	128.15	40
128.20	32	128.20	28	128.20	48	128.20	56

Underground Infrastructure Storage

STRUCTURES

	Size (mm)	Depth (m)	Area (m^2)	Volume (m^3)	T/G	Bottom Elev
CB11	600x600	1.736	0.372	1	127.90	126.16
CBMH12	1200	1.623	1.167	2	127.90	126.28
CB13	600x600	1.686	0.372	1	127.90	126.21
CBMH14	1500	1.768	1.824	3	127.90	126.13
CB15	600x600	1.456	0.372	1	127.90	126.14
CBMH16	1500	1.470	1.824	3	127.90	125.99
CB17	600x600	1.646	0.372	1	127.90	125.95
CBMH18	1500	2.058	1.824	4	127.90	125.84

PIPES

	Diameter	Length (m)	Area (m^2)	Volume (m^3)	Invert Elev	Obvert Elev
CB11-CBMH12	300	45.000	0.071	3	126.74	127.04
CB13-CBMH14	250	45.000	0.049	2	126.81	127.06
CBMH12 - CBMH14	375	35.000	0.110	4	126.57	126.95
CB15- CBMH16	250	45.000	0.049	2	126.74	126.99
CBMH14 - CBMH16	450	35.000	0.159	6	126.43	126.88
CB17- CBMH18	250	45.000	0.049	2	126.55	126.80
CBMH16- CBMH18	525	35.000	0.216	8	126.29	126.82
Total Underground Infrastructure	**41**					

Stage Storage Discharge Table B11-B18

This table combines the storage values calculated above and displays them next to discharge values at applicable elevations, taken from the Discharge table on Pg 3 of 3. Storm event elevations have been highlighted where discharge values match the Allowable Outflow values from the tables on Pg 1.

Stage	Storage CB11	Storage CBMH12	Storage CB13	Storage CBMH14	Storage C15	Storage CBMH16	Storage CB17	Storage CBMH18	Storage Pipe CB11 - CBMH12	Storage Pipe CB13-CBMH14	Storage Pipe CBMH12-CBMH14	Storage Pipe CB15-CBMH16	Storage Pipe CBMH14-CBMH16	Storage Pipe CB17-CBMH18	Storage Pipe CBMH16-CBMH18	Storage Pipe CBMH18-MH21
125.85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
126.17	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
126.40	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
126.65	0	0	0	1	0	1	0	1	0	0	2	0	0	0	4	4
126.90	0	1	0	1	0	2	0	2	2	0	4	1	6	2	8	8
127.15	0	1	0	2	0	2	0	2	3	2	4	2	6	2	8	8
127.40	0	1	0	2	0	3	1	3	3	2	4	2	6	2	8	8
127.65	1	2	1	3	1	3	1	3	3	2	4	2	6	2	8	8
127.90	1	2	1	3	1	3	1	4	3	2	4	2	6	2	8	8
127.95	1	2	1	3	1	3	1	4	3	2	4	2	6	2	8	8
128.00	1	2	1	3	1	3	1	4	3	2	4	2	6	2	8	8
128.05	1	2	1	3	1	3	1	4	3	2	4	2	6	2	8	8
128.10	1	2	1	3	1	3	1	4	3	2	4	2	6	2	8	8
128.15	1	2	1	3	1	3	1	4	3	2	4	2	6	2	8	8
128.20	1	2	1	3	1	3	1	4	3	2	4	2	6	2	8	8

Stage	Surface Storage B11	Surface Storage B12	Surface Storage B13	Surface Storage B14	Surface Storage B15	Surface Storage B16	Surface Storage B17	Surface Storage B18	Additional Surface Storage B11-B18	Surface Storage Total	**Storage Total**	**Discharge**	
125.85	0	0	0	0	0	0	0	0	0	0	0		
126.17	0	0	0	0	0	0	0	0	0	0	1		
126.40	0	0	0	0	0	0	0	0	0	0	3	6	
126.65	0	0	0	0	0	0	0	0	0	0	14	8	
126.90	0	0	0	0	0	0	0	0	0	0	36	10	
127.15	0	0	0	0	0	0	0	0	0	0	43	12	
127.40	0	0	0	0	0	0	0	0	0	0	45	13	
127.65	0	0	0	0	0	0	0	0	0	0	47	14	
127.90	0	0	0	0	0	0	0	0	0	0	49	15	
127.95	1	1	2	2	2	2	1	1	0	12	61	16	15mm
128.00	11	12	15	16	15	15	8	9	0	101	150	16	
128.05	24	28	25	24	22	23	20	21	0	187	236	16	2-Year
128.10	37	39	27	27	26	26	27	33	62	304	353	16	5-Year
128.15	53	59	30	28	27	27	35	40	176	475	524	17	
128.20	73	86	32	29	32	28	48	56	493	877	926	17	100-Year

Discharge

The table below demonstrates the selection of an orifice size that allows discharge values at elevations where the available storage matches or exceeds the Maximum Storage Required for each storm event as calculated on the Storage Required sheet (Pg 1 of 3)

Stage Storage Discharge Table

	Pipe Outlet
Invert Elevation	126.13
Centroid Elevation	126.17
Orifice Width/Weir Length	75 mm
Top of Grate Elevation	127.90
Maximum Ponding Elevation	128.20
Orifice Area (m^2)	0.004

For Orifice Flow, C = 0.60

Elevation (from centroid)	Orifice		Total Flow	Storage	
	H [m]	Q [l/s]	Q [l/s]	m^3	
126.17	x	x	x	1	
126.40	0.23	6	6	3	
126.65	0.48	8	8	14	
126.90	0.73	10	10	36	
127.15	0.98	12	12	43	
127.40	1.23	13	13	45	
127.65	1.48	14	14	47	
127.90	1.73	15	15	49	
Ponding on Surface					
127.95	1.78	16	16	61	15mm
128.00	1.83	16	16	150	
128.05	1.88	16	16	236	2-Year
128.10	1.93	16	16	353	5-Year
128.15	1.98	17	17	524	
128.20	2.03	17	17	926	100-Year

Runoff Area B19-20			
5 Year Storm Event			
Tc (min)	I (mm/hr)	Runoff (L/s)	Runoff (L/s/ha)
5	141	37	84
10	104	27	62
15	84	22	50
20	70	18	42
25	61	16	36
30	54	14	32
35	49	13	29
40	44	11	26
45	41	11	24
50	38	10	22
55	35	9	21
60	33	9	20

*Intensity equation from City of Ottawa Sewer Design Guidelines

Runoff Area B19-20			
2 Year Storm Event			
Tc (min)	I (mm/hr)	Runoff (L/s)	Runoff (L/s/ha)
5	104	27	62
10	77	20	46
15	62	16	37
20	52	13	31
25	45	12	27
30	40	10	24
35	36	9	22
40	33	9	20
45	30	8	18
50	28	7	17
55	26	7	16
60	25	6	15

*Intensity equation from City of Ottawa Sewer Design Guidelines

Runoff Area B19-20			
100 Year Storm Event			
Tc (min)	I (mm/hr)	Runoff (L/s)	Runoff (L/s/ha)
5	243	63	145
10	179	46	106
15	143	37	85
20	120	31	72
25	104	27	62
30	92	24	55
35	83	21	49
40	75	19	45
45	69	18	41
50	64	17	38
55	60	15	36

*Intensity equation from City of Ottawa Sewer Design Guidelines

Runoff Area B19-20			
15mm 3hr 10min. Chicago			
Tc (min)	I (mm/hr)	Runoff (L/s)	Runoff (L/s/ha)
5	69	18	41
10	46	12	27
15	35	9	21
20	28	7	17
25	24	6	14
30	21	5	12
35	19	5	11
40	17	4	10
45	15	4	9
50	14	4	8
55	13	3	8

*Intensity equation derived from V05 Climate Library

Storage Required

The tables on this sheet compile outflow values from the 3 restricted points within the stormwater network. Allowable Outflow values from the tables for each site region are summed and used as the Runoff value in the Storage Requirements table for the Infiltration Trench. Outflow value used from each table is highlighted in grey. The Allowable Outflow from the Infiltration Trench for each storm event is a combination of the allowable discharge rates for each storm based on the Feedmill Creek Stormwater Management Criteria and the infiltration rate for the infiltration trench as calculated in the Infiltration Trench table on the following page.

Storage Requirements for Infiltration Trench
100 Year Storm Event

Tc (min)	Runoff** (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
100	73	38	35	212
150	73	38	35	318
200	73	38	35	424
250	73	38	35	530
300	73	38	35	636
350	73	38	35	742
400	73	38	35	848
405	73	38	35	859
455	71	38	33	900
505	68	38	30	917
555	65	38	27	900
605	61	38	24	864
655	59	38	21	826
705	56	38	19	787
755	54	38	16	746
805	52	38	15	704
855	51	38	13	662
905	49	38	11	618
955	48	38	10	573
1005	46	38	9	528
1055	45	38	8	482
1105	44	38	7	436
1155	43	38	6	388
1205	43	38	5	361
1210	42	38	5	352
1215	42	38	5	343
1220	42	38	5	334
1225	42	38	4	325
1230	42	38	4	316
1280	41	38	3	226
1330	39	38	2	135
1380	38	38	1	43
1430	37	38	-1	-49
1480	36	38	-2	-142

Maximum Storage Required 100-year	917	m^3

**Runoff a total of highlighted outflow for Areas B1-B4, B5-B10, B11-B18

Storage Requirements for Area B1 - B4
100 Year Storm Event

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
100	38	112	36	76	458
150	28	82	36	46	412
200	22	65	36	29	349
250	18	54	36	18	277
300	16	47	36	11	199
350	14	42	36	6	117
400	13	37	36	1	32
405	12	37	36	1	23
455	11	34	36	-2	-65
505	10	31	36	-5	-154
555	10	29	36	-7	-245
605	9	27	36	-9	-338
655	8	25	36	-11	-431
705	8	24	36	-12	-526
755	8	22	36	-14	-621
805	7	21	36	-15	-717
855	7	20	36	-16	-813
905	6	19	36	-17	-910
955	6	18	36	-18	-1008
1005	6	18	36	-18	-1106
1055	6	17	36	-19	-1204
1105	6	16	36	-20	-1303
1155	5	16	36	-20	-1402
1205	5	15	36	-21	-1501
1210	5	15	36	-21	-1511
1215	5	15	36	-21	-1521
1220	5	15	36	-21	-1531
1225	5	15	36	-21	-1541
1230	5	15	36	-21	-1551
1280	5	15	36	-21	-1651
1330	5	14	36	-22	-1751
1380	5	14	36	-22	-1852
1430	4	13	36	-23	-1952
1480	4	13	36	-23	-2053

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B5 - B10
100 Year Storm Event

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
100	38	75	20	55	328
150	28	54	20	34	309
200	22	43	20	23	279
250	18	36	20	16	243
300	16	31	20	11	203
350	14	28	20	8	160
400	13	25	20	5	116
405	12	25	20	5	111
455	11	22	20	2	64
505	10	21	20	1	17
555	10	19	20	-1	-32
605	9	18	20	-2	-82
655	8	17	20	-3	-132
705	8	16	20	-4	-183
755	8	15	20	-5	-234
805	7	14	20	-6	-286
855	7	13	20	-7	-339
905	6	13	20	-7	-391
955	6	12	20	-8	-444
1005	6	12	20	-8	-498
1055	6	11	20	-9	-551
1105	6	11	20	-9	-605
1155	5	10	20	-10	-659
1205	5	10	20	-10	-714
1210	5	10	20	-10	-719
1215	5	10	20	-10	-725
1220	5	10	20	-10	-730
1225	5	10	20	-10	-735
1230	5	10	20	-10	-741
1280	5	10	20	-10	-796
1330	5	9	20	-11	-850
1380	5	9	20	-11	-905
1430	4	9	20	-11	-960
1480	4	9	20	-11	-1015

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B11-B18
100 Year Storm Event

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
100	38	127	17	110	662
150	28	93	17	76	682
200	22	74	17	57	682
250	18	62	17	45	672
300	16	53	17	36	655
350	14	47	17	30	633
400	13	42	17	25	608
405	12	42	17	25	605
455	11	38	17	21	577
505	10	35	17	18	547
555	10	32	17	15	515
605	9	30	17	13	482
655	8	28	17	11	447
705	8	27	17	10	412
755	8	25	17	8	375
805	7	24	17	7	338
855	7	23	17	6	300
905	6	22	17	5	262
955	6	21	17	4	223
1005	6	20	17	3	183
1055	6	19	17	2	143
1105	6	19	17	2	102
1155	5	18	17	1	61
1205	5	17	17	0	20
1210	5	17	17	0	16
1215	5	17	17	0	12
1220	5	17	17	0	8
1225	5	17	17	0	3
1230	5	17	17	0	-1
1280	5	16	17	-1	-43
1330	5	16	17	-1	-85
1380	5	15	17	-2	-127
1430	4	15	17	-2	-170
1480	4	15	17	-2	-212

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Infiltration Trench
2 Year Storm Event

Tc (min)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	70	17	53	16
10	70	17	53	32
15	70	17	53	47
20	70	17	53	63
25	70	17	53	79
30	70	17	53	95
35	70	17	53	110
40	70	17	53	126
90	70	17	53	284
100	70	17	53	316
110	70	17	53	347
115	70	17	53	363
120	70	17	53	379
150	67	17	49	444
155	66	17	49	455
160	65	17	48	457
165	64	17	46	460
225	54	17	36	488
230	53	17	35	490
235	52	17	35	492
300	46	17	28	513
320	44	17	27	518
330	44	17	26	521
340	43	17	26	524
345	43	17	25	525
350	42	17	25	526
355	42	17	25	527
360	42	17	24	528
365	42	17	24	530
370	41	17	24	531

Maximum Storage Required 2-year	528	m^3

**Runoff a total of highlighted outflow for Areas B1-B4, B5-B10, B11-B18

Storage Requirements for Area B1 - B4
2 Year Storm Event

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	104	269	35	234	70
10	77	199	35	164	98
15	62	160	35	125	113
20	52	135	35	100	120
25	45	117	35	82	123
30	40	104	35	69	124
35	36	93	35	58	123
40	33	85	35	50	120
90	18	47	35	12	65
100	17	43	35	8	51
110	16	40	35	5	35
115	15	39	35	4	28
120	15	38	35	3	20
150	12	32	35	-3	-29
155	12	31	35	-4	-38
160	12	30	35	-5	-46
165	11	29	35	-6	-55
225	9	23	35	-12	-160
230	9	23	35	-12	-169
235	9	22	35	-13	-178
300	7	18	35	-17	-299
320	7	17	35	-18	-336
330	7	17	35	-18	-355
340	6	17	35	-18	-374
345	6	16	35	-19	-383
350	6	16	35	-19	-393
355	6	16	35	-19	-402
360	6	16	35	-19	-412
365	6	16	35	-19	-421
370	6	16	35	-19	-431

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B5 - B10
2 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	104	168	19	149	45
10	77	124	19	105	63
15	62	100	19	81	73
20	52	84	19	65	78
25	45	73	19	54	81
30	40	65	19	46	82
35	36	58	19	39	83
40	33	53	19	34	82
90	18	29	19	10	56
100	17	27	19	8	49
110	16	25	19	6	41
115	15	24	19	5	37
120	15	24	19	5	33
150	12	20	19	1	7
155	12	19	19	0	3
160	12	19	19	0	-1
165	11	18	19	-1	-6
225	9	14	19	-5	-62
230	9	14	19	-5	-66
235	9	14	19	-5	-71
300	7	11	19	-8	-135
320	7	11	19	-8	-155
330	7	11	19	-8	-165
340	6	10	19	-9	-175
345	6	10	19	-9	-180
350	6	10	19	-9	-185
355	6	10	19	-9	-191
360	6	10	19	-9	-196
365	6	10	19	-9	-201
370	6	10	19	-9	-206

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Area B11-B18
2 Year Storm Event

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	104	284	16	268	80
10	77	211	16	195	117
15	62	169	16	153	138
20	52	143	16	127	152
25	45	124	16	108	162
30	40	110	16	94	169
35	36	99	16	83	174
40	33	90	16	74	178
90	18	50	16	34	182
100	17	46	16	30	179
110	16	43	16	27	176
115	15	41	16	25	174
120	15	40	16	24	172
150	12	34	16	18	158
155	12	33	16	17	156
160	12	32	16	16	153
165	11	31	16	15	150
225	9	24	16	8	114
230	9	24	16	8	111
235	9	24	16	8	107
300	7	19	16	3	62
320	7	18	16	2	48
330	7	18	16	2	41
340	6	18	16	2	33
345	6	17	16	1	29
350	6	17	16	1	26
355	6	17	16	1	22
360	6	17	16	1	18
365	6	17	16	1	14
370	6	16	16	0	11

*Intensity equation from City of Ottawa Sewer Design Guidelines

Storage Requirements for Infiltration Trench
15mm 3hr 10min. Chicago

Tc (min)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	64	7	57	17
10	64	7	57	34
20	64	7	57	68
30	64	7	57	102
40	64	7	57	136
50	64	7	57	170
60	64	7	57	204
65	63	7	56	219
70	62	7	55	231
75	59	7	51	231
80	57	7	49	236
100	50	7	42	255
120	45	7	38	272
150	40	7	33	296
155	39	7	32	294
160	38	7	31	294
165	37	7	30	294
170	36	7	29	294
175	35	7	28	293
200	32	7	24	291
300	23	7	15	274
400	18	7	10	249
450	16	7	9	235
460	16	7	8	233
470	16	7	8	230
480	15	7	8	227
490	15	7	8	224
500	15	7	7	221
510	15	7	7	218

Maximum Storage Required 15mm	296	m^3

**Runoff a total of highlighted outflow for Areas B1-B4, B5-B10, B11-B18

Storage Requirements for Area B1 - B4
15mm 3hr 10min. Chicago

Tc (min)	I* (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	69	179	29	150	45
10	46	119	29	90	54
20	28	74	29	45	53
30	21	54	29	25	46
40	17	43	29	14	35
50	14	36	29	7	22
60	12	32	29	3	9
65	11	30	29	1	2
70	11	28	29	-1	-5
75	10	26	29	-3	-12
80	10	25	29	-4	-19
100	8	21	29	-8	-49
120	7	18	29	-11	-79
150	6	15	29	-14	-126
155	6	15	29	-14	-134
160	5	14	29	-15	-142
165	5	14	29	-15	-150
170	5	14	29	-15	-158
175	5	13	29	-16	-166
200	5	12	29	-17	-206
300	3	8	29	-21	-370
400	3	7	29	-22	-537
450	2	6	29	-23	-621
460	2	6	29	-23	-637
470	2	6	29	-23	-654
480	2	6	29	-23	-671
490	2	6	29	-23	-688
500	2	6	29	-23	-705
510	2	5	29	-24	-722

*Intensity equation from V05 Climate Library

Storage Requirements for Area B5 - B10
15mm 3hr 10min. Chicago

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	69	111	19	92	28
10	46	74	19	55	33
20	28	46	19	27	32
30	21	34	19	15	27
40	17	27	19	8	20
50	14	23	19	4	11
60	12	20	19	1	2
65	11	18	19	-1	-2
70	11	17	19	-2	-7
75	10	16	19	-3	-11
80	10	16	19	-3	-16
100	8	13	19	-6	-36
120	7	11	19	-8	-56
150	6	9	19	-10	-87
155	6	9	19	-10	-92
160	5	9	19	-10	-97
165	5	9	19	-10	-103
170	5	8	19	-11	-108
175	5	8	19	-11	-113
200	5	7	19	-12	-140
300	3	5	19	-14	-247
400	3	4	19	-15	-357
450	2	4	19	-15	-412
460	2	4	19	-15	-423
470	2	4	19	-15	-434
480	2	4	19	-15	-445
490	2	3	19	-16	-456
500	2	3	19	-16	-467
510	2	3	19	-16	-478

*Intensity equation from V05 Climate Library

Storage Requirements for Area B11-B18
15mm 3hr 10min. Chicago

Tc (min)	I (mm/hr)	Runoff (L/s)	Allowable Outflow (L/s)	Runoff to be Stored (L/s)	Storage Required (m^3)
5	69	189	16	173	52
10	46	126	16	110	66
20	28	78	16	62	74
30	21	57	16	41	75
40	17	46	16	30	72
50	14	39	16	23	68
60	12	33	16	17	62
65	11	31	16	15	60
70	11	29	16	13	57
75	10	28	16	12	53
80	10	26	16	10	50
100	8	22	16	6	36
120	7	19	16	3	22
150	6	16	16	0	-2
155	6	15	16	-1	-6
160	5	15	16	-1	-10
165	5	15	16	-1	-14
170	5	14	16	-2	-18
175	5	14	16	-2	-22
200	5	12	16	-4	-42
300	3	9	16	-7	-128
400	3	7	16	-9	-216
450	2	6	16	-10	-260
460	2	6	16	-10	-269
470	2	6	16	-10	-278
480	2	6	16	-10	-287
490	2	6	16	-10	-296
500	2	6	16	-10	-305
510	2	6	16	-10	-314

*Intensity equation from V05 Climate Library

Storage Proposed

The Infiltration Trench Storage table calculates the storage proposed within the infiltration trench at various elevations and highlights the design ponding elevation for each storm event as per the Maximum Storage Required values from the previous page. The Infiltration Trench Parameters table lists the trench dimensions and calculates the volume of storage proposed below the outlet using a typical porosity value for the material selected, as well as calculates the design infiltration rate based on geotech recommendations including a safety factor. The Outflow to Trench table is a summary of values from the tables on the previous page.

Infiltration Trench Storage		
Elevation (m)	Available Storage (m^3)	
124.25	0	
124.35	36	
124.45	71	
124.55	107	
124.65	142	
124.75	178	
124.85	213	
124.95	249	
125.05	285	
125.09	299	15mm
125.15	320	
125.25	356	
125.35	391	
125.45	427	
125.55	462	
125.65	498	
125.714	521	
125.74	530	2-Year
125.75	534	
125.85	569	
125.95	605	
126.05	640	
126.15	676	
126.25	711	
126.35	747	
126.45	782	
126.55	818	
126.65	854	
126.75	889	
126.85	925	100-Year

Infiltration Trench Parameters	
Length (m)	114.0
Width (m)	7.8
Area (m^2)	889.2
Depth Below Outlet (m)	1.4
Porosity	0.4
Permanent Pool Volume	**498.0**
Infiltration Rate (m/hr)	0.075
Safety Factor	2.5
Infiltration Outflow (L/s)	**7.4**

Outflow to Trench				
		15mm 3hr	100-Year	2-Year
Areas	Structure	Outflow (L/s)	Outflow (L/s)	Outflow (L/s)
B1 - B4	MH19	29	35	35
B5 - B10	CBMH10	19	20	19
B11 - B18	CBMH18	16	17	16
Flow to Infiltration Trench (L/s)		**64**	**71**	**70**

Discharge

The table below demonstrates the selection of an orifice size that allows discharge values at elevations where the available storage matches or exceeds the Maximum Storage Required for each storm event as calculated on the Storage Required sheet (Pg 1 of 3).

Stage Storage Discharge Table

		Pipe Outlet
Invert Elevation		125.65
Centroid Elevation		125.71
Orifice Width		120 mm
Orifice Area (m^2)		0.011
C		0.600

Elevation (from centroid)	Orifice H [m]	Q [l/s]	Total Flow Q [l/s]	Q(l/s/ha)	Storage m^3	
125.714	0.00	2	2	0.51	521	
125.74	0.03	5	5	1	530	2-Year
125.75	0.04	6	6	2	534	
125.85	0.14	11	11	3	569	
125.95	0.24	15	15	4	605	
126.05	0.34	18	18	5	640	
126.15	0.44	20	20	5	676	
126.25	0.54	22	22	6	711	
126.35	0.64	24	24	6	747	
126.45	0.74	26	26	7	782	
126.55	0.84	28	28	7	818	
126.65	0.94	29	29	8	854	
126.75	1.04	31	31	8	889	
126.85	1.14	32	32	8	925	100-Year

The table below calculates a total runoff volume from a 10mm rainfall to demonstrate that available volume within the infiltration trench, below the outlet exceeds the 10mm rainfall volume.

	Area (ha)	C	10mm Rainfall Volume (m^3)
B1	3221	**0.70**	**23**
B2	2552	**0.89**	**23**
B3	3240	**0.89**	**29**
B4	3212	**0.59**	**19**
B5	1564	**0.59**	**9**
B6	1173	**0.60**	**7**
B7	2416	**0.54**	**13**
B8	1355	**0.64**	**9**
B9	1859	**0.52**	**10**
B10	1292	**0.82**	**11**
B11	2346	**0.59**	**14**
B12	1616	**0.60**	**10**
B13	1936	**0.61**	**12**
B14	1637	**0.60**	**10**
B15	2054	**0.61**	**13**
B16	1624	**0.60**	**10**
B17	2535	**0.68**	**17**
B18	2169	**0.64**	**14**
B19	989	**0.20**	**2**
B20	3349	**0.22**	**7**
Total	42140	**0.00**	**259**
Volume Available in Infiltration Trench Below Outlet Pipe (m^3)			**498**

Drawdown Time Equation (Orifice)---->

$$t = \frac{0.66\ C_2\ h^{1.5} + 2\ C_3\ h^{0.5}}{2.75\ A_o}$$

Equation 4.11 (MECP SWM Planning Design Manual, 2003)

where,
- t = Drawdown time in seconds
- C_2 = Slope coefficient from the area-depth linear regression
- C_3 = Intercept from the area-depth linear regression
- h = Maximum water elevation above the orifice (m)
- A_o = Cross-sectional area of the orifice (m^2)

The relationship between A and h using Linear Regression (i.e., $A = C_2 h + C_3$)

Drawdown Time Equation (Infiltration Trench)---->

$$A = \frac{1000*V}{P*n*t} \qquad t = \frac{1000*V}{A} / P*n$$

Equation 4.3 (MECP SWM Planning Design Manual, 2003)

where,
- A = bottom area of the trench (m²)
- V = runoff volume to be infiltrated
- P = percolation rate of surrounding native soil (mm/h)
- n = porosity of the storage media
- t = retention time

Allowable Soakaway Pit Depth>

$$d = \frac{P*t}{1000}$$

- d = maximum allowable depth of the soakaway pit (m)
- P = percolation rate (mm/h)
- t = drawdown time (h)

Equation 4.2 (MECP SWM Planning Design Manual, 2003)

Orifice Details:

Orifice Diameter =	120 mm
Orifice Invert Elevation =	125.65 m

Active Storage Details:

Active Storage Elevation (m)	Max Water Elevation Above Orifice (m)	Surface area of the Trench (m^2)	
125.65	0.00	889.20	
125.74	0.09	889.20	2-Year
126.85	1.20	889.20	100-Year

Drawdown Below Outlet (Infiltration only):	Below Outlet - Full	15mm 3hr Event
(A) Bottom Area of Trench (m²)	889.2	
(V) Runoff Volume (mm/h)	498	299
(P) Percolation Rate (mm/h)	30	
(n) Porosity	0.4	
Drawdown (hrs) (Infiltration only)	**47 hrs**	**28 hrs**

Drawdown Time Results (Outlet Only):	2-Year Storm Event	100-Year Storm Event
Orifices	120 mm	120 mm
Slope (C_2) =	0	0
Intercept (C_3) =	889	889
Maximum Water Elevation Above Orifice (h) =	0.09 m	1.20 m
Therefore, A =	889	889
Cross-sectional area of the orifice (A_o) =	0.011 m2	0.011 m2
Drawdown time	17,154 s	62,638 s
Drawdown Time (Outlet Only):	**5 hrs**	**18 hrs**

Allowable Depth:

(P) Percolation Rate (mm/h)	30
(t) Drawdown Time (h)	47
Allowable Depth (m)	**1.4**
Actual Depth (Below Outlet)	1.4
Actual Depth (Above Outlet)	1.2
Total Depth (m)	**2.6**

CP-17-0603 - 2113 Carp Road - Runoff Calculations

Imperviousness Calculation for Contributing Flows:

Contributing Drainage Areas: B1-B18

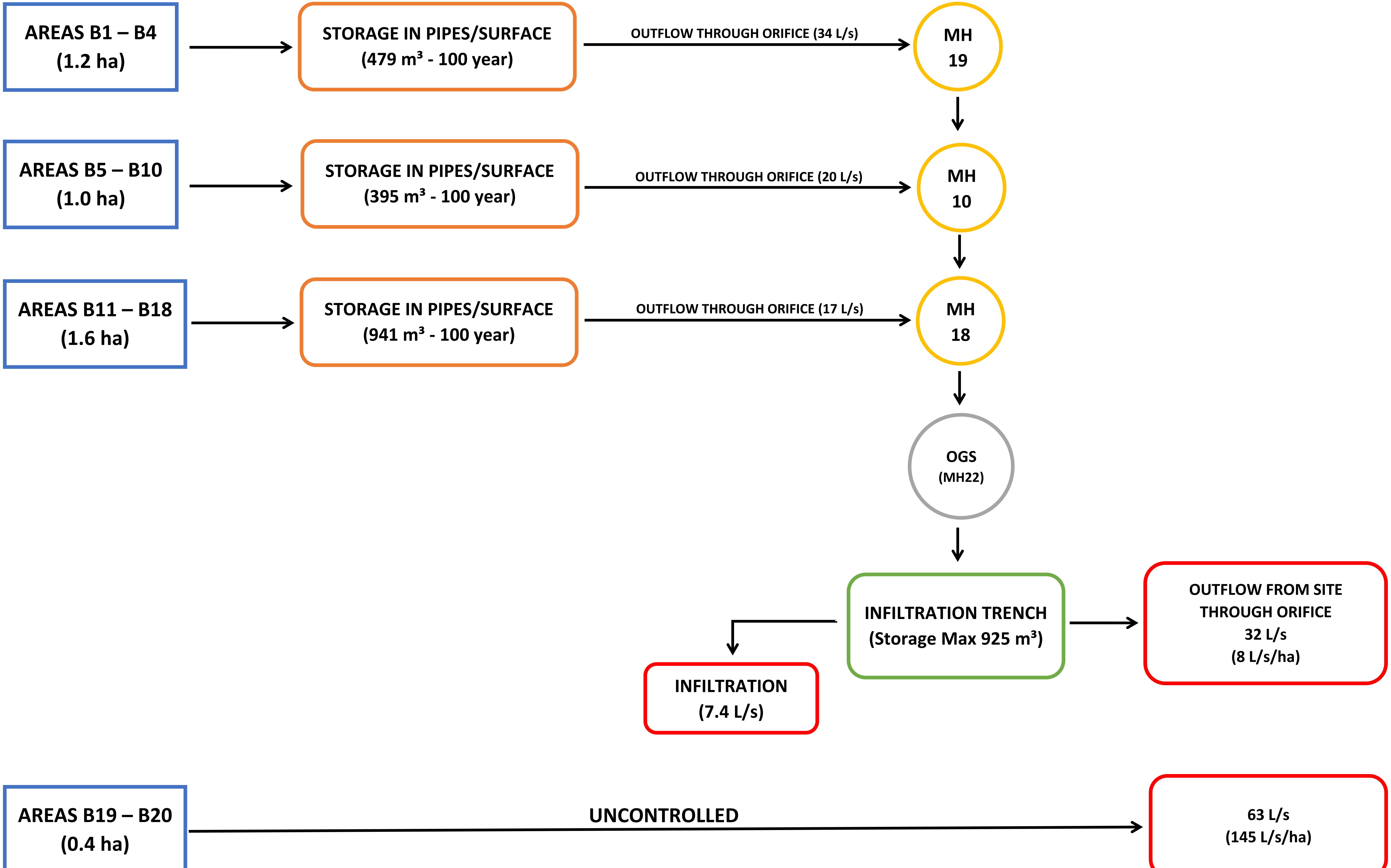
Equation;

$$\text{Impervious (\%)} = \frac{(C-0.2)}{0.7}$$

where; C= calculated runoff coefficient

Area ID	C	Imperviouness (%)	A (m^2)	A (%) of Contributing
B1	0.71	73%	0.32	8%
B2	0.89	99%	0.26	7%
B3	0.89	99%	0.32	9%
B4	0.89	98%	0.32	9%
B5	0.88	97%	0.16	4%
B6	0.90	100%	0.12	3%
B7	0.75	78%	0.24	6%
B8	0.90	100%	0.14	4%
B9	0.76	80%	0.19	5%
B10	0.82	88%	0.13	3%
B11	0.81	88%	0.23	6%
B12	0.90	100%	0.16	4%
B13	0.86	94%	0.19	5%
B14	0.90	100%	0.16	4%
B15	0.85	93%	0.21	5%
B16	0.90	100%	0.16	4%
B17	0.90	100%	0.25	7%
B18	0.85	93%	0.22	6%
		$A_{c\ total}$=	3.78	

Weighted Contributing Imperviousness = 93%


AREAS B1 – B4
(1.2 ha)
STORAGE IN PIPES/SURFACE
(479 m³ - 100 year)
OUTFLOW THROUGH ORIFICE (34 L/s)
MH
19
AREAS B5 – B10
(1.0 ha)
STORAGE IN PIPES/SURFACE
(395 m³ - 100 year)
OUTFLOW THROUGH ORIFICE (20 L/s)
MH
10
AREAS B11 – B18
(1.6 ha)
STORAGE IN PIPES/SURFACE
(941 m³ - 100 year)
OUTFLOW THROUGH ORIFICE (17 L/s)
MH
18
OGS
(MH22)
INFILTRATION TRENCH
(Storage Max 925 m³)
OUTFLOW FROM SITE
THROUGH ORIFICE
32 L/s
(8 L/s/ha)
INFILTRATION
(7.4 L/s)
AREAS B19 – B20
(0.4 ha)
UNCONTROLLED
63 L/s
(145 L/s/ha)

STORM SEWER DESIGN SHEET

PROJECT: 2113 CARP ROAD - CAR STAR
LOCATION: OTTAWA, ONTARIO
CLIENT: BBS CONSTRUCTION LTD.

McINTOSH PERRY

LOCATION				CONTRIBUTING AREA (ha)				RATIONAL DESIGN FLOW											SEWER DATA								
1	2	3	4	5 6 7	8 9 10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
STREET	AREA ID	FROM MH	TO MH	AREA	C-VALUE	INDIV AC	CUMUL AC	INLET (min)	TIME IN PIPE	TOTAL (min)	i (2) (mm/hr)	i (5) (mm/hr)	i (100) (mm/hr)	2yr PEAK FLOW (L/s)	5yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	CAPACITY (L/s)	LENGTH (m)	PIPE SIZE (mm) DIA	W	H	SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr) (L/s)	(%)
	B1	CB1	CBMH2	0.32	0.70	0.22	0.22	10.00	1.46	11.46	76.81	104.19	178.56	47.38	64.27			64.27	112.84	86.48	375			0.38	0.990	48.57	43.04%
	B2	CBMH2	CBMH4	0.26	0.89	0.23	0.45	11.46	0.83	12.29	71.63	97.08	166.26	89.44	121.22			121.22	133.02	40.37	450			0.20	0.810	11.80	8.87%
	B3	CB3	CBMH4	0.32	0.89	0.29	0.29	10.00	0.40	10.40	76.81	104.19	178.56	61.68	83.67			83.67	100.88	33.20	300			1.00	1.383	17.21	17.06%
	B4	CBMH4	MH19	0.32	0.59	0.19	0.93	12.29	0.79	13.08	69.01	93.49	160.05	177.95	241.06			241.06	286.47	46.58	600			0.20	0.982	45.41	15.85%
	B5	CB5	CBMH6	0.16	0.59	0.09	0.09	10.00	0.55	10.55	76.81	104.19	178.56	19.72	26.75			26.75	34.22	35.00	200			1.00	1.055	7.46	21.81%
	B6	CBMH6	CBMH8	0.12	0.60	0.07	0.16	10.55	0.71	11.27	74.75	101.36	173.66	33.81	45.86			45.86	59.68	35.00	300			0.35	0.818	13.83	23.17%
	B7	CB7	CBMH8	0.24	0.54	0.13	0.13	10.00	0.48	10.48	76.81	104.19	178.56	27.86	37.79			37.79	62.04	35.00	250			1.00	1.224	24.24	39.08%
	B8	CBMH8	CBMH10	0.14	0.64	0.09	0.38	11.27	1.23	12.50	72.26	97.95	167.76	76.33	103.46			103.46	133.02	59.75	450			0.20	0.810	29.56	22.22%
	B9	CB9	CBMH10	0.19	0.52	0.10	0.10	10.00	0.35	10.35	76.81	104.19	178.56	20.64	28.00			28.00	34.22	21.91	200			1.00	1.055	6.21	18.16%
	B10	CBMH10	MH20	0.13	0.82	0.11	0.58	12.50	0.40	12.90	68.39	92.63	158.57	110.68	149.92		19.00	149.92	200.65	21.65	525			0.20	0.898	50.73	25.28%
	B11	CB11	CBMH12	0.23	0.59	0.14	0.14	10.00	0.92	10.92	76.81	104.19	178.56	29.55	40.08			40.08	59.68	45.00	300			0.35	0.818	19.60	32.84%
	B12	CBMH12	CBMH14	0.16	0.60	0.10	0.24	10.92	0.73	11.64	73.45	99.59	170.59	48.06	65.16			65.16	91.46	35.00	375			0.25	0.802	26.29	28.75%
	B13	CB13	CBMH14	0.19	0.61	0.12	0.12	10.00	0.91	10.91	76.81	104.19	178.56	25.22	34.21			34.21	41.62	45.00	250			0.45	0.821	7.41	17.80%
	B14	CBMH14	CBMH16	0.16	0.60	0.10	0.45	11.64	0.72	12.36	71.02	96.24	164.81	89.18	120.85			120.85	133.02	35.00	450			0.20	0.810	12.16	9.15%
	B15	CB15	CBMH16	0.21	0.61	0.13	0.13	10.00	0.91	10.91	76.81	104.19	178.56	26.76	36.30			36.30	41.62	45.00	250			0.45	0.821	5.32	12.78%
	B16	CBMH16	CBMH18	0.16	0.60	0.10	0.67	12.36	0.65	13.01	68.78	93.17	159.49	128.97	174.69			174.69	200.65	34.98	525			0.20	0.898	25.95	12.93%
	B17	CB17	CBMH18	0.25	0.68	0.17	0.17	10.00	0.61	10.61	76.81	104.19	178.56	36.80	49.92			49.92	62.04	45.00	250			1.00	1.224	12.11	19.53%
	B18	CBMH18	MH21	0.22	0.64	0.14	0.99	13.01	0.28	13.29	66.89	90.58	155.02	183.29	248.19		17.00	248.19	286.47	16.54	600			0.20	0.982	38.27	13.36%
		MH19	MH20			0.00	0.93	13.08	0.58	13.66	66.71	90.33	154.59	172.02	232.92		59.00	232.92	286.47	34.25	600			0.20	0.982	53.55	18.69%
		MH20	MH21			0.00	1.51	13.66	0.50	14.16	65.12	88.15	150.83	273.32	369.98		78.00	369.98	438.47	35.63	675			0.25	1.187	68.49	15.62%
		MH21	MH22			0.00	3.42	14.16	0.30	14.46	63.82	86.37	147.76	607.33	821.90		95.00	607.33	687.10	26.83	750			0.35	1.507	79.77	11.61%
		Inf. Trench	Outlet			0.00	3.76	14.46	0.11	14.57	63.08	85.36	146.00	658.97	891.67		32.00	658.97	779.10	11.22	750			0.45	1.708	120.13	15.42%

Definitions:
Q = 2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (ha)
i = Rainfall intensity in millimeters per hour (mm/hr)
[i = 732.951 / (TC+6.199)^0.810] 2 YEAR
[i = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1735.688 / (TC+6.014)^0.820] 100 YEAR

Notes:
1. Mannings coefficient (n) = 0.013

Designed: C.D.H.
Checked: R.P.K.
Project No.: CP-17-0603

No.	Revision	Date
1	ISSUED FOR SITE PLAN CONTROL	2019-07-08
2	REVISED AS PER COMMENTS	2019-03-06
3	REVISED AS PER COMMENTS	2019-07-08

Sheet No: 1 of 1

APPENDIX F
QUALITY TREATMENT UNIT SIZING

Detailed Stormceptor Sizing Report – 2113 Carp Rd.

Project Information & Location			
Project Name	2113 Carp Rd.	**Project Number**	-
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	2/26/2019
Designer Information		**EOR Information (optional)**	
Name	Brandon O'Leary	**Name**	Charissa Hampel
Company	Forterra	**Company**	McIntosh Perry
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	2113 Carp Rd.
Recommended Stormceptor Model	EFO12
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	48	42	265 L (70 gal)
EFO6	62	65	610 L (160 gal)
EFO8	69	79	1070 L (280 gal)
EFO10	77	87	1670 L (440 gal)
EFO12	81	92	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)**	2029.1
Elevation (ft)	370	**Total Infiltration (mm)**	1450.0
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	17499.0

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)	4.23
Imperviousness %	93

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

Stormceptor® FORTERRA

Site Name	2113 Carp Rd.

Site Details

Drainage Area	
Total Area (ha)	4.23
Imperviousness %	93
Oil Spill Capture Volume (L)	

Infiltration Parameters	
Horton's equation is used to estimate infiltration	
Max. Infiltration Rate (mm/hr)	61.98
Min. Infiltration Rate (mm/hr)	10.16
Decay Rate (1/sec)	0.00055
Regeneration Rate (1/sec)	0.01

Surface Characteristics	
Width (m)	411.00
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

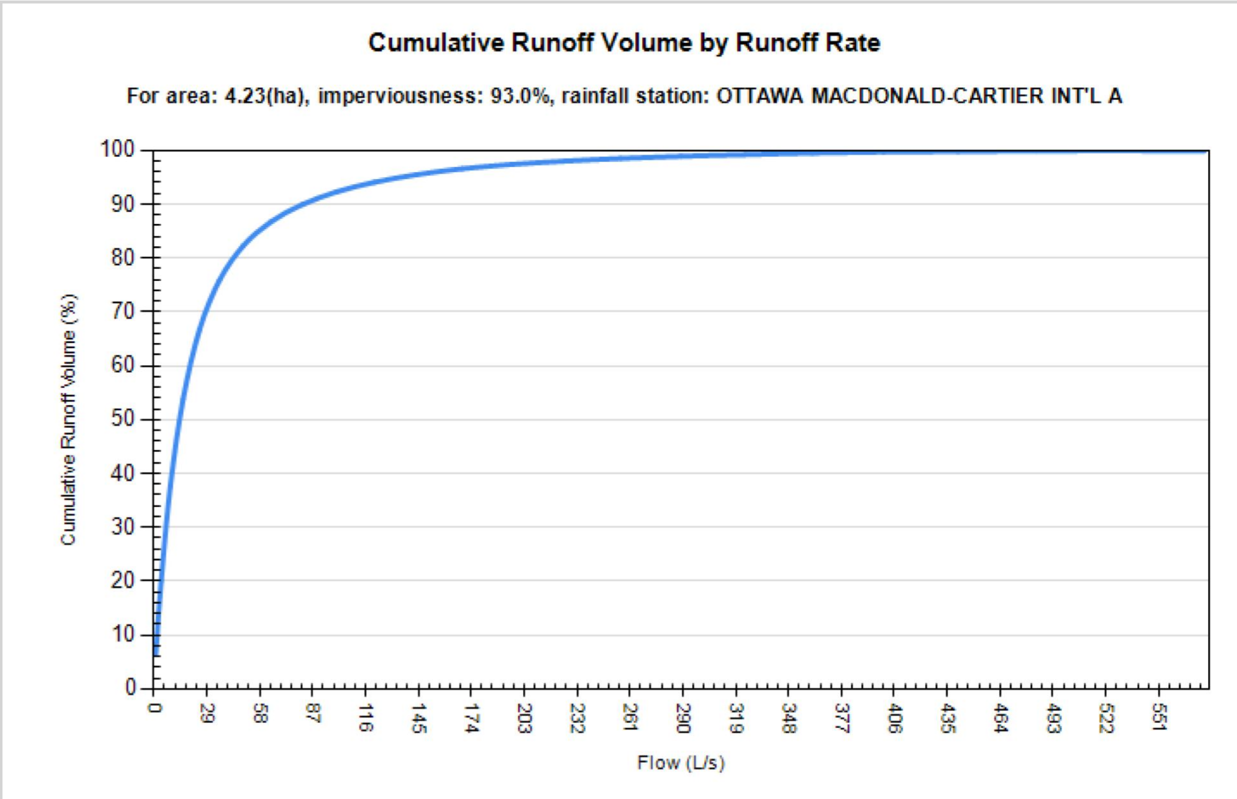
Winter Months	
Winter Infiltration	0

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

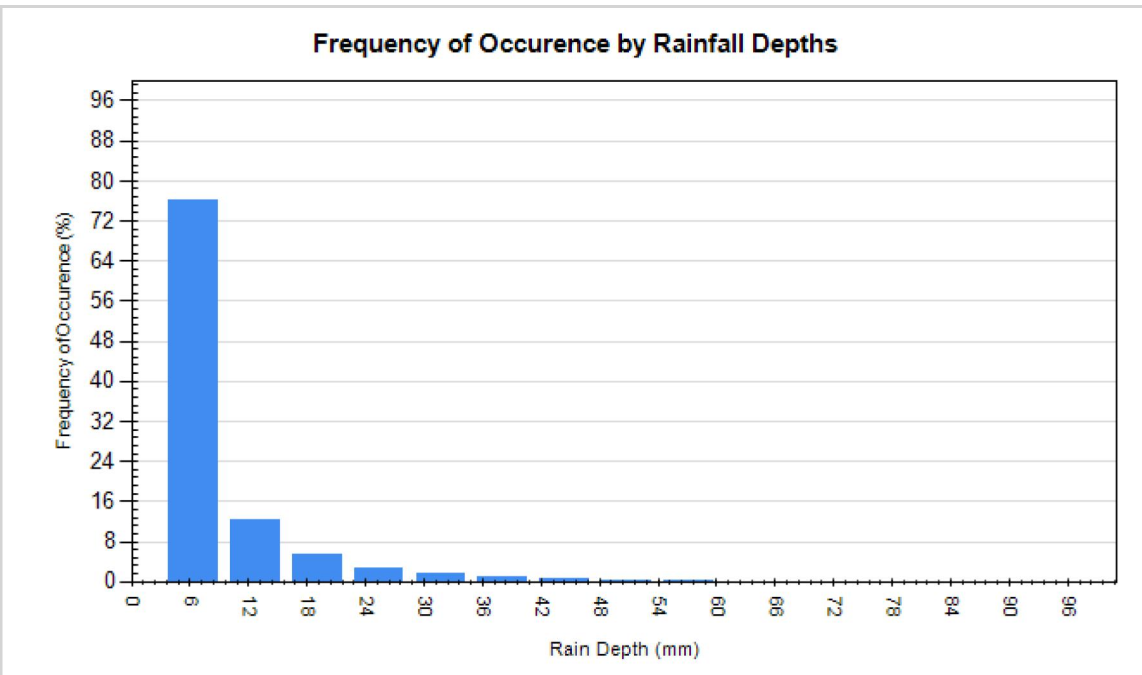
Buildup/Wash-off Parameters	
Target Event Mean Conc. (EMC) mg/L	125
Exponential Buildup Power	0.40
Exponential Washoff Exponent	0.20

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	47836	695721	6.4
4	149252	594349	20.1
9	279314	464462	37.6
16	399754	343813	53.8
25	495642	247824	66.7
36	564471	179207	75.9
49	611760	131776	82.3
64	644638	98902	86.7
81	668235	75302	89.9
100	686202	57353	92.3
121	699970	43551	94.1
144	710404	33124	95.5
169	718073	25451	96.6
196	724130	19401	97.4
225	728873	14654	98.0
256	732549	10978	98.5
289	735428	8098	98.9
324	737688	5838	99.2
361	739587	3937	99.5
400	740997	2528	99.7
441	741978	1547	99.8
484	742556	969	99.9
529	742874	651	99.9
576	743148	377	99.9


Cumulative Runoff Volume by Runoff Rate
For area: 4.23(ha), imperviousness: 93.0%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A
Cumulative Runoff Volume (%)
0
10
20
30
40
50
60
70
80
90
100
0
29
58
87
116
145
174
203
232
261
290
319
348
377
406
435
464
493
522
551
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



APPENDIX G
CITY OF OTTAWA CHECKLIST

McINTOSH PERRY

4. Development Servicing Study Checklist

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

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

4.1 General Content

Criteria	Location (if applicable)
• Executive Summary (for larger reports only).	N/A
• Date and revision number of the report.	On Cover
• Location map and plan showing municipal address, boundary, and layout of proposed development.	Appendix 'E'
• Plan showing the site and location of all existing services.	Site Servicing Plan
• Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	1.1 Purpose 1.2 Site Description 6.0 Stormwater Management
• Summary of Pre-consultation Meetings with City and other approval agencies.	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.	1.1 Purpose 1.2 Site Description 6.0 Stormwater Management
• Statement of objectives and servicing criteria.	3.0 Pre-Consultation Summary
• Identification of existing and proposed infrastructure available in the immediate area.	N/A

• 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).	Lot Grading, Drainage Plan, Sediment and Erosion Control Plan
• 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.	Lot Grading, Drainage Plan, Sediment and Erosion Control Plan
• 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.	See Geotech
• All preliminary and formal site plan submissions should have the following information: o Metric scale o North arrow (including construction North) o Key plan o Name and contact information of applicant and property owner o Property limits including bearings and dimensions o Existing and proposed structures and parking areas o Easements, road widening and rights-of-way o Adjacent street names	Lot Grading, Drainage Plan, Sediment and Erosion Control Plan

4.2 Development Servicing Report: Water

Criteria	Location (if applicable)
• Confirm consistency with Master Servicing Study, if available	N/A
• Availability of public infrastructure to service proposed development	N/A
• Identification of system constraints	N/A
• Identify boundary conditions	N/A
• Confirmation of adequate domestic supply and pressure	N/A
• 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.	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	N/A

• 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.	N/A
• 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.	Appendix 'B'
• Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	N/A

4.3 Development Servicing Report: Wastewater

Criteria	Location (if applicable)
• 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).	N/A
• 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.	5.2 Sanitary Servicing

• 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)	N/A
• Calculations related to dry-weather and wet-weather flow rates from the development in standard MOE sanitary sewer design table (Appendix 'C') format.	N/A
• Description of proposed sewer network including sewers, pumping stations, and forcemains.	5.2 Sanitary Servicing
• 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
• 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

Criteria	Location (if applicable)
• Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)	6.0 Stormwater Management
• Analysis of available capacity in existing public infrastructure.	N/A
• A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Pre- and Post-Development Plans
• 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.	6.0 Stormwater Management
• Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	6.0 Stormwater Management
• Description of the stormwater management concept with facility locations and descriptions with references and supporting information.	6.0 Stormwater Management
• 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.	N/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).	Appendix 'F'
• Identification of watercourses within the proposed development and how watercourses will be protected, or, if	Sediment and Erosion Control Plan

necessary, altered by the proposed development with applicable approvals.	
• Calculate pre and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	6.0 Stormwater Management, Appendix 'F'
• Any proposed diversion of drainage catchment areas from one outlet to another.	6.0 Stormwater Management
• Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	6.0 Stormwater Management
• 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.	Appendix 'A'
• Identification of potential impacts to receiving watercourses	N/A
• Identification of municipal drains and related approval requirements.	N/A
• Descriptions of how the conveyance and storage capacity will be achieved for the development.	6.0 Stormwater Management
• 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	Lot Grading, Drainage Plan & sediment Control Plan
• Inclusion of hydraulic analysis including hydraulic grade line elevations.	N/A

• Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	7.0 Sediment and Erosion Control
• 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

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

Criteria	Location (if applicable)
• Conservation Authority as the designated approval agency for modification of floodplain, potential impact on fish habitat, proposed works in or adjacent to a watercourse, cut/fill permits and Approval under Lakes and Rivers Improvement Act. The Conservation Authority is not the approval authority for the Lakes and Rivers Improvement Act. Where there are Conservation Authority regulations in place, approval under the Lakes and Rivers Improvement Act is not required, except in cases of dams as defined in the Act.	N/A
• 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

Criteria	Location (if applicable)

• Clearly stated conclusions and recommendations	8.0 Summary 9.0 Recommendations
• Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.	All are stamped
• All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario	All are stamped