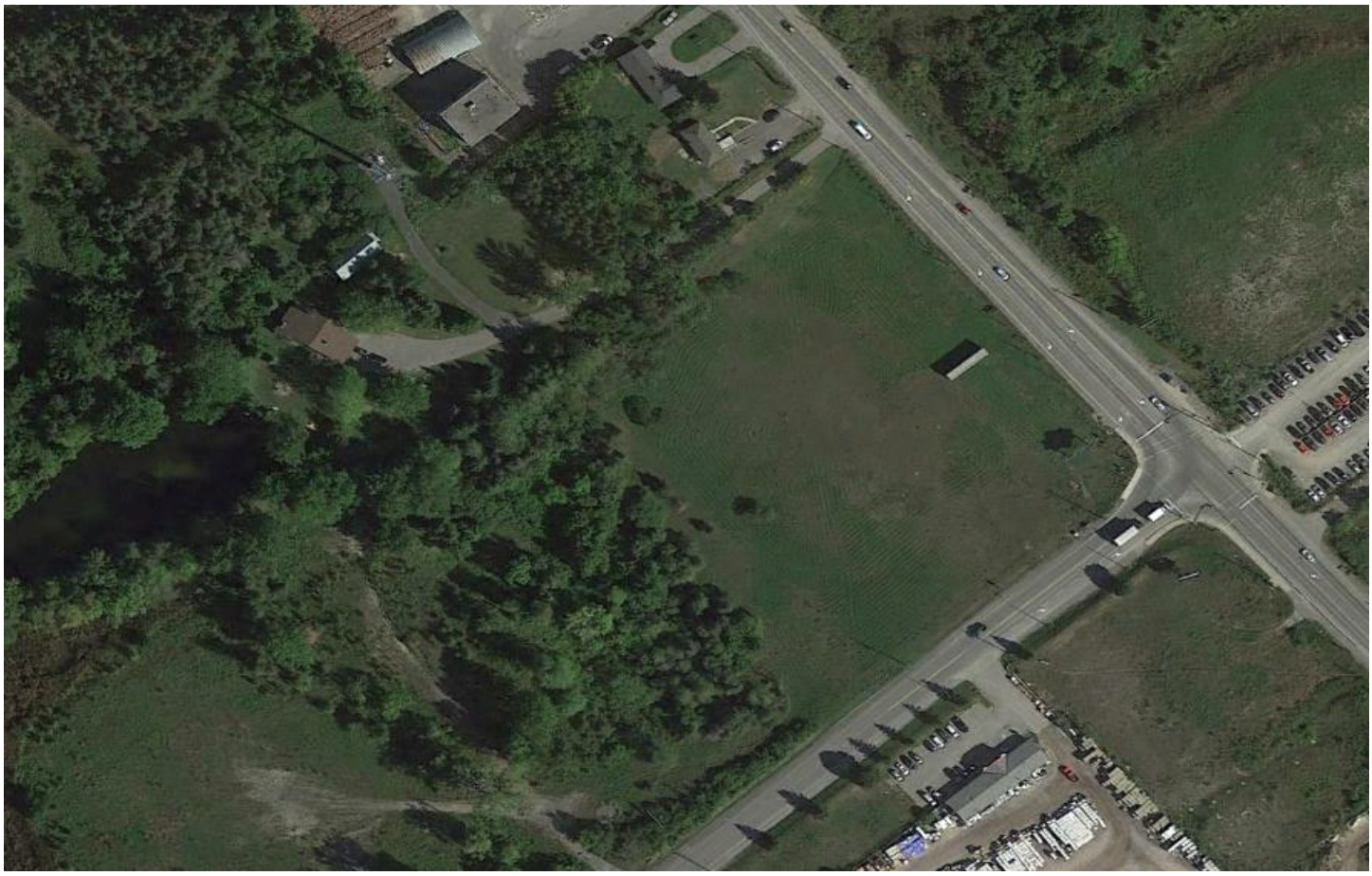
SERVICING AND STORMWATER MANAGEMENT REPORT



Project No.: 0CP-17-0603

Project Name.: Carp Road Body Shop

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Rev 01: November 30, 2018

McINTOSH PERRY

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 – MOECP). 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 Asseciates 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. 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 approximate 100m north west of the intersection of Carp Road and Westbrook Road. There is an existing maintenance hole at the south west 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 75mm water service to the building.

The proposed building will be equipped with a sprinkler system for fire protection. The required fire protection from the Ontario Building Code (OBC) is 9,000 L/min (See Appendix 'B' for calculation).

The required fire protection from the Fire Underwriters Survey (FUS) is 5,000 L/min (provided for information purposes only.)

The water demands for the new building has been calculated as per the Ottawa Design Guidelines – Water Distribution and are as follows: the average and maximum daily demands are 1.70 L/s and 2.56 L/s respectively. The maximum hourly demand was calculated as 4.60 L/s (Refer to Appendix 'B' for flow details). Boundary conditions have been provided by the City of Ottawa and can be found in Appendix 'B'. Based on the boundary conditions provided by the City of Ottawa a water model was conducted using Bentley's WaterCAD software. The model tested three scenarios; the average day, peak hourly and maximum day plus fire flow. The results are available within Appendix 'B'. From the water model the existing 300 mm watermain within Westbrook Road and the proposed water network can adequately service the proposed development and is adequate in accordance with OBC 3.2.5.7.

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.

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. The new storm sewer network will direct 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. 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 water 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:

Service	Minimum Cover
Storm Sewer	1.8m
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 in Section 6.1. 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.

Quality Control

The site will include a quality treatment unit to achieve an 80% total suspended solids removal (enhanced level).

Quantity Control

The site has been designed to:

- 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;
- 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
- 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 Sewer Design Guidelines)
A = Drainage area in hectares

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

Building roofs, Asphalt, Concrete	0.90
Grass, undeveloped areas	0.20
Gravel	0.60

As per the City of Ottawa requirement, the 5-year balanced 'C' value must increase 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 City of 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.

Table 1: 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

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.

6.4 Post-Development Drainage

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 C for detailed calculations and 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 124 mm diameter orifice plug (Design head of 1.67 m) within the southwest inlet pipe of the manhole in the northeast corner of the section (MH19). Flow from this section will be restricted to 40 and 41 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 77 mm diameter orifice plug (Design head of 2.68 m) within the northeast inlet pipe of the manhole just south of the southwest corner of the section (MH20). Flow from this section will be restricted to 20 L/s for both the 5 and 100-year storm events. 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 78 mm diameter orifice plug within the southeast inlet pipe of the manhole in the northeast corner of the section (MH21). Flow from this section will be restricted to 18 L/s for both the 5 and 100-year storm events. 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.

6.5 Quantity Control

Detailed stormwater peak flow rates and storage calculations have been provided in Appendix C. 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.

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. Runoff to the infiltration trench was

determined by combining the allowable outflow from each section into one distribution. 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. A flow chart has been provided in Appendix C to represent visually the flows, restrictions and outflows, in addition to detailed calculations.

A design infiltration rate of 100 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 a reasonable middle ground was selected.

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 C 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).

Outflow from the site as detailed in Section 6.4 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 into a large infiltration trench along the eastern side of the site. 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 MOECC 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 has been proposed at the east side of the side adjacent to Carp Road providing 430 m^3 available quality volume (below the gravity outlet of the trench to the municipal ditch.

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 in Appendix F 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 Infiniti Dealership 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 quality treatment unit 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.

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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 the Environment and Climate Change, 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.

McINTOSH PERRY

APPENDIX A
CITY OF OTTAWA PRE-CONSULTATION NOTES

McINTOSH PERRY

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

McINTOSH PERRY

McINTOSH PERRY

CP-17-0603 - 2113 Carp Road - Water Demands

Project:	2113 Carp Road
Project No.:	CP-17-0603
Designed By:	C.D.H.
Checked By:	R.P.K.
Date:	2018/11/05
Site Area:	4.21 gross ha

AVERAGE DAILY DEMAND

DEMAND TYPE	AMOUNT	UNITS
Residential	350	L/c/d
Industrial - Light	*35,000*	*L/gross ha/d*
Industrial - Heavy	55,000	L/gross ha/d
Shopping Centres	2,500	L/(1000m² /d
Hospital	900	L/(bed/day)
Schools	70	L/(Student/d)
Trailer Parks no Hook-Ups	340	L/(space/d)
Trailer Park with Hook-Ups	800	L/(space/d)
Campgrounds	225	L/(campsite/d)
Mobile Home Parks	1,000	L/(Space/d)
Motels	150	L/(bed-space/d)
Hotels	225	L/(bed-space/d)
Tourist Commercial	28,000	L/gross ha/d
Other Commercial	28,000	L/gross ha/d
AVERAGE DAILY DEMAND	1.71	L/s

MAXIMUM DAILY DEMAND

DEMAND TYPE	AMOUNT	UNITS
Residential	2.5 x avg. day	L/c/d
Industrial	*1.5 x avg. day*	*L/gross ha/d*
Commercial	1.5 x avg. day	L/gross ha/d
Institutional	1.5 x avg. day	L/gross ha/d
MAXIMUM DAILY DEMAND	2.56	L/s

MAXIMUM HOUR DEMAND

DEMAND TYPE	AMOUNT	UNITS
Residential	2.2 x max. day	L/c/d
Industrial	*1.8 x max. day*	*L/gross ha/d*
Commercial	1.8 x max. day	L/gross ha/d
Institutional	1.8 x max. day	L/gross ha/d
MAXIMUM HOUR DEMAND	4.60	L/s

WATER DEMAND DESIGN FLOWS PER UNIT COUNT
CITY OF OTTAWA - WATER DISTRIBUTION GUIDELINES, JULY 2010

McINTOSH PERRY

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 loadbearing 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

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.

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

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

McINTOSH PERRY

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	102.60	48.08	160.32

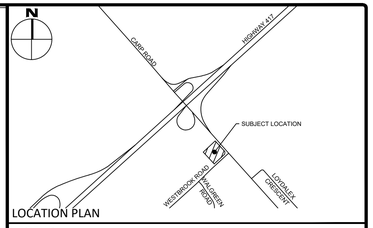
Peak Hourly

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	276.00	41.02	155.34

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	9,019.05	42.29	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)	41.39	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:

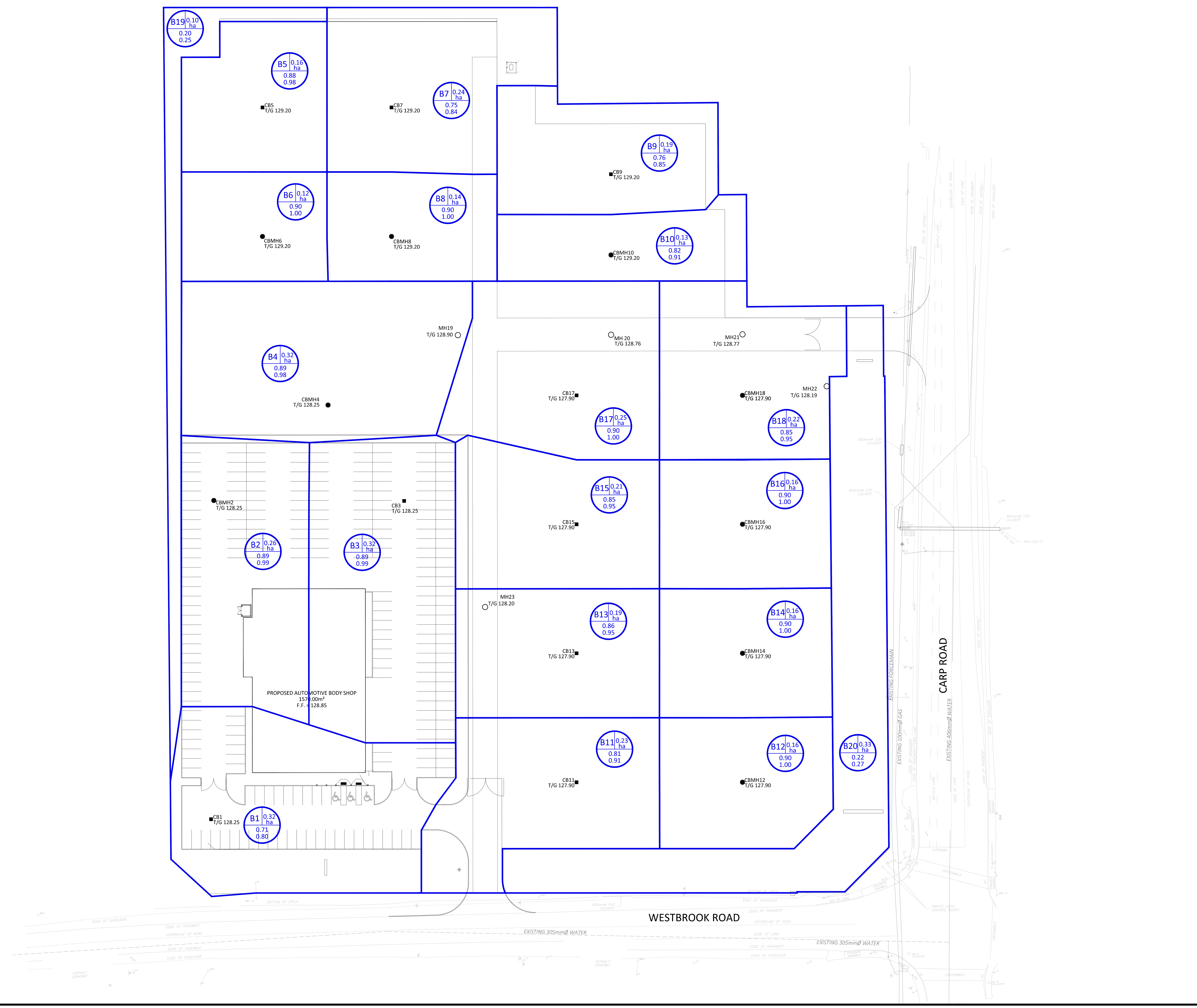
PRE-DEVELOPMENT DRAINAGE AREA PLAN

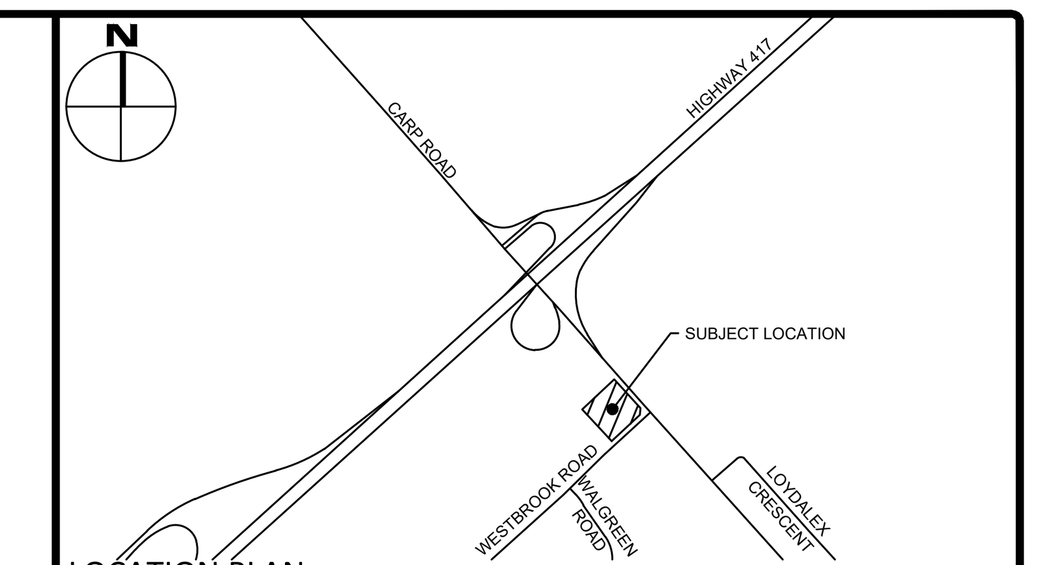
Scale:	1:500	Project Number:	CP-17-0603
Drawn By:	C.D.H.		
Checked By:	R.P.K.	Drawing Number:	PRE
Designed By:	C.D.H.		

FILENAME: H:\01 Project - Proposals\2017 Jobs\CP\CP-17-0603 BBS_Body Shop_2113 Carp Road\Civil\15 - Drawings\DCP-17-0603 - Presentation.dwg
LAST SAVED: Monday, November 12, 2018 LAST SAVED BY: c.hampel
LAST PLOTTED: Tuesday, November 27, 2018 [CB FILE LOSS]

APPENDIX D
POST-DEVELOPMENT DRAINAGE PLAN

McINTOSH PERRY





LOCATION 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
1	ISSUED FOR SITE PLAN CONTROL	NOV. XX, 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:
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\mpdocuments\01 Project - Proposals\2017 Jobs\CP\0CP-17-0603 BBS_Body Shop_2113 Carp Road\Civil\03 - Drawing\CP-17-0603 - Presentation.dwg
LAST SAVED: Thursday, November 01, 2018 LAST SAVED BY: c.champel
LAST PLOTTED: Thursday, November 01, 2018 CTB FILE USED: ----

APPENDIX E
STORMWATER MANAGEMENT CALCULATIONS

McINTOSH PERRY

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

Tc = 39.6327

Tc = 39.63

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

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

Tc = 2.84605 + 0

Tc = 2.85

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

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

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

Storage Required

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	40	326	98
10	104	270	40	230	138
15	84	217	40	177	159
20	70	182	40	142	171
25	61	158	40	118	177
30	54	140	40	100	180
35	49	126	40	86	180
40	44	115	40	75	179
45	41	105	40	65	176
50	38	98	40	58	173
55	35	91	40	51	169
60	33	85	40	45	163

Maximum Storage Required 5-year	180	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	40	187	112
15	62	183	40	143	129
20	52	154	40	114	137
25	45	134	40	94	141
30	40	119	40	79	141
35	36	107	40	67	140
40	33	97	40	57	138
45	30	90	40	50	134
50	28	83	40	43	129
55	26	78	40	38	124
60	25	73	40	33	118
65	23	69	40	29	111

Maximum Storage Required 2-year	141	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	41	182	436
45	69	205	41	164	441
50	64	189	41	148	445
55	60	177	41	136	447
60	56	166	41	125	448
65	53	156	41	115	448
70	50	147	41	106	447
75	47	140	41	99	445
80	45	133	41	92	443
85	43	127	41	86	440
90	41	122	41	81	436
95	39	117	41	76	432

Maximum Storage Required 100-year	448	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	30	117	35
10	46	98	30	68	41
15	35	75	30	45	40
20	28	61	30	31	37
25	24	51	30	21	32
30	21	45	30	15	27
35	19	40	30	10	21
40	17	36	30	6	14
45	15	33	30	3	7
50	14	30	30	0	0
55	13	28	30	-2	-7
60	12	26	30	-4	-14

Maximum Storage Required 5-year	41	m^3

*Intensity equation derived from V05 Climate Library

Storage Proposed

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

Underground Infrastructure Storage						
Structures						
	Size (mm)	Depth (m)	Area (m^2)	Volume (m^3)	T/G	Bottom Elev
CB1	600x600	1.85	0.372	1	128.25	126.40
CBMH2	1200	1.84	1.167	2	128.25	126.41
CB3	600x600	2.16	0.372	1	128.25	126.09
CBMH4	1500	2.07	1.824	4	128.25	126.18
MH19	1800	2.88	2.545	7	128.90	126.03
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	450	33.20	0.159	5	126.69	127.14
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

Stage Storage Discharge Table B1-B4

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	Discharge	
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	0	0	0	0	0	0	0	0	0	0	1		
126.30	0	0	0	0	1	0	0	0	0	0	0	0	0	1		
126.40	0	0	0	0	1	0	0	0	0	0	0	0	0	1		
126.50	0	0	0	1	1	0	0	0	0	0	0	0	0	2		
126.75	0	0	0	1	2	0	0	0	7	0	0	0	0	10	x	
127.00	0	1	0	1	2	0	3	3	13	0	0	0	0	24	11	
127.20	0	1	0	2	3	5	6	5	13	0	0	0	0	36	18	
127.25	0	1	0	2	3	5	6	5	13	0	0	0	0	36	19	
127.40	0	1	0	2	3	10	6	5	13	0	0	0	0	42	23	
127.75	1	2	1	3	4	10	6	5	13	0	0	0	0	44	30	15mm
128.00	1	2	1	3	5	10	6	5	13	0	0	0	0	46	34	
128.25	1	2	1	4	6	10	6	5	13	0	0	0	0	47	38	
128.30	1	2	1	4	6	10	6	5	13	1	1	1	0	51	38	
128.35	1	2	1	4	6	10	6	5	13	4	5	7	3	67	39	
128.40	1	2	1	4	6	10	6	5	13	12	17	24	9	110	40	
128.45	1	2	1	4	6	10	6	5	13	28	40	56	22	194	40	2, 5-Year
128.50	1	2	1	4	6	10	6	5	13	44	76	102	43	313	41	
128.55	1	2	1	4	6	10	6	5	13	75	118	160	71	472	41	100-Year

Discharge

Stage Storage Discharge Table

	Pipe Outlet		
Invert Elevation	126.82	For Orifice Flow, C =	0.60
Centroid Elevation	126.88		
Orifice Width	124 mm		
Top of Grate Elevation	128.25		
Maximum Ponding	128.55		
Orifice Area (m^2)	0.012		

Elevation	Orifice 1		Total Flow	Storage	
	(from	Q [l/s]	Q [l/s]	m^3	
126.88	x	x	x	x	
126.50	x	x	x	2	
126.75	x	x	x	9	
127.00	0.12	11	11	22	
127.20	0.32	18	18	34	
127.25	0.37	19	19	35	
127.40	0.52	23	23	40	
127.75	0.87	30	30	42	15mm Chicago
128.00	1.12	34	34	44	
128.25	1.37	38	38	46	
Ponding on Surface					
128.30	1.42	38	38	49	
128.35	1.47	39	39	65	
128.40	1.52	40	40	108	
128.45	1.57	40	40	192	2, 5-Year
128.50	1.62	41	41	311	
128.55	1.67	41	41	470	100-Year

Storage Required

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	20	67	121
35	49	79	20	59	123
40	44	72	20	52	124
45	41	66	20	46	124
50	38	61	20	41	123
55	35	57	20	37	122
60	33	53	20	33	120
65	31	50	20	30	118
70	29	48	20	28	116
75	28	45	20	25	113
80	27	43	20	23	110
85	25	41	20	21	107

Maximum Storage Required 5-year **124** 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	80	72
20	52	84	19	65	78
25	45	73	19	54	80
30	40	65	19	45	82
35	36	58	19	39	82
40	33	53	19	34	81
45	30	49	19	29	80
50	28	45	19	26	78
55	26	42	19	23	75
60	25	40	19	20	73
65	23	37	19	18	70

Maximum Storage Required 2-year **82** 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 5-year **50** m^3

*Intensity equation derived from V05 Climate Library

Storage Proposed

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	1.824	5	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	250	35.000	0.049	2	127.03	127.28
CB7-CBMH8	300	35.000	0.071	2	126.84	127.14
CBMH6 - CBMH8	375	35.000	0.110	4	126.73	127.11
CB9- CBMH10	300	21.900	0.071	2	126.68	126.98
CBMH8 - CBMH10	525	59.750	0.216	13	126.49	127.02
CBMH10- MH20	600	21.650	0.283	6	126.30	126.90

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

Stage Storage Discharge Table B5-B10

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	Storage Pipe CBMH10- MH20	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	0	
126.50	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	
126.60	0	0	0	1	1	1	0	0	0	0	0	3	0	0	0	0	0	0	6	0	
126.70	0	0	0	1	1	1	0	0	0	0	0	3	0	0	0	0	0	0	7	0	
126.80	0	0	0	1	1	1	0	0	0	1	6	3	0	0	0	0	0	0	15	0	
126.90	0	1	0	1	1	2	0	0	2	1	6	6	0	0	0	0	0	0	21	3	
127.00	0	1	0	1	2	2	0	1	2	2	13	6	0	0	0	0	0	0	30	5	
127.10	0	1	0	2	2	2	0	1	4	2	13	6	0	0	0	0	0	0	33	7	
127.20	0	1	0	2	2	2	1	2	4	2	13	6	0	0	0	0	0	0	35	8	
128.00	1	2	1	3	4	4	2	2	4	2	13	6	0	0	0	0	0	0	42	13	
129.20	1	3	1	5	6	6	2	2	4	2	13	6	0	0	0	0	0	0	51	19	15mm
129.25	1	3	1	5	6	6	2	2	4	2	13	6	1	1	1	1	1	1	57	19	
129.30	1	3	1	5	6	6	2	2	4	2	13	6	5	6	4	6	5	5	82	19	2-Year
129.35	1	3	1	5	6	6	2	2	4	2	13	6	18	21	15	19	15	15	154	20	5-Year
129.38	1	3	1	5	6	6	2	2	4	2	13	6	29	36	26	32	32	33	239	20	
129.40	1	3	1	5	6	6	2	2	4	2	13	6	36	36	30	37	58	61	309	20	
129.45	1	3	1	5	6	6	2	2	4	2	13	6	48	36	42	50	93	78	398	20	100-Year
129.50	1	3	1	5	6	6	2	2	4	2	13	6	75	36	67	74	138	80	521	20	

Discharge

Stage Storage Discharge Table

	Pipe Outlet		
Invert Elevation	126.79	For Orifice Flow, C =	0.60
Centroid Elevation	126.82		
Orifice Width/Weir Length	77 mm		
Top of Grate Elevation	129.20		
Maximum Ponding Elevation	129.50		
Orifice Area (m^2)	0.005		

Elevation (from centroid)	Orifice		Total Flow	Storage	
	H [m]	Q [l/s]	Q [l/s]	m^3	
126.82	x	x	x	x	
126.90	0.08	3	3	21	
127.00	0.18	5	5	30	
127.10	0.28	7	7	33	
127.20	0.38	8	8	35	
128.00	1.18	13	13	42	
129.20	2.38	19	19	51	15mm
Ponding on Surface					
129.25	2.43	19	19	57	
129.30	2.48	19	19	82	2-Year
129.35	2.53	20	20	154	5-Year
129.38	2.56	20	20	239	
129.40	2.58	20	20	309	
129.45	2.63	20	20	398	100-Year
129.50	2.68	20	20	521	

Storage Required

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	18	72	260
65	31	85	18	67	262
70	29	81	18	63	263
75	28	76	18	58	263
80	27	73	18	55	263
85	25	70	18	52	263
90	24	67	18	49	262
95	23	64	18	46	262
100	22	61	18	43	261
105	22	59	18	41	259
110	21	57	18	39	258
115	20	55	18	37	256

Maximum Storage Required 5-year	263	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	18	92	165
35	36	99	18	81	170
40	33	90	18	72	173
45	30	83	18	65	175
50	28	77	18	59	177
55	26	72	18	54	177
60	25	67	18	49	178
65	23	63	18	45	177
70	22	60	18	42	177
75	21	57	18	39	176
80	20	54	18	36	175
85	19	52	18	34	173

Maximum Storage Required 2-year	178	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	18	170	611
65	53	177	18	159	619
70	50	167	18	149	627
75	47	159	18	141	633
80	45	151	18	133	639
85	43	146	18	128	650
90	41	138	18	120	650
95	39	124	18	106	602
100	38	119	18	101	607
105	36	110	18	92	581
110	35	106	18	88	583

Maximum Storage Required 100-year	650	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	14	133	40
10	46	98	14	84	50
15	35	75	14	61	55
20	28	61	14	47	56
25	24	51	14	37	56
30	21	45	14	31	55
35	19	40	14	26	54
40	17	36	14	22	53
45	15	33	14	19	51
50	14	30	14	16	48
55	13	28	14	14	46

Maximum Storage Required 5-year	56	m^3

*Intensity equation derived from V05 Climate Library

Storage Proposed

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	375	45.000	0.110	5	126.74	127.12
CB13-CBMH14	300	45.000	0.071	3	126.81	127.11
CBMH12 - CBMH14	450	35.000	0.159	6	126.57	127.02
CB15- CBMH16	300	45.000	0.071	3	126.74	127.04
CBMH14 - CBMH16	525	35.000	0.216	8	126.43	126.96
CB17- CBMH18	375	45.000	0.110	5	126.55	126.93
CBMH16- CBMH18	600	35.000	0.283	10	126.29	126.89
CBMH18- MH21	675	16.500	0.358	6	126.14	126.82
Total Underground Infrastructure	**59**					

Stage Storage Discharge Table B1-B4

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
126.15	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	3	0	0	0	5	3
126.90	0	1	0	1	0	2	0	2	2	0	6	2	8	5	10	6
127.15	0	1	0	2	0	2	0	2	5	3	6	3	8	5	10	6
127.40	0	1	0	2	0	3	1	3	5	3	6	3	8	5	10	6
127.65	1	2	1	3	1	3	1	3	5	3	6	3	8	5	10	6
127.90	1	2	1	3	1	3	1	4	5	3	6	3	8	5	10	6
127.95	1	2	1	3	1	3	1	4	5	3	6	3	8	5	10	6
128.00	1	2	1	3	1	3	1	4	5	3	6	3	8	5	10	6
128.05	1	2	1	3	1	3	1	4	5	3	6	3	8	5	10	6
128.10	1	2	1	3	1	3	1	4	5	3	6	3	8	5	10	6
128.15	1	2	1	3	1	3	1	4	5	3	6	3	8	5	10	6
128.20	1	2	1	3	1	3	1	4	5	3	6	3	8	5	10	6

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		
126.15	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	16	9	
126.90	0	0	0	0	0	0	0	0	0	0	45	11	
127.15	0	0	0	0	0	0	0	0	0	0	54	13	
127.40	0	0	0	0	0	0	0	0	0	0	56	14	15mm
127.65	0	0	0	0	0	0	0	0	0	0	58	16	
127.90	0	0	0	0	0	0	0	0	0	0	60	17	
127.95	1	1	2	2	2	2	1	1	0	12	72	17	
128.00	11	12	15	16	15	15	8	9	0	101	161	17	
128.05	24	28	25	24	22	23	20	21	0	187	247	18	2-Year
128.10	37	39	27	27	26	26	27	33	62	304	364	18	5-Year
128.15	53	59	30	28	27	27	35	40	176	475	535	18	
128.20	73	86	32	29	32	28	48	56	493	877	937	18	100-Year

Discharge

Stage Storage Discharge Table

	Pipe Outlet		
Invert Elevation	126.11	For Orifice Flow, C =	0.60
Centroid Elevation	126.15		
Orifice Width/Weir Length	78 mm		
Top of Grate Elevation	127.90		
Maximum Ponding Elevation	128.20		
Orifice Area (m^2)	0.005		

Elevation (from centroid)	Orifice		Total Flow	Storage	
	H [m]	Q [l/s]	Q [l/s]	m^3	
126.15	x	x	x	1	
126.40	0.25	6	6	3	
126.65	0.50	9	9	16	
126.90	0.75	11	11	45	
127.15	1.00	13	13	54	
127.40	1.25	14	14	56	15mm
127.65	1.50	16	16	58	
127.90	1.75	17	17	60	
Ponding on Surface					
127.95	1.80	17	17	72	
128.00	1.85	17	17	161	
128.05	1.90	18	18	247	2-Year
128.10	1.95	18	18	364	5-Year
128.15	2.00	18	18	535	
128.20	2.05	18	18	937	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

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	79	52	27	165
150	79	52	27	247
200	79	52	27	329
250	79	52	27	411
300	79	52	27	494
350	79	52	27	576
400	75	52	24	570
405	75	52	23	568
455	72	52	20	548
505	69	52	17	525
555	66	52	14	469
605	62	52	11	395
655	60	52	8	318
705	57	52	6	240
755	55	52	4	161
805	59	52	8	370
855	52	52	0	-1
905	50	52	-2	-84
955	49	52	-3	-167
1005	49	52	-2	-129
1055	48	52	-4	-256
1105	46	52	-6	-385
1155	44	52	-7	-515
1205	43	52	-9	-646
1210	42	52	-9	-659
1215	42	52	-9	-672
1220	42	52	-9	-685
1225	42	52	-10	-699
1230	42	52	-10	-712
1280	41	52	-11	-844
1330	39	52	-12	-976
1380	38	52	-13	-1110
1430	37	52	-14	-1244
1480	36	52	-16	-1378

Maximum Storage Required 100-year **576** 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	41	71	428
150	28	82	41	41	367
200	22	65	41	24	289
250	18	54	41	13	202
300	16	47	41	6	109
350	14	42	41	1	12
400	13	37	41	-4	-88
405	12	37	41	-4	-98
455	11	34	41	-7	-201
505	10	31	41	-10	-306
555	10	29	41	-12	-412
605	9	27	41	-14	-519
655	8	25	41	-16	-628
705	8	24	41	-17	-737
755	8	22	41	-19	-847
805	7	21	41	-20	-958
855	7	20	41	-21	-1070
905	6	19	41	-22	-1182
955	6	18	41	-23	-1294
1005	6	18	41	-23	-1407
1055	6	17	41	-24	-1521
1105	6	16	41	-25	-1634
1155	5	16	41	-25	-1748
1205	5	15	41	-26	-1863
1210	5	15	41	-26	-1874
1215	5	15	41	-26	-1886
1220	5	15	41	-26	-1897
1225	5	15	41	-26	-1909
1230	5	15	41	-26	-1920
1280	5	15	41	-26	-2035
1330	5	14	41	-27	-2150
1380	5	14	41	-27	-2266
1430	4	13	41	-28	-2381
1480	4	13	41	-28	-2497

*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	18	109	656
150	28	93	18	75	673
200	22	74	18	56	670
250	18	62	18	44	657
300	16	53	18	35	637
350	14	47	18	29	612
400	13	42	18	24	584
405	12	42	18	24	581
455	11	38	18	20	550
505	10	35	18	17	517
555	10	32	18	14	482
605	9	30	18	12	446
655	8	28	18	10	408
705	8	27	18	9	370
755	8	25	18	7	330
805	7	24	18	6	290
855	7	23	18	5	249
905	6	22	18	4	207
955	6	21	18	3	165
1005	6	20	18	2	123
1055	6	19	18	1	79
1105	6	19	18	1	36
1155	5	18	18	0	-8
1205	5	17	18	-1	-52
1210	5	17	18	-1	-57
1215	5	17	18	-1	-61
1220	5	17	18	-1	-66
1225	5	17	18	-1	-70
1230	5	17	18	-1	-75
1280	5	16	18	-2	-119
1330	5	16	18	-2	-164
1380	5	15	18	-3	-210
1430	4	15	18	-3	-255
1480	4	15	18	-3	-301

*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	77	24	53	16
10	77	24	53	32
15	77	24	53	47
20	77	24	53	63
25	77	24	53	79
30	77	24	53	95
35	77	24	53	111
40	77	24	53	126
90	77	24	53	284
100	77	24	53	316
110	77	24	53	348
115	76	24	52	357
120	75	24	50	363
150	69	24	44	400
155	68	24	44	406
160	67	24	43	412
165	66	24	42	411
225	56	24	31	421
230	55	24	31	422
235	54	24	30	422
300	48	24	24	424
320	46	24	22	424
330	46	24	21	424
340	45	24	21	423
345	44	24	20	411
350	44	24	19	406
355	43	24	19	402
360	43	24	18	397

Maximum Storage Required 2-year **424** 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	40	229	69
10	77	199	40	159	95
15	62	160	40	120	108
20	52	135	40	95	114
25	45	117	40	77	116
30	40	104	40	64	115
35	36	93	40	53	112
40	33	85	40	45	108
90	18	47	40	7	38
100	17	43	40	3	21
110	16	40	40	0	2
115	15	39	40	-1	-7
120	15	38	40	-2	-16
150	12	32	40	-8	-74
155	12	31	40	-9	-84
160	12	30	40	-10	-94
165	11	29	40	-11	-104
225	9	23	40	-17	-228
230	9	23	40	-17	-238
235	9	22	40	-18	-249
300	7	18	40	-22	-389
320	7	17	40	-23	-432
330	7	17	40	-23	-454
340	6	17	40	-23	-476
345	6	16	40	-24	-487
350	6	16	40	-24	-498
355	6	16	40	-24	-509
360	6	16	40	-24	-520

*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

*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	18	266	80
10	77	211	18	193	116
15	62	169	18	151	136
20	52	143	18	125	150
25	45	124	18	106	159
30	40	110	18	92	165
35	36	99	18	81	170
40	33	90	18	72	173
90	18	50	18	32	171
100	17	46	18	28	167
110	16	43	18	25	163
115	15	41	18	23	160
120	15	40	18	22	158
150	12	34	18	16	140
155	12	33	18	15	137
160	12	32	18	14	134
165	11	31	18	13	131
225	9	24	18	6	87
230	9	24	18	6	83
235	9	24	18	6	79
300	7	19	18	1	26
320	7	18	18	0	10
330	7	18	18	0	1
340	6	18	18	0	-8
345	6	17	18	-1	-12
350	6	17	18	-1	-16
355	6	17	18	-1	-21
360	6	17	18	-1	-25

*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	63	21	42	13
10	63	21	42	25
20	63	21	42	50
30	63	21	42	75
40	63	21	42	100
50	63	21	42	125
60	63	21	42	150
65	63	21	42	163
70	61	21	40	166
75	59	21	38	171
80	58	21	37	176
100	54	21	33	195
120	51	21	30	213
150	48	21	27	240
155	48	21	26	244
160	47	21	26	248
165	46	21	25	247
170	45	21	24	246
175	45	21	23	246
200	42	21	20	244
300	34	21	13	227
400	30	21	8	203
450	28	21	7	189
460	28	21	7	186
470	28	21	7	183
480	27	21	6	163
490	27	21	5	153
500	26	21	5	144

Maximum Storage Required 15mm **248** 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	30	149	45
10	46	119	30	89	53
20	28	74	30	44	52
30	21	54	30	24	44
40	17	43	30	13	32
50	14	36	30	6	19
60	12	32	30	2	6
65	11	30	30	0	-2
70	11	28	30	-2	-9
75	10	26	30	-4	-16
80	10	25	30	-5	-24
100	8	21	30	-9	-55
120	7	18	30	-12	-87
150	6	15	30	-15	-135
155	6	15	30	-15	-143
160	5	14	30	-16	-152
165	5	14	30	-16	-160
170	5	14	30	-16	-168
175	5	13	30	-17	-177
200	5	12	30	-18	-218
300	3	8	30	-22	-388
400	3	7	30	-23	-561
450	2	6	30	-24	-648
460	2	6	30	-24	-665
470	2	6	30	-24	-682
480	2	6	30	-24	-700
490	2	6	30	-24	-717
500	2	6	30	-24	-735

*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	104	168	19	149	45
10	77	124	19	105	63
20	52	84	19	65	78
30	40	65	19	46	82
40	33	53	19	34	82
50	28	45	19	26	79
60	25	40	19	21	75
65	23	37	19	18	72
70	22	35	19	16	69
75	21	34	19	15	66
80	20	32	19	13	63
100	17	27	19	8	49
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
170	11	18	19	-1	-10
175	11	18	19	-1	-15
200	10	16	19	-3	-38
300	7	11	19	-8	-135
400	6	9	19	-10	-237
450	5	8	19	-11	-288
460	5	8	19	-11	-299
470	5	8	19	-11	-309
480	5	8	19	-11	-320
490	5	8	19	-11	-330
500	5	8	19	-11	-341

*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	104	284	14	270	81
10	77	211	14	197	118
20	52	143	14	129	154
30	40	110	14	96	172
40	33	90	14	76	183
50	28	77	14	63	189
60	25	67	14	53	192
65	23	63	14	49	193
70	22	60	14	46	194
75	21	57	14	43	194
80	20	54	14	40	194
100	17	46	14	32	191
120	15	40	14	26	187
150	12	34	14	20	176
155	12	33	14	19	174
160	12	32	14	18	172
165	11	31	14	17	170
170	11	30	14	16	168
175	11	30	14	16	166
200	10	27	14	13	154
300	7	19	14	5	98
400	6	15	14	1	36
450	5	14	14	0	3
460	5	14	14	0	-4
470	5	14	14	0	-11
480	5	13	14	-1	-18
490	5	13	14	-1	-24
500	5	13	14	-1	-31

*Intensity equation from V05 Climate Library

Storage Proposed

Infiltration Trench Storage		
Elevation (m)	Available Storage (m^3)	
124.21	0	
124.31	31	
124.36	46	
124.41	61	
124.51	92	
124.61	123	
124.71	154	
124.76	169	
124.81	184	
124.91	215	
124.96	230	
125.02	249	15mm
125.11	276	
125.21	307	
125.31	338	
125.41	369	
125.51	399	
125.59	424	2-Year
125.61	430	
125.71	461	
125.81	492	
125.91	522	
126.01	553	
126.09	578	100-Year
126.11	584	
126.21	614	
126.31	645	
126.41	676	
126.51	707	
126.61	737	
126.71	768	
126.81	799	

Infiltration Trench	
Length (m)	64.0
Width (m)	12.0
Area (m^2)	768.0
Depth Below Outlet (m)	1.4
Porosity	0.4
Permanent Pool Volume	**430.1**
Infiltration Rate (m/hr)	0.1
Infiltration Outflow (L/s)	**21.3**

Outflow to Trench				
		5-Year	**100-Year**	**2-Year**
Areas	**Structure**	**Outflow (L/s)**	**Outflow (L/s)**	**Outflow (L/s)**
B1 - B4	MH19	40	41	38
B5 - B10	MH20	20	20	19
B11 - B18	MH21	17	18	17
Flow to Infiltration Trench (L/s)		**77**	**79**	**73**

Discharge

Stage Storage Discharge Table

	Pipe Outlet
Invert Elevation	125.61
Centroid Elevation	125.69
Orifice Width	155 mm
Orifice Area (m^2)	0.019
C	0.600

Elevation (from centroid)	Orifice		Total Flow		Storage	
	H [m]	Q [l/s]	Q [l/s]	Q(l/s/ha)	m^3	
125.69	x	x	x	x	430	
125.71	0.02	8	8	2	461	
125.81	0.12	18	18	5	492	
125.91	0.22	24	24	6	522	
126.01	0.32	28	28	8	553	
126.09	0.40	32	32	8	578	100-Year
126.11	0.42	33	33	9	584	
126.21	0.52	36	36	10	614	
126.31	0.62	40	40	10	645	
126.41	0.72	43	43	11	676	
126.51	0.82	45	45	12	707	
126.61	0.92	48	48	13	737	
126.71	1.02	51	51	13	768	
126.81	1.12	53	53	14	799	

	Area	10mm Rainfall Volume (m^3)
B1	3221	**23**
B2	2552	**23**
B3	3240	**29**
B4	3212	**19**
B5	1564	**9**
B6	1173	**7**
B7	2416	**13**
B8	1355	**9**
B9	1859	**10**
B10	1292	**11**
B11	2346	**14**
B12	1616	**10**
B13	1936	**12**
B14	1637	**10**
B15	2054	**13**
B16	1624	**10**
B17	2535	**17**
B18	2169	**14**
B19	989	**2**
B20	3349	**7**
Total	42140	**259**
Volume Available in Infiltration Trench Below Outlet Pipe (m^3)		**430**

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 (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	5yr PEAK FLOW (L/s)	10yr 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)			SLOPE (%)	VELOCITY (m/s)	AVAIL CAP (5yr)				
																									DIA	W	H			(L/s)	(%)			
	B1	CB1	CBMH2	0.32			0.70			0.22	0.22	10.00	1.80	11.80	104.19	122.14	178.56	64.27				64.27	91.46	86.48	375			0.25	0.802	27.18	29.72%			
	B2	CBMH2	CBMH4	0.26			0.89			0.23	0.45	11.80	0.83	12.63	95.57	111.99	163.65	119.34				119.34	133.02	40.37	450			0.20	0.810	13.68	10.29%			
	B3	CB3	CBMH4	0.32			0.89			0.29	0.29	10.00	0.68	10.68	104.19	122.14	178.56	83.67				83.67	133.02	33.20	450			0.20	0.810	49.35	37.10%			
	B4	CBMH4	MH19	0.32			0.59			0.19	0.93	12.63	0.79	13.42	92.10	107.90	157.65	237.48				237.48	286.47	46.58	600			0.20	0.982	48.99	17.10%			
	B5	CB5	CBMH6	0.16			0.59			0.09	0.09	10.00	0.67	10.67	104.19	122.14	178.56	26.75				26.75	43.87	35.00	250			0.50	0.866	17.11	39.01%			
	B6	CBMH6	CBMH8	0.12			0.60			0.07	0.16	10.67	0.73	11.40	100.76	118.10	172.63	45.59				45.59	91.46	35.00	375			0.25	0.802	45.87	50.16%			
	B7	CB7	CBMH8	0.24			0.54			0.13	0.13	10.00	0.71	10.71	104.19	122.14	178.56	37.79				37.79	59.68	35.00	300			0.35	0.818	21.89	36.67%			
	B8	CBMH8	CBMH10	0.14			0.64			0.09	0.38	11.40	1.11	12.51	97.33	114.06	166.69	102.80				102.80	200.65	59.75	525			0.20	0.898	97.84	48.76%			
	B9	CB9	CBMH10	0.19			0.52			0.10	0.10	10.00	0.45	10.45	104.19	122.14	178.56	28.00				28.00	59.68	21.91	300			0.35	0.818	31.68	53.08%			
	B10	CBMH10	MH20	0.13			0.82			0.11	0.58	12.51	0.37	12.88	92.57	108.46	158.46	149.82				149.82	286.47	21.65	600			0.20	0.982	136.65	47.70%			
	B11	CB11	CBMH12	0.23			0.59			0.14	0.14	10.00	0.94	10.94	104.19	122.14	178.56	40.08				40.08	91.46	45.01	375			0.25	0.802	51.37	56.17%			
	B12	CBMH12	CBMH14	0.16			0.60			0.10	0.24	10.94	0.72	11.66	99.50	116.61	170.44	65.11				65.11	133.02	35.00	450			0.20	0.810	67.91	51.05%			
	B13	CB13	CBMH14	0.19			0.61			0.12	0.12	10.00	0.92	10.92	104.19	122.14	178.56	34.21				34.21	59.68	45.00	300			0.35	0.818	25.47	42.68%			
	B14	CBMH14	CBMH16	0.16			0.60			0.10	0.45	11.66	0.65	12.30	96.19	112.72	164.72	120.79				120.79	200.65	35.00	525			0.20	0.898	79.86	39.80%			
	B15	CB15	CBMH16	0.21			0.61			0.13	0.13	10.00	0.92	10.92	104.19	122.14	178.56	36.30				36.30	59.68	45.00	300			0.35	0.818	23.38	39.18%			
	B16	CBMH16	CBMH18	0.16			0.60			0.10	0.67	12.30	0.59	12.90	93.41	109.45	159.92	175.15				175.15	286.47	34.98	600			0.20	0.982	111.31	38.86%			
	B17	CB17	CBMH18	0.25			0.68			0.17	0.17	10.00	0.93	10.93	104.19	122.14	178.56	49.92				49.92	91.46	45.00	375			0.25	0.802	41.53	45.41%			
	B18	CBMH18	MH21	0.22			0.64			0.14	0.99	12.90	0.26	13.16	91.02	106.64	155.79	249.41				249.41	392.18	16.54	675			0.20	1.062	142.76	36.40%			
		MH19	MH20							0.00	0.93	13.42	0.58	14.00	89.04	104.30	152.36	229.60				229.60	286.47	34.25	600			0.20	0.982	56.87	19.85%			
		MH20	MH21							0.00	1.51	14.00	0.52	14.52	86.93	101.82	148.72	364.86				364.86	519.40	35.63	750			0.20	1.139	154.54	29.75%			
		MH21	MH22							0.00	3.42	14.52	0.31	14.83	85.14	99.71	145.62	810.12				810.12	1,274.02	26.83	1050			0.20	1.425	463.90	36.41%			

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 = 998.071 / (TC+6.053)^0.814] 5 YEAR
[i = 1174.184 / (TC+6.014)^0.816] 10 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	2018-11-30

Sheet No: 1 of 1

APPENDIX F
CITY OF OTTAWA CHECKLIST

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City of Ottawa

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 (C102)
☐ 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).	Site Grading, Drainage, Sediment & Erosion Control Plan (C101)
☐ 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.	Site Grading, Drainage, Sediment & Erosion Control Plan (C101)
☐ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.	N/A
☐ Proposed phasing of the development, if applicable.	N/A
☐ Reference to geotechnical studies and recommendations concerning servicing.	Section 2.0 Backround Studies
☐ All preliminary and formal site plan submissions should have the following information: ○ Metric scale ○ North arrow (including construction North) ○ Key plan ○ Name and contact information of applicant and property owner ○ Property limits including bearings and dimensions ○ Existing and proposed structures and parking areas ○ Easements, road widening and rights-of-way ○ Adjacent street names	Site Grading, Drainage, Sediment & Erosion Control Plan (C101)

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.	Section 5.2 Sanitary Sewer

☐ 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.	Section 5.2 Sanitary Sewer
☐ 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)	Section 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 & 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.	Section 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.	Section 6.0 Stormwater Management
☐ Description of the stormwater management concept with facility locations and descriptions with references and supporting information.	Section 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 necessary, altered by the proposed development with applicable approvals.	Site Grading, Drainage, Sediment & Erosion Control Plan
☐ Calculate pre-and post development peak flow rates including a description of existing site conditions and proposed impervious areas and drainage catchments in comparison to existing conditions.	Section 6.0 Stormwater Management Appendix F
☐ Any proposed diversion of drainage catchment areas from one outlet to another.	Section 6.0 Stormwater Management
☐ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	Section 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.	Section 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.	Site Grading, Drainage, Sediment & Erosion Control Plan (C101)
☐ 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.	Section 7.0 Sediment & 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	Section 8.0 Summary Section 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