Site Servicing and Stormwater Management Report – 2-Storey Chiropractor Office, 1994 St. Joseph Boulevard

Job #160401518

Prepared for:
Pulickal Holdings Inc.

Prepared by:
Stantec Consulting Ltd.

July 17, 2020

Revision	Description	Prepared by		Checked by
0	Site Servicing and Stormwater Management Report	A. Paerez	July 17, 2020	K. Kilborn

Sign-off Sheet

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Prepared by ________________________________

(signature)

Ana M. Paerez, P.Eng.

Reviewed by ________________________________

(signature)

Kris Kilborn

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1.0 INTRODUCTION

Stantec Consulting Ltd. has been commissioned by Pulickal Holdings Inc. to prepare a site servicing and stormwater management (SWM) report in support of their site plan control application for their proposed development located on 1994 St. Joseph Boulevard in the city of Ottawa. The site is situated in the south-eastern quadrant of the intersection of St. Joseph Boulevard and Jeanne D'Arc Boulevard. The site location is shown in **Figure 1** below.

The proposed development will replace an existing dwelling with a 2-storey chiropractor office, comprised of a reception, a waiting room and four offices (see site plan in **Appendix E**) . The 0.15 ha site is presently zoned AM3 (Mixed Use / Commercial Zone), which permits the proposed development plan.

The intent of this report is to provide a servicing scenario for the site that is free of conflicts, provides on-site servicing in accordance with City of Ottawa design guidelines, and utilizes the existing local infrastructure in accordance with the guidelines outlined per consultation with City of Ottawa staff.

Figure 1: Location Plan

2.0 BACKGROUND

Documents referenced in preparation of the servicing and SWM design for the proposed 1994 St. Joseph Boulevard development include:

- Geotechnical Investigation – Proposed Commercial Development 1994 St. Joseph Boulevard, Orleans, City of Ottawa, Ontario, Kollaard Associates, June 21, 2019
- *City of Ottawa Sewer Design Guidelines*, 2nd Ed., City of Ottawa, October 2012
- Technical Bulletin ISTB-2014-02 Revision to Ottawa Design Guidelines – Water, City of Ottawa, May 2014
- Technical Bulletin PIEDTB-2016-01 Revisions to Ottawa Design Guidelines – Sewer, City of Ottawa, September 2016
- Technical Bulletin ISTB-2018-01 Revision to Ottawa Design Guidelines – Sewer, City of Ottawa, March 2018
- City of Ottawa Water Distribution Design Guidelines, City of Ottawa, October 2012
- Technical Bulletin ISTB-2018-02 Revision to Ottawa Design Guidelines – Water Distribution, City of Ottawa, March 2018

3.0 WATER SUPPLY SERVICING

3.1 BACKGROUND

The proposed development consists of one 2-storey commercial building complete with associated infrastructure and access areas. The proposed building consists of a reception, a waiting room and four offices. The site will be serviced via the existing watermain service that is connected to the existing 900 mm dia. watermain within the St. Joseph Boulevard right of way (ROW) at the northern boundary of the site (see **Drawing SSP-1**).

The property is located within the City's Pressure Zone 1E. The proposed ground elevation at the water service connection is approximately 64.29 m. Under normal operating conditions, hydraulic gradelines vary from approximately 110.6 m to 114.4 m, and under maximum day plus fire flow, the hydraulic gradeline is approximately 112.7 m as confirmed through boundary conditions provided by the City of Ottawa (see **Appendix A.3**).

3.2 WATER DEMANDS

Water demands for the development were estimated using the Ministry of Environment's Design Guidelines for Drinking Water Systems (2008) and the Ottawa Design Guidelines – Water Distribution (2010). A daily commercial rate of 28,000 L/ha/day has been applied for the gross building area. See **Appendix A.1** for detailed water demand estimates.

The average day demand (AVDY) for the site was determined to be 0.03 L/s. The maximum daily demand (MXDY) is 1.5 times the AVDY for residential areas, which results in 0.04 L/s. The peak hour demand (PKHR) is 1.8 times the MXDY for residential areas totaling 0.07 L/s.

The Fire Underwriter Survey (FUS) calculations were used to determine the fire flow required for the proposed site. Under the FUS guidelines the type of building construction was considered to be wood frame, without a sprinkler system. Based on FUS calculations (see **Appendix A.2**), the required fire flows for this development are 150 L/s (9,000 L/min).

3.3 PROPOSED WATER SERVICING

Per the City`s site boundary conditions and based on an approximate elevation of 64.29 m, adequate domestic water flows are available with a pressure range of 46.3 m (65.9 psi) to 50.1 m (71.3 psi). This pressure range is within the guidelines of 40-80 psi specified in the City of Ottawa Design Guidelines for Water Distribution.

The 112.7 m HGL provided for the proposed development under maximum day and fire flow demands of 150 L/s (9,000 L/min) results in a residual pressure of 48.4 m (68.8 psi), which is greater than the minimum allowable residual pressure of 20 psi under maximum day and fire flow conditions. An existing hydrant is located across from the subject site on St. Joseph Boulevard.

3.4 SUMMARY OF FINDINGS

The proposed development is serviced by the City of Ottawa's water distribution system. The available water supply is sufficient to meet both domestic and fire protection requirements.

4.0 WASTEWATER SERVICING

4.1 BACKGROUND

The site will be serviced via an existing 450 mm diameter sanitary sewer situated within the St. Joseph Boulevard ROW at the northern boundary of the site (see **Drawing SSP-1**). It is proposed to use the existing 135mm diameter sanitary service lateral coming out of the site.

4.2 DESIGN CRITERIA

As outlined in the City of Ottawa Sewer Design Guidelines and the Ontario Ministry of the Environment, Conservation and Parks (MECP) Design Guidelines for Sewage Works, the following criteria were used to calculate estimated wastewater flow rates and to size the sanitary sewers:

- Minimum Velocity – 0.6 m/s (0.8 m/s for upstream sections)
- Maximum Velocity – 3.0 m/s
- Manning roughness coefficient for all smooth wall pipes – 0.013
- Minimum size – 200mm dia. for residential areas
- Average Wastewater Generation (Commercial) – 28,000 L/ha/day
- Peak Factor – 1.5
- Extraneous Flow Allowance – 0.33 L/s/ha
- Manhole Spacing – 120 m
- Minimum Cover – 2.5m

4.3 PROPOSED SERVICING

The proposed site will be serviced by a gravity sewer which will direct the proposed wastewater peak flows (approx. 0.12 L/s with allowance for infiltration) to the existing service lateral and ultimately to the 450 mm diameter sanitary sewer on St. Joseph Boulevard. A sanitary sewer design sheet for the proposed service lateral is included in **Appendix B.1**. A full port backwater valve is to be installed on the sanitary service within the site to prevent any surcharge from the downstream sewer main from impacting the proposed property.

5.0 STORMWATER MANAGEMENT

5.1 OBJECTIVES

The objective of this stormwater management plan is to determine the measures necessary to control the quantity of stormwater released from the proposed development to the allowable release rate obtained from the criteria established during the pre-consultation process, and to provide sufficient detail for approval and construction.

5.2 SWM CRITERIA AND CONSTRAINTS

Criteria were established by combining current design practices outlined by the City of Ottawa Design Guidelines (2012), and through consultation with City of Ottawa staff. The following summarizes the criteria, with the source of each criterion indicated in brackets:

General

- Wherever feasible and practical, site-level measures should be used to reduce and control the volume and rate of runoff. (City of Ottawa)
- Assess impact of 100-year event outlined in the City of Ottawa Sewer Design Guidelines on major & minor drainage system (City of Ottawa)

Storm Sewer & Inlet Controls

- Size storm sewers to convey 5-year storm event under free-flow conditions using City of Ottawa I-D-F parameters (City of Ottawa - **Appendix G**).
- Site discharge rates for all storm events up to and including the 100-year storm to be restricted to the 5-year storm with a maximum pre-development runoff coefficient (c) of 0.50 (City of Ottawa - **Appendix G**).
- Proposed site to discharge into the existing 1500 mm diameter storm trunk sewer within the St. Joseph Boulevard ROW (City of Ottawa).
- 100-year Storm HGL to be a minimum of 0.30 m below building foundation footing (City of Ottawa). However, this is not a concern for this site since there is no basement and the storm service lateral will be equipped with a full port backwater valve.

Surface Storage & Overland Flow

- Maximum depth of flow under either static or dynamic conditions shall be less than 0.35 m (City of Ottawa).
- Provide adequate emergency overflow conveyance off-site (City of Ottawa).

Foundation drainage for the proposed building will be provided through the existing 100 mm diameter service lateral coming out of the site equipped with a full port backwater valve as shown on **Drawing SD-1**.

5.3 STORMWATER MANAGEMENT

The intent of the stormwater management plan presented herein is to mitigate any negative impact that the proposed development will have on the existing storm sewer infrastructure and adjacent properties while providing adequate capacity to service the proposed commercial development.

The proposed stormwater management plan is designed to detain runoff on the roof of the proposed building and underground below the parking areas to ensure that peak flows after re-development will not exceed the allowable site release rate detailed below.

5.3.1 Allowable Release Rate

Based on consultation with City of Ottawa staff, the peak post-development discharge from the subject site up to the 100-year storm is to be limited to that of the 5-year event discharge under pre-development conditions, to a maximum runoff coefficient, C of 0.50. Based on existing development conditions, prior to demolition of the site, the overall runoff coefficient was approximately 0.67 as shown in the detailed calculations included in **Appendix C.3**.

The predevelopment release rate for the site has been determined using the rational method based on the criteria above. The time of concentration for the existing development area of approximately 7 minutes was calculated using the Federal Aviation Agency Equation as shown in the detailed calculations included in **Appendix C.3**. Peak flow rates have been calculated using the rational method as follows:

$Q = 2.78\ C\ I\ A$
Where: Q = peak flow rate, L/s
A = drainage area, ha
I = rainfall intensity, mm/hr (per Ottawa IDF curves for a minimum T_c of 10 minutes)
C = site runoff coefficient (maximum of 0.50)

Detailed peak flow calculations are provided in **Appendix C.3**. The target release rate for the site is summarized in **Table 1** below.

Table 1: Storm Target Release Rate

Design Storm	Area (ha)	Runoff Coefficient (C)	Time of Concentration (min)	Site Storm Target Peak Outflow (L/s)
up to 100-year storm	0.15	0.50	10	21.72

5.3.2 Storage Requirements

The proposed site is 87% impervious and as such, it requires quantity control measures to meet the stormwater release criteria. It is proposed that rooftop storage in combination with underground storage on the parking areas be used to reduce the site's peak outflow to the target release rate. **Drawing SD-1** shows the drainage areas, ICD and roof drain schedules, location of underground storage areas, and proposed storm sewer infrastructure.

5.4 PCSWMM MODEL

Key parameters for the subject area are summarized below; an example input file is provided for the 100-year, 3hr Chicago storm which indicates all other parameters (see **Appendix C.2**). This analysis was performed using PCSWMM, which is a front-end GUI to the EPA-SWMM engine. Model files can be examined in any program which can read EPA-SWMM files version 5.1.013.

5.4.1 Hydrologic Parameters

Table 2 presents the general subcatchment parameters used:

Table 2: General Subcatchment Parameters

Subcatchment Parameter	Value
Infiltration Method	Horton
Max. Infil. Rate (mm/hr)	76.2
Min. Infil. Rate (mm/hr)	13.2
Decay Constant (1/hr)	4.14
N Imperv	0.013
N Perv	0.25
Dstore Imperv (mm)	1.57
Dstore Perv (mm)	4.67

Table 3 presents the individual parameters that vary for each of the proposed subcatchments.

Table 3: Subcatchment Parameters

Area ID	Area (ha)	Width (m)	Slope (%)	% Impervious	Runoff Coefficient
BLDG	0.041	56.0	1.0	1.0%	0.21
CB-1	0.096	106.0	1.0	84.3%	0.79
UNC-1	0.009	9.0	2.0	71.4%	0.70

Table 4 summarizes the storage node parameters used in the model. All catchbasins have been modeled as having an outlet invert as depicted on **Drawings SSP-1**. Detailed storage calculations are include in **Appendix C.2**.

Table 4: Storage Node Parameters

Storage Node	Drainage Area ID	Invert Elevation (m)	Rim Elevation[1] (m)	Total Depth (m)	Underground Storage Description
ROOF	BLDG	100.00	100.30	0.30	Roof Storage
CB1	CB-1	61.84	64.14	2.30	35m of 900 mm dia. pipe

1. The rim of the storage node represents the maximum allowable flow depth elevation above the storage node (equal to the top of the CB plus the static ponding depth).
2. Storage Node ROOF represents the proposed building roof storage so the rim and invert elevations used are assumed values to obtain the ponding depths.

5.4.2 Hydraulic Parameters

Storm sewers were modeled to assess friction losses, exit losses, to estimate storage requirements and to determine minor system peak outflows to the outlet. The detailed storm sewer design sheet is included in **Appendix C.1**.

Table 5 below presents the parameters for the outlet link which represents the proposed ICD. A discharge coefficient of 0.65 was applied for the modeled ICD.

Table 5: Outlet Parameters for Proposed Catchments

Orifice Name	Catchbasin ID	Tributary Area ID	ICD Type
CB1-IC	CB 1	CB-1	90mm diameter vertical orifice

The proposed building will provide roof storage. Roof storage requirements and controlled release rate estimates were obtained assuming Standard Watts Model R1100 Accuflow roof drains, 25% open. It is important to note that these roof drains can be replaced by other approved equivalent and that the number of drains can be reduced if multiple-notch drains are used (see detailed roof calculations in **Appendix C.2**). **Table 6** below presents the parameters for the outlet link and storage node used to represent the proposed roof drains and available storage.

Table 6: Roof Drain Assumptions for Proposed Building

Area ID	Area (m^2)	Number of Drains	Storage Available (m^3)
BLDG	400	2	16

5.4.3 Model Results and Discussion

Due to grading constraints, one minor subcatchment at the access road (UNC-1) cannot be graded to enter the site minor system and as such it will sheet drain uncontrolled to St. Joseph Boulevard. Runoff from this uncontrolled area has been considered in the overall release rate to the St. Joseph storm sewer.

Table 7 summarizes the peak uncontrolled 100-year catchment release rates for the uncontrolled catchment tributary to the outlet.

Table 7: Peak Uncontrolled (Non-Tributary) 100-Year Release Rate

Area ID	Area (ha)	Qrelease (L/s)
UNC-1	0.009	4.2

Table 8 provides a summary of the storage results from the PCSWMM model. Detailed storage calculations are provided in **Appendix C.2**.

Table 8: Post Development Storage Requirements

Storage Node ID	Catchbasin Top of Grate Elevation (m)	Available Storage (m^3)			Storage Requirements (m^3)	
		Surface Storage	Underground Storage	Total Storage	5-year	100-year
CB-1	64.04	3.0	22.3	25.3	9.0	21.0
ROOF	N/A	16.0	N/A	16.0	2.0	10.0

As can be seen in the above table sufficient storage is provided underground to contain the 100-year runoff from the site.

As an additional check, the rational method was also used as a comparison to assess the 5-year and 100-year storage requirements for the site as shown in detailed calculations included in **Appendix C.3.** The results show that the rational method storage requirements and resulting peak flows are relatively close to the results obtained in PCSWMM (see comparison table in **Appendix C.2**).

Table 9 summarizes the proposed ICD / roof drain release rates.

Table 9: Proposed ICD/Roof Drains 100-Year Release Rates

Drainage Area	ICD Type	Catchbasin ID	100-year Head (m)	100-Year Release Rate (L/s)
CB-1	90mm diameter Vertical Orifice	CB-1	0.87	16.6
BLDG	2 x Standard Watts Model R1100 Accuflow Roof Drains- 25% open	N/A	0.13	1.8

Table 10 shows the proposed stormwater release rate from the site as obtained from the PCSWMM model for the 5-year and 100-year, 3hr Chicago storms.

Table 10: Summary of Site Release Rates

Storm Event	Minor System 100-Year Release Rate (L/s)	Uncontrolled Area release Rate (L/s)	Target Release Rate (L/s)
100-year	18.2	4.2	21.7
5-year	14.6	2.4	

As can be seen in the table above, the total 100-year release rate from the site is approximately 22.4 L/s which exceeds the target release rate by 0.7 L/s.

5.5 QUALITY CONTROL

The site requires quality control measures to meet 80% Total suspended solids (TSS) removal to conform with the restrictions set out by the RVCA during pre-consultation (see correspondence in **Appendix C.4**). The proposed Stormceptor STC-300 has been sized to provide 88% TSS removal from the contributing parking lot areas. For further details regarding the sizing and specifications of the Stormceptor STC-300 see **Appendix C.4**.

6.0 GRADING AND DRAINAGE

The proposed development site measures approximately 0.16 ha in area. The topography across the site is relatively flat, and currently drains from south to north, with overland flow generally being directed to the St. Joseph Boulevard ROW (see **Drawing EX-1**). A detailed grading plan (see **Drawing GP-1**) has been provided to satisfy the stormwater management requirements, adhere to any geotechnical restrictions (see **Section 10.0**) for the site, and provide for minimum cover requirements for storm and sanitary sewers where possible. Site grading has been established to provide emergency overland flow routes required for stormwater management in accordance with City of Ottawa requirements.

7.0 UTILITIES

As the subject site lies within a mature developed area, Hydro, Bell, Gas and Cable servicing for the proposed development should be readily available within subsurface plant and adjacent overhead utility lines within the St. Joseph Boulevard ROW. Exact size, location and routing of utilities, along with determination of any off-site works required for redevelopment, will be finalized after design circulation.

8.0 APPROVALS

Pre-consultation with Ontario Ministry of Environment, Conservation and Parks (MECP) staff concerning Environmental Compliance Approval (ECA) under the Ontario Water Resources Act is forthcoming. A transfer of review submission ECA will be required for approval of the proposed building service connections and stormwater management system.

If the anticipated pumping volumes exceed 400,000 L/day of ground and/or surface water, a temporary Ministry of the Environment, Conservation and Parks (MECP) permit to take water (PTTW) will be required for this project during the construction phase.

Requirement for a MECP posting on the Environmental Activity Sector Registry (EASR) for water taking associated with sewer construction and building footing excavation will be confirmed by the geotechnical consultant.

9.0 EROSION CONTROL DURING CONSTRUCTION

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

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

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

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

Refer to **Drawing EC DS-1** for the proposed location of silt fences and other erosion control structures.

10.0 GEOTECHNICAL INVESTIGATION

A geotechnical Investigation report was prepared by Kollaard Associates on October 7, 2019 regarding conditions within the subject area and construction recommendations. For details which are not summarized below, please see the original Kollaard Report located in **Appendix D**. The field work for this investigation was carried out between June 6 and 7, 2019 in conjunction with an environmental site assessment at the site.

Beneath the asphaltic concrete at BH4 and from the surface at BH1, BH2 and BH3, a layer of grey crushed stone ranging in thickness from about 200 to 320 millimetres was encountered at the boreholes. Following the asphaltic concrete and grey crushed stone layers, fill materials consisting of grey silty sand, grey silty clay, yellow brown silty sand and yellow brown sand and gravel with a trace to some asphaltic concrete, organics, wood, concrete debris and glass was encountered. The fill materials ranged in thickness from about 0.48 to 3.15 metres and were encountered to depths of about 0.8 to 3.35 metres below the existing ground surface.

From the surface at borehole BH4, a layer of topsoil with a thickness of about 0.1 metres was encountered. The material was classified as topsoil based on the colour and the presence of organic materials.

Beneath the fill materials and topsoil, a deposit of red brown and/or grey silty clay was encountered at all of the boreholes. The results of the in situ vane shear testing and tactile examination carried out for the silty clay material indicate that the silty clay is firm to stiff in consistency. It is considered that the silty clay deposit layer is about 27.4 metres in thickness. Borehole BH2 was terminated on practical refusal to cone penetration on a boulder or cobbles at a depth of about 33.47 metres below the existing ground surface.

Groundwater seepage was encountered within each of the boreholes at the time of drilling at depths ranging between 1.2 and 2.1 metres below the existing ground surface. On June 10, 2019, groundwater was measured within standpipes installed within boreholes BH1 and BH3 at depths ranging between 1.2 to 3.2 metres below the existing ground surface. It should be noted that the groundwater levels may be higher during wet periods of the year such as the early spring.

The allowable bearing pressure is subject to a maximum grade raise of 0.5 metres above the existing ground surface and to maximum strip and pad footing widths of 1.5 metres.

11.0 CONCLUSIONS

11.1 WATER SERVICING

Based on the supplied boundary conditions for existing watermains and estimated domestic and fire flow demands for the subject site, it is anticipated that the existing 900 mm diameter watermain on St. Joseph Boulevard will provide sufficient capacity to sustain both the required domestic demands and emergency fire flow demands of the proposed site. It is proposed to use the existing water service coming out of the site at the northern boundary of the property to service the proposed building.

11.2 SANITARY SERVICING

The proposed site will be serviced by the existing 135mm diameter service lateral which will direct wastewater flows (approx. 0.12 L/s) to the existing 450 mm diameter sanitary sewer within the St. Joseph Boulevard ROW at the northern boundary of the property.

11.3 STORMWATER SERVICING

The proposed stormwater management plan is in compliance with the goals specified through consultation with the City of Ottawa. Rooftop storage and controlled roof release, and subsurface storage combined with a catchbasin ICD will limit 100-year post development peak flows from the site to the target peak outflow. Foundation drainage for the proposed building will be provided through the existing 100 mm diameter service lateral at the northern boundary of the property.

11.4 GRADING

Grading for the site has been designed to provide an emergency overland flow route to St. Joseph Boulevard. Erosion and sediment control measures will be implemented during construction to reduce the impact on existing infrastructure and adjacent properties.

11.5 UTILITIES

Utility infrastructure exists within overhead lines and subsurface plant within the St. Joseph Boulevard ROW at the northern boundary of the proposed site. It is anticipated that existing infrastructure will be sufficient to provide a means of distribution for the proposed site. Exact size, location and routing of utilities will be finalized after design circulation.

11.6 APPROVALS/PERMITS

A transfer of review submission ECA will be required for approval of the proposed building service connections and stormwater management system. Requirement for registration on the Environmental Activity Sector Registry (EASR) for water taking associated with sewer construction and building footing excavation will be confirmed by the geotechnical consultant. No other approval requirements from other regulatory agencies are anticipated.

Appendix A WATER SUPPLY SERVICING

A.1 DOMESTIC WATER DEMAND ESTIMATE

1994 St. Joseph Blvd - Domestic Water Demand Estimates

Demand conversion factors as per City Guidelines:

Commercial 28,000 L/ha-day

Building ID	Area (m^2)	Population	Daily Rate of Demand	Avg Day Demand		Max Day Demand [1]		Peak Hour Demand [2]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Commercial	772	-	2.8	1.5	0.03	2.3	0.04	4.1	0.07
Total Site :				**1.5**	**0.03**	**2.3**	**0.04**	**4.1**	**0.07**

For the purpose of this study it is predicted that retail and office facilities will be operated 12 hours per day.

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

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

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

A.2 FIRE FLOW REQUIREMENTS PER FUS GUIDELINES

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401518
Project Name: 1994 St. Joseph Blvd
Date: 5/14/2020
Fire Flow Calculation #: 1
Description: Personal Service Building

Notes:

Step	Task	Notes						Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Wood Frame						1.5	-
2	Determine Ground Floor Area of One Unit	-						387	-
	Determine Number of Adjoining Units	Includes adjacent wood frame structures separated by 3m or less						1	-
3	Determine Height in Storeys	Does not include floors >50% below grade or open attic space						2	-
4	Determine Required Fire Flow	(F = 220 x C x $A^{1/2}$). Round to nearest 1000 L/min						-	9000
5	Determine Occupancy Charge	Limited Combustible						-15%	7650
6	Determine Sprinkler Reduction	None						0%	0
		Non-Standard Water Supply or N/A						0%	
		Not Fully Supervised or N/A						0%	
		% Coverage of Sprinkler System						100%	
7	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	-	-
		North	> 45	17	2	31-60	Wood Frame or Non-Combustible	0%	1607
		East	20.1 to 30	26	2	31-60	Wood Frame or Non-Combustible	8%	
		South	30.1 to 45	14	2	0-30	Wood Frame or Non-Combustible	5%	
		West	20.1 to 30	26	2	31-60	Wood Frame or Non-Combustible	8%	
8	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min							9000
		Total Required Fire Flow in L/s							150.0
		Required Duration of Fire Flow (hrs)							2.00
		Required Volume of Fire Flow (m^3)							1080

A.3 BOUNDARY CONDITIONS

Johnson, Warren

From:	Mashaie, Sara <sara.mashaie@ottawa.ca>
Sent:	Friday, March 27, 2020 8:19 AM
To:	Johnson, Warren
Cc:	Kilborn, Kris; Murshid, Shoma
Subject:	RE: 1994 St. Joseph Boulevard Boundary Request
Attachments:	1994 St. Joseph Boulevard_Boundary Conditions_25March2020.docx

Hi Warren,

Please find attached the boundary conditions for the above-noted site.

Regards,

Sara Mashaie, P.Eng., ing.
Project Manager | Gestionnaire de Projet
Development Review, East Branch | Examen des projets d'aménagement, Secteur est
Planning, Infrastructure and Economic Development Department | Services de la planification, de l'infrastructure et du développement économique
City of Ottawa | Ville d'Ottawa
110 Laurier Avenue West. Ottawa, ON | 110, avenue. Laurier Ouest. Ottawa (Ontario) K1P 1J1
613.580.2424 ext./poste 27885, sara.mashaie@ottawa.ca

From: Johnson, Warren <Warren.Johnson@stantec.com>
Sent: March 10, 2020 1:55 PM
To: Mashaie, Sara <sara.mashaie@ottawa.ca>
Cc: Kilborn, Kris <kris.kilborn@stantec.com>
Subject: 1994 St. Joseph Boulevard Boundary Request

Would you be able to provide me with watermain hydraulic boundary conditions for a proposed site located at 1994 St. Joseph Boulevard? The site consists of an approximately 386m2 proposed 2 storey commercial building containing medical offices and associated parking area. The water servicing will connect to the existing 400mm watermain on St. Joseph Boulevard fronting the site.

Attached are the FUS calculations for the proposed building and site location map with the approximate proposed connection point.

Estimated domestic demands and fire flow requirements for the site are as follows (see attached):
Average Day Demand – 0.05L/s
Max Day Demand - 0.07L/s

Peak Hour Demand - 0.13L/s

Fire Flow Requirement per FUS – 150L/s

Warren Johnson C.E.T.
Civil Engineering Technologist

Direct: 613-784-2272
warren.johnson@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4

Stantec

Boundary Conditions
1994 St. Joseph Boulevard

Provided Information

Scenario	Demand	
	L/min	L/s
Average Daily Demand	3	0.05
Maximum Daily Demand	4	0.07
Peak Hour	8	0.13
Fire Flow Demand #1	9,000	150.00

Location

Results

Connection 1 – St. Joseph Boulevard

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	114.4	71.6
Peak Hour	110.6	66.1
Max Day plus Fire 1	112.7	69.2

[1] Ground Elevation = 64.1 m

Notes:

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.

Appendix B WASTEWATER SERVICING

B.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION:

1994 St Joseph Boulevard

DATE: 5/14/2020
REVISION: 1
DESIGNED BY: WAJ
CHECKED BY: AMP

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401518

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)=	4.0	AVG. DAILY FLOW / PERSON	280 L/p/day	MINIMUM VELOCITY	0.60 m/s
MIN PEAK FACTOR (RES.)=	2.0	COMMERCIAL	28,000 L/ha/day	MAXIMUM VELOCITY	3.00 m/s
PEAKING FACTOR (INDUSTRIAL):	2.4	INDUSTRIAL (HEAVY)	55,000 L/ha/day	MANNINGS n	0.013
PEAKING FACTOR (ICI >20%):	1.5	INDUSTRIAL (LIGHT)	35,000 L/ha/day	BEDDING CLASS	B
PERSONS / SINGLE	3.4	INSTITUTIONAL	28,000 L/ha/day	MINIMUM COVER	2.50 m
PERSONS / TOWNHOME	2.7	INFILTRATION	0.33 L/s/ha	HARMON CORRECTION FACTOR	0.8
PERSONS / APARTMENT	1.8				

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL	
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (ha)	UNITS SINGLE	UNITS TOWN	UNITS APT	POP.	CUMULATIVE AREA (ha)	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW (L/s)	AREA (ha)	ACCU. AREA (ha)
SITE	BLDG	MAIN	0.00	0	0	0	0	0.00	0	3.80	0.0	0.15	0.15

AREA ID NUMBER	INDUSTRIAL (L) AREA (ha)	INDUSTRIAL (L) ACCU. AREA (ha)	INDUSTRIAL (H) AREA (ha)	INDUSTRIAL (H) ACCU. AREA (ha)	INSTITUTIONAL AREA (ha)	INSTITUTIONAL ACCU. AREA (ha)	GREEN / UNUSED AREA (ha)	GREEN / UNUSED ACCU. AREA (ha)	C+I+I PEAK FLOW (L/s)	INFILTRATION TOTAL AREA (ha)	INFILTRATION ACCU. AREA (ha)	INFILT. FLOW (l/s)	TOTAL FLOW (L/s)	PIPE LENGTH (m)	DIA (mm)	MATERIAL	CLASS	SLOPE (%)	CAP. (FULL) (l/s)	CAP. V PEAK FLOW (%)	VEL. (FULL) (m/s)	VEL. (ACT.) (m/s)
SITE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.15	0.15	0.05	0.12	19.3	135	PVC	DR 28	1.00	11.5	**1.04%**	0.80	0.21
															135							

Appendix C STORMWATER MANAGEMENT

C.1 STORM SEWER DESIGN SHEET

Stantec

1994 St Joseph Boulevard

DATE:	2020-05-14
REVISION:	1
DESIGNED BY:	WAJ
CHECKED BY:	AMP

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: **160401518**

DESIGN PARAMETERS

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

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

MANNING'S n = 0.013 BEDDING CLASS = B

MINIMUM COVER: 2.00 m

TIME OF ENTRY 10 min

LOCATION			DRAINAGE AREA																								
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)
CB-1	CB1	STC300	0.00	0.10	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.000	0.000	0.079	0.079	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	22.9
BLDG	STC300	100	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.079	0.000	0.000	0.000	0.000	10.05	76.61	103.93	121.83	178.10	1.8	1.8	24.6
	100	MAIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.079	0.000	0.000	0.000	0.000	10.16	76.21	103.37	121.17	177.14	0.0	1.8	24.4
																				10.36							

LOCATION			PIPE SELECTION											
AREA ID NUMBER	FROM M.H.	TO M.H.	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
CB-1	CB1	STC300	3.0	200	200	CIRCULAR	PVC	SDR 35	1.00	33.3	**68.65%**	1.05	0.99	0.05
BLDG	STC300	100	6.1	300	300	CIRCULAR	PVC	SDR 35	1.00	96.2	**25.54%**	1.37	0.96	0.11
	100	MAIN	19.6	300	300	CIRCULAR	PVC	SDR 35	4.40	201.7	**12.11%**	2.87	1.60	0.20
				1500	1500									

C.2 PCSWMM INPUT FILE EXAMPLE, INPUT PARAMETERS, AND MRM RESULT COMPARISON

```
[TITLE]


[OPTIONS]
;;Options            Value
;;------------------ ------------
FLOW_UNITS           LPS
INFILTRATION         HORTON
FLOW_ROUTING         DYNWAVE
LINK_OFFSETS         ELEVATION
MIN_SLOPE            0
ALLOW_PONDING        YES
SKIP_STEADY_STATE    NO
START_DATE           05/09/2019
START_TIME           00:00:00
REPORT_START_DATE    05/09/2019
REPORT_START_TIME    00:00:00
END_DATE             05/10/2019
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:01:00
DRY_STEP             00:01:00
ROUTING_STEP         1
RULE_STEP            00:00:00
INERTIAL_DAMPING     PARTIAL
NORMAL_FLOW_LIMITED  BOTH
FORCE_MAIN_EQUATION  H-W
VARIABLE_STEP        0
LENGTHENING_STEP     0
MIN_SURFAREA         0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              6

[FILES]
USE HOTSTART "C:\ana's\st.joseph\PCSWMM\100-YR.HSF"

[EVAPORATION]
;;Type          Parameters
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO

[RAINGAGES]
;;               Rain      Time   Snow   Data
;;Name           Type      Intrvl Catch  Source
;;-------------- --------- ------ ------ ----------
RG1              INTENSITY 0:10   1.0    TIMESERIES OTT_CHI_100YR_03HR

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.
  Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope
  Length   Pack
;;-------------- ---------------- ---------------- -------- -------- --------
-------- -------- --------
;0.90
```

```
BLDG             RG1              ROOF             0.04119  1        56       1
  0
;0.79
CB-1             RG1              CB1              0.0961   84.285   106      1
  0
;0.70
UNC-1            RG1              UNC              0.008689 71.429   9        2
  0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo
PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ----------
----------
BLDG             0.013      0.25       1.57       4.67       0          OUTLET
CB-1             0.013      0.25       1.57       4.67       0          OUTLET
UNC-1            0.013      0.25       1.57       4.67       0          OUTLET

[INFILTRATION]
;;Subcatchment   MaxRate    MinRate    Decay      DryTime    MaxInfil
;;-------------- ---------- ---------- ---------- ---------- ----------
BLDG             76.2       13.2       4.14       7          0
CB-1             76.2       13.2       4.14       7          0
UNC-1            76.2       13.2       4.14       7          0

[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
OF1              60.23      FIXED        60.98            NO
UNC              0          FREE                          NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve
      Evap.
;;Name           Elev.    Depth    Depth    Curve      Params
      Frac.    Infiltration parameters
;;-------------- -------- -------- -------- ---------- -------- -------- --------
-------- -------- -----------------------
CB1              61.84    2.3      0        TABULAR    CB1-V                      0
      0
ROOF             100      0.3      0        TABULAR    ROOF-V                     0
      0
STC300           61.5     2.6      0        FUNCTIONAL 0        0        1.13     0
      0
STM100           60.79    3.24     0        FUNCTIONAL 0        0        1.13     0
      0

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet
Outlet     Init.      Max.
;;Name           Node             Node             Length     N          Offset
Offset     Flow       Flow
;;-------------- ---------------- ---------------- ---------- ---------- ----------
---------- ---------- ----------
C2               STC300           STM100           6.1        0.013      61.71
61.65      0          0
C3               STM100           OF1              19.6       0.013      61.09
60.23      0          0

[ORIFICES]
;;               Inlet            Outlet           Orifice      Crest      Disch.
 Flap Open/Close
```

```
;;Name           Node             Node             Type         Height     Coeff.
 Gate Time
;;-------------- ---------------- ---------------- ------------ ----------
---------- ---- ----------
CB1-IC           CB1              STC300           SIDE         61.84      0.65
 NO   0

[OUTLETS]
;;               Inlet            Outlet           Outflow    Outlet
Qcoeff/                    Flap
;;Name           Node             Node             Height     Type
QTable           Qexpon     Gate
;;-------------- ---------------- ---------------- ---------- ----------------
---------------- ---------- ----
ROOF-IC          ROOF             STC300           100        TABULAR/HEAD
ROOF-Q                     NO

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4
Barrels
;;-------------- ------------ ---------------- ---------- ---------- ----------
----------
C2               CIRCULAR     0.3              0          0          0          1

C3               CIRCULAR     0.3              0          0          0          1

CB1-IC           CIRCULAR     0.09             0          0          0

[TRANSECTS]

NC 0.02     0.02     0.013
X1 PrivateRd        2        0        6        0.0       0.0       0.0      0.0
0.0
GR 0.21     0        0        6

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------
C2               0          0.06       0          NO         0

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
ROOF-Q           Rating     0          0
ROOF-Q                      0.025      0.6309
ROOF-Q                      0.05       1.2618
ROOF-Q                      0.075      1.4195
ROOF-Q                      0.1        1.5773
ROOF-Q                      0.125      1.735
ROOF-Q                      0.15       1.8927

CB1-V            Storage    0          0
CB1-V                       0.9        49.5
CB1-V                       0.901      0
CB1-V                       2.2        0
CB1-V                       2.3        20
CB1-V                       2.301      0

ROOF-V           Storage    0          0
ROOF-V                      0.025      9
ROOF-V                      0.05       36
ROOF-V                      0.075      80
ROOF-V                      0.1        142
```

```
ROOF-V                       0.125      222
ROOF-V                       0.15       320

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
100yr+20_3hr_chicago             0:10       7.254876
100yr+20_3hr_chicago             0:20       9.050628
100yr+20_3hr_chicago             0:30       12.19056
100yr+20_3hr_chicago             0:40       19.162668
100yr+20_3hr_chicago             0:50       48.785964
100yr+20_3hr_chicago             1:00       214.2708
100yr+20_3hr_chicago             1:10       64.858236
100yr+20_3hr_chicago             1:20       32.78244
100yr+20_3hr_chicago             1:30       21.888468
100yr+20_3hr_chicago             1:40       16.484304
100yr+20_3hr_chicago             1:50       13.270512
100yr+20_3hr_chicago             2:00       11.142252
100yr+20_3hr_chicago             2:10       9.628668
100yr+20_3hr_chicago             2:20       8.496264
100yr+20_3hr_chicago             2:30       7.616376
100yr+20_3hr_chicago             2:40       6.912348
100yr+20_3hr_chicago             2:50       6.335736
100yr+20_3hr_chicago             3:00       5.854452

2yr3hrChicago                0:10       2.81459
2yr3hrChicago                0:20       3.49824
2yr3hrChicago                0:30       4.68718
2yr3hrChicago                0:40       7.30485
2yr3hrChicago                0:50       18.20881
2yr3hrChicago                1:00       76.805
2yr3hrChicago                1:10       24.07906
2yr3hrChicago                1:20       12.36376
2yr3hrChicago                1:30       8.32403
2yr3hrChicago                1:40       6.30341
2yr3hrChicago                1:50       5.09498
2yr3hrChicago                2:00       4.29133
2yr3hrChicago                2:10       3.71786
2yr3hrChicago                2:20       3.28762
2yr3hrChicago                2:30       2.95254
2yr3hrChicago                2:40       2.68388
2yr3hrChicago                2:50       2.46348
2yr3hrChicago                3:00       2.27921

OTT_CHI_100YR_03HR             0:00       0
OTT_CHI_100YR_03HR             0:10       6.05
OTT_CHI_100YR_03HR             0:20       7.54
OTT_CHI_100YR_03HR             0:30       10.16
OTT_CHI_100YR_03HR             0:40       15.97
OTT_CHI_100YR_03HR             0:50       40.65
OTT_CHI_100YR_03HR             1:00       178.56
OTT_CHI_100YR_03HR             1:10       54.05
OTT_CHI_100YR_03HR             1:20       27.32
OTT_CHI_100YR_03HR             1:30       18.24
OTT_CHI_100YR_03HR             1:40       13.74
OTT_CHI_100YR_03HR             1:50       11.06
OTT_CHI_100YR_03HR             2:00       9.29
OTT_CHI_100YR_03HR             2:10       8.02
OTT_CHI_100YR_03HR             2:20       7.08
OTT_CHI_100YR_03HR             2:30       6.35
OTT_CHI_100YR_03HR             2:40       5.76
OTT_CHI_100YR_03HR             2:50       5.28
OTT_CHI_100YR_03HR             3:00       4.88
```

```
[REPORT]
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]
Subcatch   BLDG             ROOF
Subcatch   CB-1             PARKING
Subcatch   UNC-1            UNC
Node       CB1              CB
Node       ROOF             roof
Node       STC300           MH
Node       STM100           MH
Link       C2               PIPE
Link       C3               PIPE
Link       CB1-IC           PIPE

[MAP]
DIMENSIONS       379937.556849999 5036461.09828624 379997.642150001 5036526.86022556
UNITS            Meters
```

Project #160401518, 1994 St. Joseph Blvd
Roof Drain Design Sheet, Area BLDG
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0006	0	0.025	9	0	0	0.025
0.050	0.0006	0.0013	1	0.050	36	1	1	0.050
0.075	0.0007	0.0014	2	0.075	80	1	2	0.075
0.100	0.0008	0.0016	5	0.100	142	3	5	0.100
0.125	0.0009	0.0017	9	0.125	222	5	9	0.125
0.150	0.0009	0.0019	16	0.150	320	7	16	0.150

Drawdown Estimate

Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
0.5	410.9	0.5	0.11415
1.9	991.5	1.4	0.38955
4.7	1737.7	2.7	0.87224
9.2	2604.4	4.5	1.59567
15.9	3561.4	6.7	2.58496

Rooftop Storage Summary

Total Building Area (sq.m)		400
Assume Available Roof Area (sq.m)	80%	320
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		2
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		16
Estimated 100 Year Drawdown Time (h)		1.7

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

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

From Watts Drain Catalogue

Head (m) L/s

Head (m)	Open	75%	50%	**25%**	Closed
0.025	0.3155	0.31545	0.31545	**0.31545**	0.31545
0.050	0.6309	0.6309	0.6309	**0.6309**	0.6309
0.075	0.9464	0.86749	0.78863	**0.70976**	0.6309
0.100	1.2618	1.10408	0.94635	**0.78863**	0.6309
0.125	1.5773	1.34067	1.10408	**0.86749**	0.6309
0.150	1.8927	1.57726	1.2618	**0.94635**	0.6309

Calculation Results (Volume from PCSWMM)

	5yr	**100yr**	**Available**
Qresult (L/s)	1.42	1.75	-
Depth (mm)	0.075	0.128	0.150
Volume (cu.m)	2.0	10.0	16.0
Draintime (hrs)	0.4	1.7	

Project 160401518 - Two Storey Commercial Building, 1994 St. Joseph Boulevard
Underground Storage Calculations

Area ID	Type of Storage	Pipe Dia. (mm) / Surface Length (m)	Pipe Length (m) / Surface Width (m)	Pipe/Stormtech Storage (m^3)	Surface Storage Available (m3)	Total Storage Available (m^3)	Equivalent Underground Area in PCSWMM (m^2)	Equivalent Surface Area in PCSWMM (m^2)
CB-1	Pipe Storage	900	35	22.3	1	23.3	49.5	20.0

Project #160401518, 1994 St. Joseph Blvd

Result Comparison between MRM and PCSWMM

	5-year Storm				100-year Storm			
	Modified Rational Metod		PCSWMM		Modified Rational Metod		PCSWMM	
Area ID	Storage Required (m^3)	Release Rate (L/s)	Storage Required (m^3)	Release Rate (L/s)	Storage Required (m^3)	Release Rate (L/s)	Storage Required (m^3)	Release Rate (L/s)
BLDG	6.7	1.6	2.0	1.4	15.7	1.9	10.0	1.8
CB-1	8.2	9.2	9.0	13.2	20.8	15.6	21.0	16.6

C.3 EXISTING DEVELOPMENT CALCULATIONS AND POST DEVELOPMENT MRM CALCULATIONS

Stormwater Management Calculations

File No: **160401518**
Project: **1994 St Joseph Blvd**
Date: **08-May-20**

Existing-Development Site Conditions:

Overall Runoff Coefficient for Existing Site

Runoff Coefficient Table						
Sub-catchment Area Catchment Type		**Area (ha) "A"**		**Runoff Coefficient "C"**	**"A x C"**	**Overall Runoff Coefficient**
Existing Development	Roof	0.040		0.90	0.036	
	Grass	0.050		0.20	0.010	
	Parking	0.060		0.90	0.054	
	Total		0.150		0.100	**0.67**

Federal Aviation Agency Equation (1970)- Time of Concentration

$$t_c = 1.8(1.1 - C)L^{1/2} s^{-0.333}$$

Where C = Rational formula drainage coefficient
s = channel slope (%)
t_c= time of concentration (min)

- Valid for small watersheds where sheet and overland flow dominate
- L, s and C are for the main flow path

L =	155.4	ft
S =	2.67	%
Tc =	7	min

Stormwater Management Calculations

File No: **160401518**
Project: **1994 St. Joseph Blvd**
Date: **08-May-20**

SWM Approach:
Post-development to 5-year pre-development with C=0.50

Post-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table

Sub-catchment Area Catchment Type	ID / Description		Area (ha) "A"		Runoff Coefficient "C"	"A x C"		Overall Runoff Coefficient
Roof with Storage	BLDG	Hard	0.040		0.90	0.036		
		Soft	0.000		0.20	0.000		
	Subtotal			0.040			0.036	0.90
Controlled - Tributary	CB-1	Hard	0.084		0.90	0.076		
		Soft	0.016		0.20	0.003		
	Subtotal			0.100			0.079	0.79
Uncontrolled - Non-Tributary	UNC-1	Hard	0.007		0.90	0.006		
		Soft	0.003		0.20	0.001		
	Subtotal			0.010			0.007	0.70
Total				**0.150**			**0.122**	
Overall Runoff Coefficient= C:								**0.81**

Total Roof Areas	**0.040 ha**
Total Tributary Surface Areas (Controlled and Uncontrolled)	**0.100 ha**
Total Tributary Area to Outlet	**0.140 ha**
Total Uncontrolled Areas (Non-Tributary)	**0.010 ha**
Total Site	**0.150 ha**

Stormwater Management Calculations

Project #160401518, 1994 St. Joseph Blvd
Modified Rational Method Calculatons for Storage

5 yr Intensity | $I = a/(t + b)^c$ | a = 998.071 | b = 6.053 | c = 0.814
City of Ottawa

t (min)	I (mm/hr)
10	104.19
20	70.25
30	53.93
40	44.18
50	37.65
60	32.94
70	29.37
80	26.56
90	24.29
100	22.41
110	20.82
120	19.47

Project #160401518, 1994 St. Joseph Blvd
Modified Rational Method Calculatons for Storage

100 yr Intensity | $I = a/(t + b)^c$ | a = 1735.688 | b = 6.014 | c = 0.820
City of Ottawa

t (min)	I (mm/hr)
10	178.56
20	119.95
30	91.87
40	75.15
50	63.95
60	55.89
70	49.79
80	44.99
90	41.11
100	37.90
110	35.20
120	32.89

5 AND 100 YEAR Target Release from the Site

Subdrainage Area: Existing Site Area
Area (ha): 0.1500
C: 0.50 (Minimum C of 0.50 as per City of Ottawa Consultation)

tc (min)	I (5 yr) (mm/hr)	Qtarget (L/s)
10	104.19	**21.72**

*Tc based on a minimum value of 10 minutes as per City requirements

5 YEAR Modified Rational Method for Entire Site

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

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	10.43	1.60	8.83	5.30	103.1	0.00
20	70.25	7.03	1.64	5.39	6.47	109.6	0.00
30	53.93	5.40	1.65	3.75	**6.75**	111.1	0.00
40	44.18	4.42	1.64	2.78	6.67	110.7	0.00
50	37.65	3.77	1.64	2.13	6.40	109.2	0.00
60	32.94	3.30	1.62	1.67	6.03	107.1	0.00
70	29.37	2.94	1.61	1.33	5.60	104.7	0.00
80	26.56	2.66	1.59	1.07	5.12	102.1	0.00
90	24.29	2.43	1.57	0.86	4.64	99.1	0.00
100	22.41	2.24	1.55	0.70	4.18	94.9	0.00
110	20.82	2.08	1.52	0.56	3.73	90.8	0.00
120	19.47	1.95	1.49	0.46	3.28	86.7	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Level	111.11	0.11	1.65	6.75	16.00	0.00

100 YEAR Modified Rational Method for Entire Site

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

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	19.86	1.77	18.08	10.85	130.9	0.00
20	119.95	13.34	1.84	11.50	13.80	141.8	0.00
30	91.87	10.22	1.87	8.35	15.02	146.4	0.00
40	75.15	8.36	1.88	6.47	15.54	148.3	0.00
50	63.95	7.11	1.89	5.23	**15.68**	148.8	0.00
60	55.89	6.22	1.88	4.33	15.60	148.5	0.00
70	49.79	5.54	1.88	3.66	15.37	147.7	0.00
80	44.99	5.00	1.87	3.13	15.04	146.4	0.00
90	41.11	4.57	1.86	2.71	14.64	144.9	0.00
100	37.90	4.21	1.85	2.36	14.19	143.3	0.00
110	35.20	3.91	1.84	2.08	13.70	141.5	0.00
120	32.89	3.66	1.83	1.83	13.18	139.6	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Level	148.81	0.15	1.89	15.68	16.00	0.00

Subdrainage Area: CB-1 — Controlled - Tributary
Area (ha): 0.10
C: 0.79

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	22.88	9.23	13.65	8.19
20	70.25	15.43	8.95	6.48	7.77
30	53.93	11.84	8.17	3.67	6.61
40	44.18	9.70	7.41	2.30	5.51
50	37.65	8.27	6.74	1.53	4.60
60	32.94	7.24	6.16	1.07	3.87
70	29.37	6.45	5.67	0.78	3.29
80	26.56	5.83	5.25	0.59	2.82
90	24.29	5.33	4.88	0.45	2.45
100	22.41	4.92	4.56	0.36	2.14
110	20.82	4.57	4.29	0.29	1.89
120	19.47	4.28	4.04	0.23	1.68

Orifice Diameter: 90.00 mm
Invert Elevation 61.84 m
T/G Elevation 64.04 m
Max Storage Depth 0.28 m (below ground)
Downstream W/L 60.98 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
2-year Water Level	62.12	0.28	9.23	8.19	22.25	OK

Subdrainage Area: CB-1 — Controlled - Tributary
Area (ha): 0.10
C: 0.99

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	49.02	15.31	33.71	20.23
20	119.95	32.93	15.58	17.35	20.82
30	91.87	25.22	14.73	10.49	18.87
40	75.15	20.63	13.78	6.85	16.43
50	63.95	17.56	12.88	4.68	14.04
60	55.89	15.34	12.04	3.31	11.91
70	49.79	13.67	11.12	2.55	10.72
80	44.99	12.35	10.32	2.03	9.76
90	41.11	11.29	9.65	1.63	8.82
100	37.90	10.41	9.08	1.33	7.96
110	35.20	9.66	8.57	1.09	7.20
120	32.89	9.03	8.12	0.91	6.54

Orifice Diameter: 90 mm — Volume in MH: *0.00 m3*
Invert Elevation 61.84 m
T/G Elevation 64.04 m — Subsurface storage (35m of 900mm Pipe) *22.25 m3*
Max Storage Depth 0.80 m (below ground)
Downstream W/L 60.98 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Level	62.64	0.80	15.58	20.82	22.25	OK
					1.44	

Stormwater Management Calculations

Project #160401518, 1994 St. Joseph Blvd
Modified Rational Method Calculatons for Storage

Subdrainage Area: UNC-1   Uncontrolled - Non-Tributary
Area (ha): 0.01
C: 0.70

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	2.03	2.03		
20	70.25	1.37	1.37		
30	53.93	1.05	1.05		
40	44.18	0.86	0.86		
50	37.65	0.73	0.73		
60	32.94	0.64	0.64		
70	29.37	0.57	0.57		
80	26.56	0.52	0.52		
90	24.29	0.47	0.47		
100	22.41	0.44	0.44		
110	20.82	0.41	0.41		
120	19.47	0.38	0.38		

SUMMARY TO OUTLET

		Vrequired	Vavailable*	
Tributary Area	0.140 ha			
Total 5yr Flow to Sewer	11 L/s	15	38 m^3	Ok
Non-Tributary Area	0.010 ha			
Total 5yr Flow Uncontrolled	2 L/s			
Total Area	0.150 ha			
Total 5yr Flow	13 L/s			
Target	22 L/s			

Project #160401518, 1994 St. Joseph Blvd
Modified Rational Method Calculatons for Storage

Subdrainage Area: UNC-1   Uncontrolled - Non-Tributary
Area (ha): 0.01
C: 0.88

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	4.34	4.34		
20	119.95	2.92	2.92		
30	91.87	2.23	2.23		
40	75.15	1.83	1.83		
50	63.95	1.56	1.56		
60	55.89	1.36	1.36		
70	49.79	1.21	1.21		
80	44.99	1.09	1.09		
90	41.11	1.00	1.00		
100	37.90	0.92	0.92		
110	35.20	0.86	0.86		
120	32.89	0.80	0.80		

SUMMARY TO OUTLET

		Vrequired	Vavailable*	
Tributary Area	0.140 ha			
Total 100yr Flow to Sewer	17 L/s	36	38 m^3	Ok
Non-Tributary Area	0.010 ha			
Total 100yr Flow Uncontrolled	4 L/s			
Total Area	0.150 ha			
Total 100yr Flow	22 L/s			
Target	22 L/s			

Project #160401518, 1994 St. Joseph Blvd
Roof Drain Design Sheet, Area BLDG
Standard Zurn Model Z-105-5 Control-Flo Single Notch Roof Drain

Rating Curve				Volume Estimation				Water Depth
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	(m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0006	0	0.025	9	0	0	0.025
0.050	0.0006	0.0013	1	0.050	36	1	1	0.050
0.075	0.0007	0.0014	2	0.075	80	1	2	0.075
0.100	0.0008	0.0016	5	0.100	142	3	5	0.100
0.125	0.0009	0.0017	9	0.125	222	5	9	0.125
0.150	0.0009	0.0019	16	0.150	320	7	16	0.150

Drawdown Estimate

Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
0.5	410.9	0.5	0.114148
1.9	991.5	1.4	0.389554
4.7	1737.7	2.7	0.872239
9.2	2604.4	4.5	1.595673
15.9	3561.4	6.7	2.584959

Rooftop Storage Summary

Total Building Area (sq.m)		400
Assume Available Roof Area (sq.m)	80%	320
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		2
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		16
Estimated 100 Year Drawdown Time (h)		2.5

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

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

From Watts Drain Catalogue

Head (m)	L/s Open	75%	50%	**25%**	Closed
0.025	0.3155	0.31545	0.31545	**0.31545**	0.31545
0.050	0.6309	0.6309	0.6309	**0.6309**	0.6309
0.075	0.9464	0.86749	0.78863	**0.70976**	0.6309
0.100	1.2618	1.10408	0.94635	**0.78863**	0.6309
0.125	1.5773	1.34067	1.10408	**0.86749**	0.6309
0.150	1.8927	1.57726	1.2618	**0.94635**	0.6309

Calculation Results

	5yr	100yr	Available
Qresult (cu.m/s)	0.0016	0.0019	-
Depth (m)	0.111	0.149	0.150
Volume (cu.m)	6.7	15.7	16.0
Draintime (hrs)	1.2	2.5	

C.4 RVCA WATER QUALITY CRITERIA CORRESPONDENCE AND SIZING

From: Eric Lalande
To: Paerez, Ana
Cc: Jamie Batchelor
Subject: Re: 1994 St. Joseph Boulevard
Date: Monday, March 23, 2020 5:39:15 PM

Hi Ana,

The RVCA will require enhanced water quality protection (80% TSS removal) for the proposed development. Opportunities for lot level low impact design elements are encouraged to be integrated where possible.

Thank you,

Eric Lalande, MCIP, RPP
Planner, RVCA
613-692-3571 x1137

From: Paerez, Ana <Ana.Paerez@stantec.com>
Sent: March 23, 2020 1:39 PM
To: Eric Lalande <eric.lalande@rvca.ca>
Cc: Kilborn, Kris <kris.kilborn@stantec.com>; Johnson, Warren <Warren.Johnson@stantec.com>; Johnston, Anthony <Anthony.Johnston@stantec.com>
Subject: 1994 St. Joseph Boulevard

Good afternoon Eric,
I am working on a re-development site on 1994 St. Joseph Boulevard. The proposed redevelopment will consist of a two-storey service building and associated parking and access infrastructure that will be serviced through an existing 1500 mm diameter trunk storm sewer on St. Joseph Boulevard that ultimately discharges into Billberry Creek (attached preliminary servicing plan).
Could you please confirm whether quality control is required for the site and if so, what is the criteria.
Thank you,

Ana Paerez, P. Eng.
Water Resources Engineer

Direct: 506 204-5856
Fax: 506 858-8698
Ana.Paerez@stantec.com

Stantec

Stormceptor Sizing Detailed Report

PCSWMM for Stormceptor

Project Information

Date	5/13/2020
Project Name	1994 St. Joseph Boulevard
Project Number	160401518
Location	Ottawa, ON

Stormwater Quality Objective

This report outlines how Stormceptor System can achieve a defined water quality objective through the removal of total suspended solids (TSS). Attached to this report is the Stormceptor Sizing Summary.

Stormceptor System Recommendation

The Stormceptor System model STC 300 achieves the water quality objective removing 88% TSS for a Fine (organics, silts and sand) particle size distribution.

The Stormceptor System

The Stormceptor oil and sediment separator is sized to treat stormwater runoff by removing pollutants through gravity separation and flotation. Stormceptor's patented design generates positive TSS removal for all rainfall events, including large storms. Significant levels of pollutants such as heavy metals, free oils and nutrients are prevented from entering natural water resources and the re-suspension of previously captured sediment (scour) does not occur.

Stormceptor provides a high level of TSS removal for small frequent storm events that represent the majority of annual rainfall volume and pollutant load. Positive treatment continues for large infrequent events, however, such events have little impact on the average annual TSS removal as they represent a small percentage of the total runoff volume and pollutant load.

Stormceptor is the only oil and sediment separator on the market sized to remove TSS for a wide range of particle sizes, including fine sediments (clays and silts), that are often overlooked in the design of other stormwater treatment devices.

Small storms dominate hydrologic activity, US EPA reports

"*Early efforts in stormwater management focused on flood events ranging from the 2-yr to the 100-yr storm. Increasingly stormwater professionals have come to realize that small storms (i.e. < 1 in. rainfall) dominate watershed hydrologic parameters typically associated with water quality management issues and BMP design. These small storms are responsible for most annual urban runoff and groundwater recharge. Likewise, with the exception of eroded sediment, they are responsible for most pollutant washoff from urban surfaces. Therefore, the small storms are of most concern for the stormwater management objectives of ground water recharge, water quality resource protection and thermal impacts control.*"

"*Most rainfall events are much smaller than design storms used for urban drainage models. In any given area, most frequently recurrent rainfall events are small (less than 1 in. of daily rainfall).*"

"Continuous simulation offers possibilities for designing and managing BMPs on an individual site-by-site basis that are not provided by other widely used simpler analysis methods. Therefore its application and use should be encouraged."

– US EPA Stormwater Best Management Practice Design Guide, Volume 1 – General Considerations, 2004

Design Methodology

Each Stormceptor system is sized using PCSWMM for Stormceptor, a continuous simulation model based on US EPA SWMM. The program calculates hydrology from up-to-date local historical rainfall data and specified site parameters. With US EPA SWMM's precision, every Stormceptor unit is designed to achieve a defined water quality objective.

The TSS removal data presented follows US EPA guidelines to reduce the average annual TSS load. Stormceptor's unit process for TSS removal is settling. The settling model calculates TSS removal by analyzing (summary of analysis presented in Appendix 2):

- Site parameters
- Continuous historical rainfall, including duration, distribution, peaks (Figure 1)
- Interevent periods
- Particle size distribution
- Particle settling velocities (Stokes Law, corrected for drag)
- TSS load (Figure 2)
- Detention time of the system

The Stormceptor System maintains continuous positive TSS removal for all influent flow rates. Figure 3 illustrates the continuous treatment by Stormceptor throughout the full range of storm events analyzed. It is clear that large events do not significantly impact the average annual TSS removal. There is no decline in cumulative TSS removal, indicating scour does not occur as the flow rate increases.

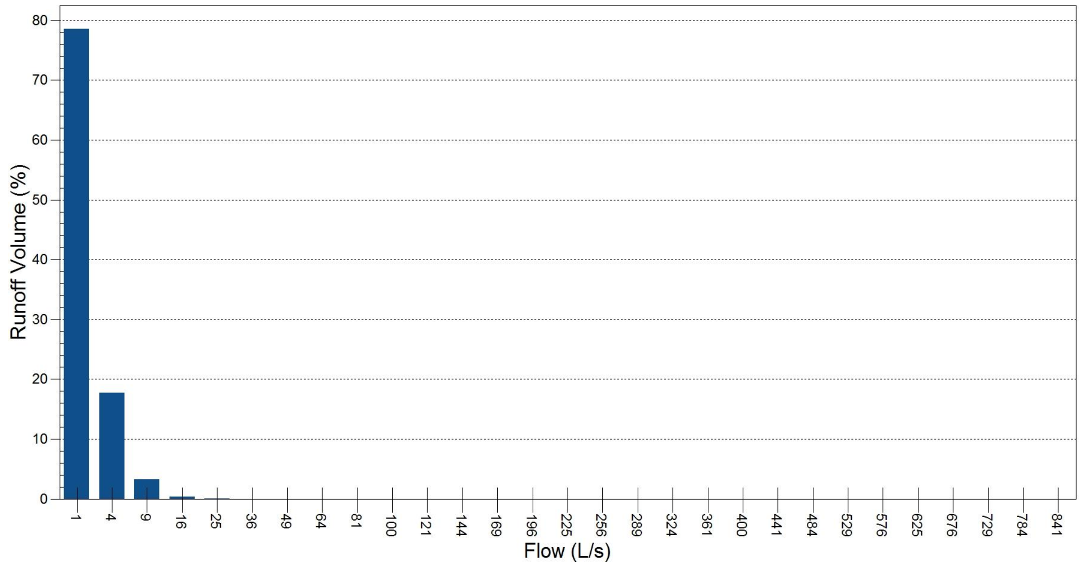


Figure 1. Runoff Volume by Flow Rate for OTTAWA MACDONALD-CARTIER INT'L A – ON 6000, 1967 to 2003 for 0.1 ha, 85% impervious. Small frequent storm events represent the majority of annual rainfall volume. Large infrequent events have little impact on the average annual TSS removal, as they represent a small percentage of the total annual volume of runoff.

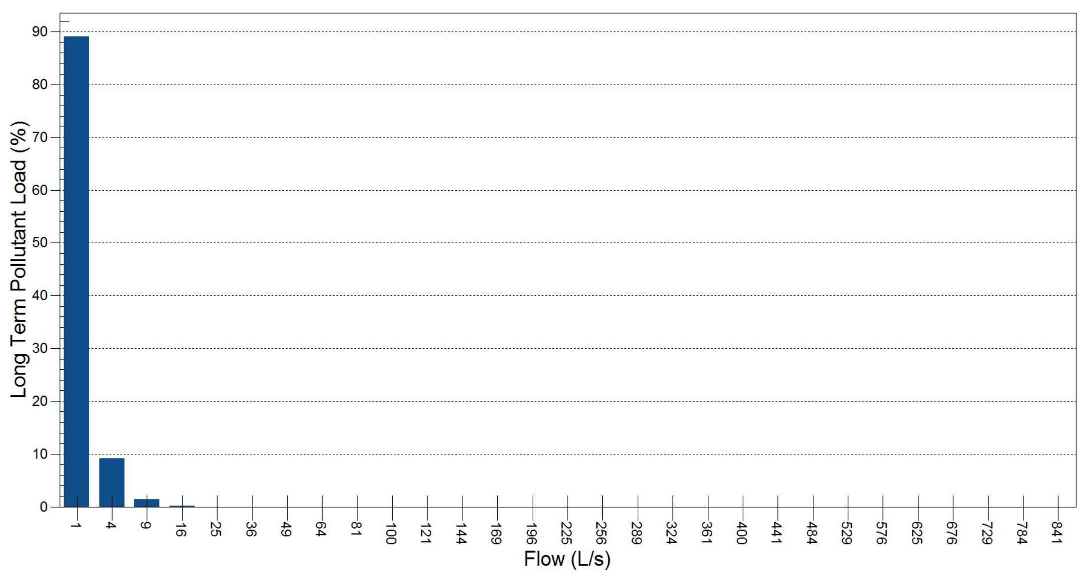
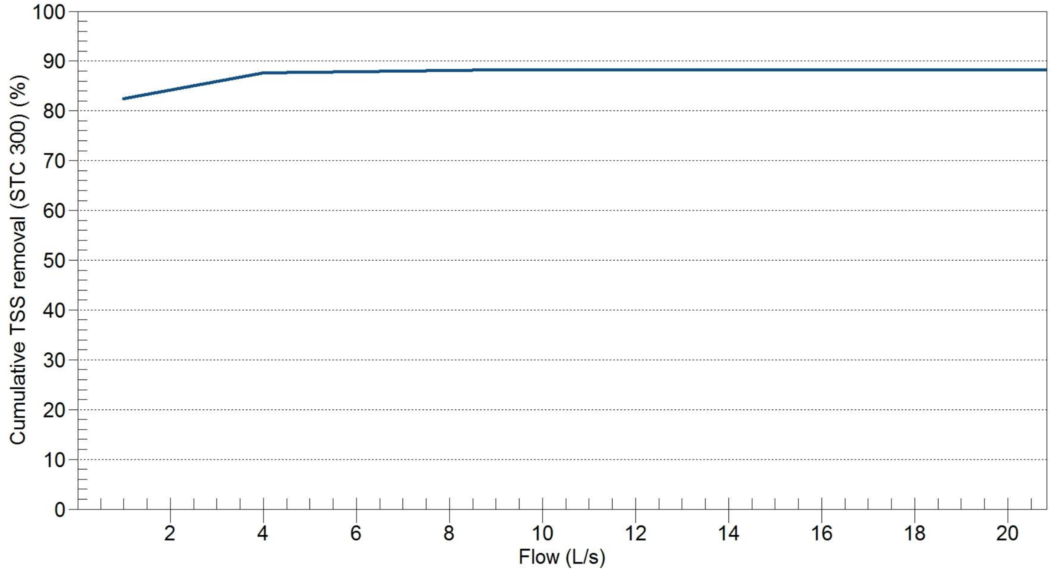


Figure 2. Long Term Pollutant Load by Flow Rate for OTTAWA MACDONALD-CARTIER INT'L A – 6000, 1967 to 2003 for 0.1 ha, 85% impervious. The majority of the annual pollutant load is transported by small frequent storm events. Conversely, large infrequent events carry an insignificant percentage of the total annual pollutant load.



Stormceptor Model	STC 300	Drainage Area (ha)	0.1
TSS Removal (%)	88	Impervious (%)	85

Figure 3. Cumulative TSS Removal by Flow Rate for OTTAWA MACDONALD-CARTIER INT'L A – 6000, 1967 to 2003. Stormceptor continuously removes TSS throughout the full range of storm events analyzed. Note that large events do not significantly impact the average annual TSS removal. Therefore no decline in cumulative TSS removal indicates scour does not occur as the flow rate increases.

Stormceptor®

Appendix 1
Stormceptor Design Summary

Project Information

Date	5/13/2020
Project Name	1994 St. Joseph Boulevard
Project Number	160401518
Location	Ottawa, ON

Designer Information

Company	Stantec Consulting Ltd.
Contact	Ana M. Paerez

Notes

N/A

Drainage Area

Total Area (ha)	0.1
Imperviousness (%)	85

The Stormceptor System model STC 300 achieves the water quality objective removing 88% TSS for a Fine (organics, silts and sand) particle size distribution.

Rainfall

Name	OTTAWA MACDONALD-CARTIER INT'L A
State	ON
ID	6000
Years of Records	1967 to 2003
Latitude	45°19'N
Longitude	75°40'W

Water Quality Objective

TSS Removal (%)	80

Upstream Storage

Storage (ha-m)	Discharge (L/s)
0	0

Stormceptor Sizing Summary

Stormceptor Model	TSS Removal %
STC 300	**88**
STC 750	92
STC 1000	93
STC 1500	93
STC 2000	95
STC 3000	96
STC 4000	97
STC 5000	97
STC 6000	98
STC 9000	98
STC 10000	98
STC 14000	99

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Particle Size Distribution

Removing silt particles from runoff ensures that the majority of the pollutants, such as hydrocarbons and heavy metals that adhere to fine particles, are not discharged into our natural water courses. The table below lists the particle size distribution used to define the annual TSS removal.

Fine (organics, silts and sand)								
Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
20	20	1.3	0.0004					
60	20	1.8	0.0016					
150	20	2.2	0.0108					
400	20	2.65	0.0647					
2000	20	2.65	0.2870					

Stormceptor Design Notes

- Stormceptor performance estimates are based on simulations using PCSWMM for Stormceptor version 1.0
- Design estimates listed are only representative of specific project requirements based on total suspended solids (TSS) removal.
- Only the STC 300 is adaptable to function with a catch basin inlet and/or inline pipes.
- Only the Stormceptor models STC 750 to STC 6000 may accommodate multiple inlet pipes.
- Inlet and outlet invert elevation differences are as follows:

Inlet and Outlet Pipe Invert Elevations Differences

Inlet Pipe Configuration	STC 300	STC 750 to STC 6000	STC 9000 to STC 14000
Single inlet pipe	75 mm	25 mm	75 mm
Multiple inlet pipes	75 mm	75 mm	Only one inlet pipe.

- Design estimates are based on stable site conditions only, after construction is completed.
- Design estimates assume that the storm drain is not submerged during zero flows. For submerged applications, please contact your local Stormceptor representative.
- Design estimates may be modified for specific spills controls. Please contact your local Stormceptor representative for further assistance.
- For pricing inquiries or assistance, please contact Imbrium Systems Inc., 1-800-565-4801.

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Appendix 2
Summary of Design Assumptions

SITE DETAILS

Site Drainage Area

Total Area (ha)	0.1	Imperviousness (%)	85

Surface Characteristics

Width (m)	63.24555
Slope (%)	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency

Sediment build-up reduces the storage volume for sedimentation. Frequency of maintenance is assumed for TSS removal calculations.

Maintenance Frequency (months)	12

Infiltration Parameters

Horton's equation is used to estimate infiltration

Max. Infiltration Rate (mm/h)	61.98
Min. Infiltration Rate (mm/h)	10.16
Decay Rate (s^{-1})	0.00055
Regeneration Rate (s^{-1})	0.01

Evaporation

Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow

Dry Weather Flow (L/s)	No

Upstream Attenuation

Stage-storage and stage-discharge relationship used to model attenuation upstream of the Stormceptor System is identified in the table below.

Storage ha-m	Discharge L/s
0	0

PARTICLE SIZE DISTRIBUTION

Particle Size Distribution

Removing fine particles from runoff ensures the majority of pollutants, such as heavy metals, hydrocarbons, free oils and nutrients are not discharged into natural water resources. The table below identifies the particle size distribution selected to define TSS removal for the design of the Stormceptor System.

Fine (organics, silts and sand)								
Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s		Particle Size µm	Distribution %	Specific Gravity	Settling Velocity m/s
20	20	1.3	0.0004					
60	20	1.8	0.0016					
150	20	2.2	0.0108					
400	20	2.65	0.0647					
2000	20	2.65	0.2870					

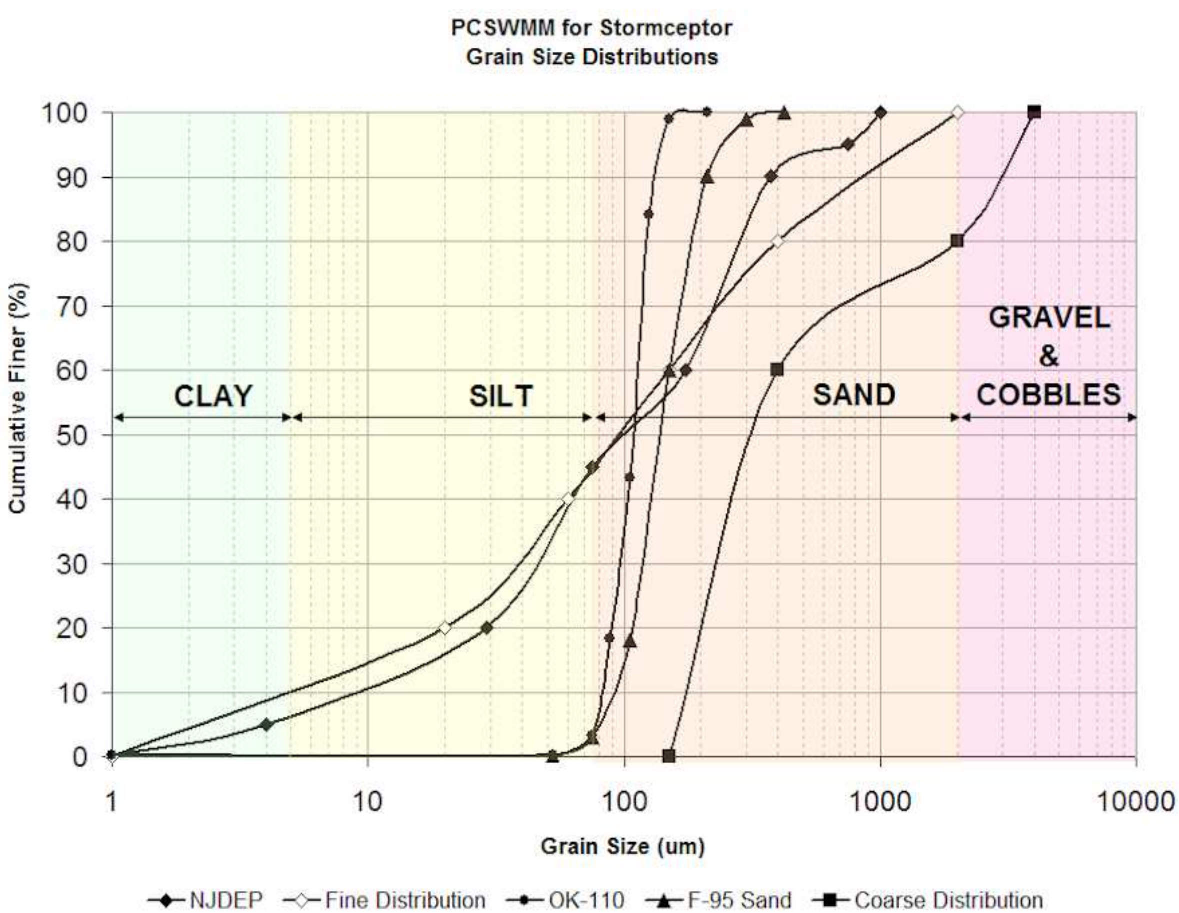

Figure 1. PCSWMM for Stormceptor standard design grain size distributions.

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TSS LOADING

TSS Loading Parameters

TSS Loading Function	Buildup / Washoff

Parameters

Target Event Mean Concentration (EMC) (mg/L)	125
Exponential Buildup Power	0.4
Exponential Washoff Exponential	0.2

HYDROLOGY ANALYSIS

PCSWMM for Stormceptor calculates annual hydrology with the US EPA SWMM and local continuous historical rainfall data. Performance calculations of the Stormceptor System are based on the average annual removal of TSS for the selected site parameters. The Stormceptor System is engineered to capture fine particles (silts and sands) by focusing on average annual runoff volume ensuring positive removal efficiency is maintained during all rainfall events, while preventing the opportunity for negative removal efficiency (scour).

Smaller recurring storms account for the majority of rainfall events and average annual runoff volume, as observed in the historical rainfall data analyses presented in this section.

Rainfall Station

Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A		
Rainfall File Name	ON6000.NDC	Total Number of Events	4537
Latitude	45°19'N	Total Rainfall (mm)	20978.1
Longitude	75°40'W	Average Annual Rainfall (mm)	567.0
Elevation (m)	371	Total Evaporation (mm)	1547.9
Rainfall Period of Record (y)	37	Total Infiltration (mm)	3133.3
Total Rainfall Period (y)	37	Percentage of Rainfall that is Runoff (%)	78.3

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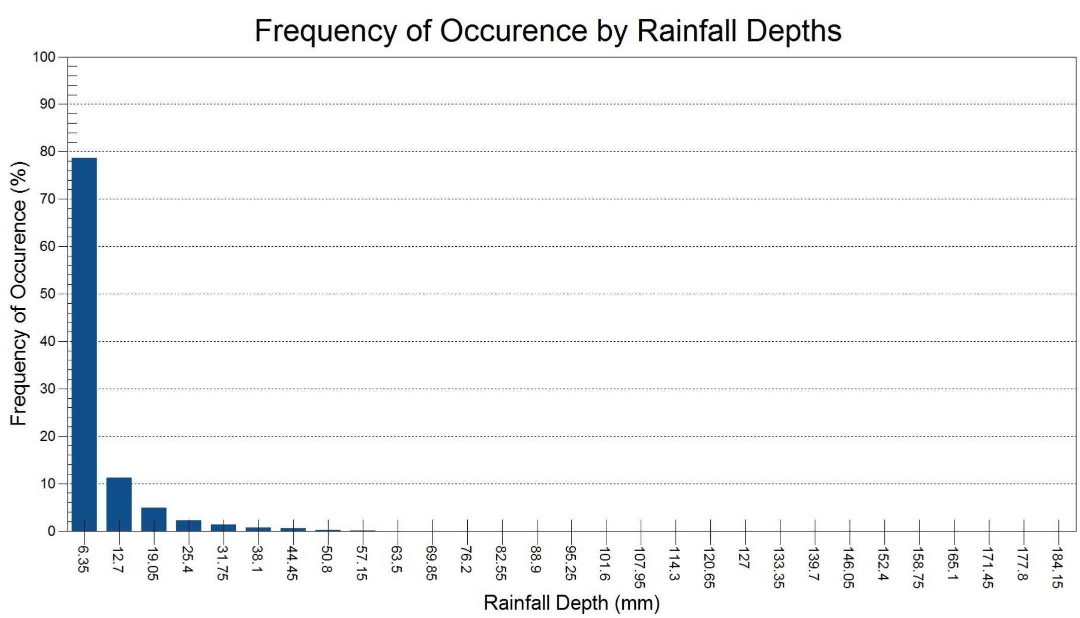
Rainfall Event Analysis

Rainfall Depth mm	No. of Events	Percentage of Total Events %	Total Volume mm	Percentage of Annual Volume %
6.35	3564	78.6	5671	27.0
12.70	508	11.2	4533	21.6
19.05	223	4.9	3434	16.4
25.40	102	2.2	2244	10.7
31.75	60	1.3	1704	8.1
38.10	33	0.7	1145	5.5
44.45	28	0.6	1165	5.6
50.80	9	0.2	416	2.0
57.15	5	0.1	272	1.3
63.50	1	0.0	63	0.3
69.85	1	0.0	64	0.3
76.20	1	0.0	76	0.4
82.55	0	0.0	0	0.0
88.90	1	0.0	84	0.4
95.25	0	0.0	0	0.0
101.60	0	0.0	0	0.0
107.95	0	0.0	0	0.0
114.30	1	0.0	109	0.5
120.65	0	0.0	0	0.0
127.00	0	0.0	0	0.0
133.35	0	0.0	0	0.0
139.70	0	0.0	0	0.0
146.05	0	0.0	0	0.0
152.40	0	0.0	0	0.0
158.75	0	0.0	0	0.0
165.10	0	0.0	0	0.0
171.45	0	0.0	0	0.0
177.80	0	0.0	0	0.0
184.15	0	0.0	0	0.0
190.50	0	0.0	0	0.0
196.85	0	0.0	0	0.0
203.20	0	0.0	0	0.0
209.55	0	0.0	0	0.0
>209.55	0	0.0	0	0.0

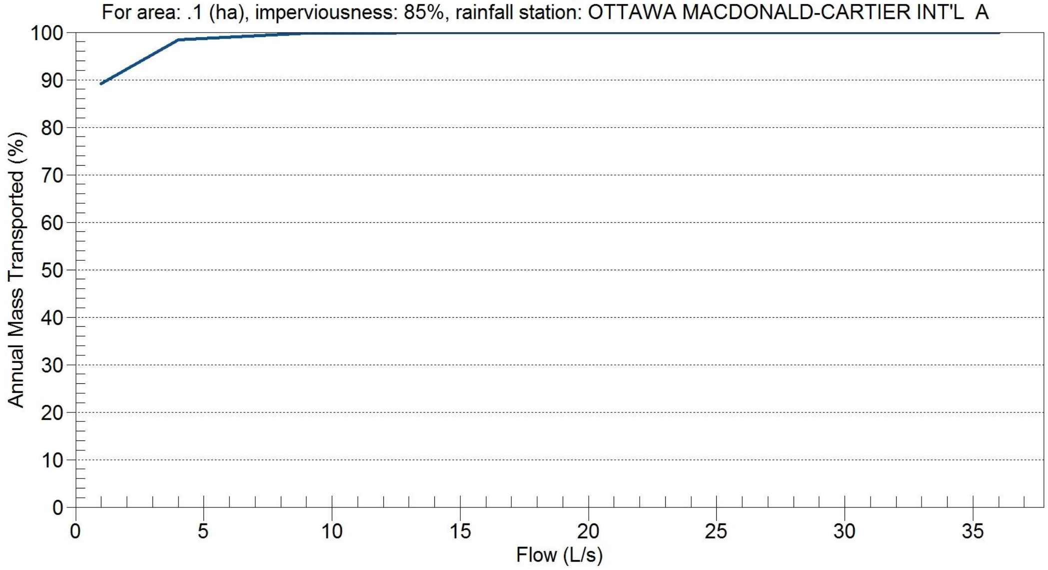


Pollutograph

Flow Rate L/s	Cumulative Mass %
1	89.2
4	98.4
9	99.8
16	100.0
25	100.0
36	100.0
49	100.0
64	100.0
81	100.0
100	100.0
121	100.0
144	100.0
169	100.0
196	100.0
225	100.0
256	100.0
289	100.0
324	100.0
361	100.0
400	100.0
441	100.0
484	100.0
529	100.0
576	100.0
625	100.0
676	100.0
729	100.0
784	100.0
841	100.0
900	100.0

Cumulative Mass Transported by Flow Rate

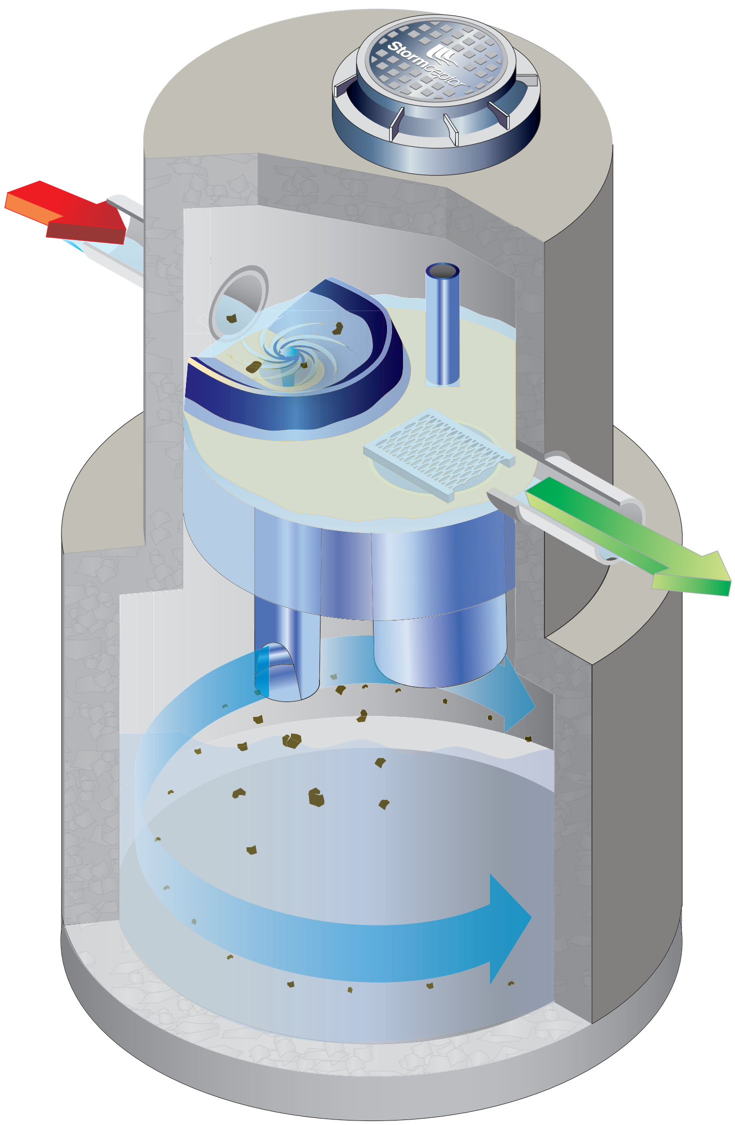
For area: .1 (ha), imperviousness: 85%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A



C.5 STORMCEPTOR OWNER MANUAL

Stormceptor®

Owner's Manual



Stormceptor is protected by one or more of the following patents:

Canadian Patent No. 2,137,942
Canadian Patent No. 2,175,277
Canadian Patent No. 2,180,305
Canadian Patent No. 2,180,338
Canadian Patent No. 2,206,338
Canadian Patent No. 2,327,768
U.S. Patent No. 5,753,115
U.S. Patent No. 5,849,181
U.S. Patent No. 6,068,765
U.S. Patent No. 6,371,690
U.S. Patent No. 7,582,216
U.S. Patent No. 7,666,303
Australia Patent No. 693.164
Australia Patent No. 707,133
Australia Patent No. 729,096
Australia Patent No. 779,401
Australia Patent No. 2008,279,378
Australia Patent No. 2008,288,900
Indonesia Patent No. 0007058
Japan Patent No. 3581233
Japan Patent No. 9-11476
Korean Patent No. 0519212
Malaysia Patent No. 118987
New Zealand Patent No. 314,646
New Zealand Patent No. 583,008
New Zealand Patent No. 583,583
South African Patent No. 2010/00682
South African Patent No. 2010/01796
Other Patents Pending

Table of Contents

Congratulations!

Your selection of a Stormceptor® means that you have chosen the most recognized and efficient stormwater oil/sediment separator available for protecting the environment. Stormceptor is a pollution control device often referred to as a “Hydrodynamic Separator (HDS)” or an “Oil Grit Separator (OGS)”, engineered to remove and retain pollutants from stormwater runoff to protect our lakes, rivers and streams from the harmful effects of non-point source pollution.

1 – Stormceptor Overview

Stormceptor is a patented stormwater quality structure most often utilized as a treatment component of the underground storm drain network for stormwater pollution prevention. Stormceptor is designed to remove sediment, total suspended solids (TSS), other pollutants attached to sediment, hydrocarbons and free oil from stormwater runoff. Collectively the Stormceptor provides spill protection and prevents non-point source pollution from entering downstream waterways.

Key benefits of Stormceptor include:

- Removes sediment, suspended solids, debris, nutrients, heavy metals, and hydrocarbons (oil and grease) from runoff and snowmelt.
- Will not scour or re-suspend trapped pollutants.
- Provides sediment and oil storage.
- Provides spill control for accidents, commercial and industrial developments.
- Easy to inspect and maintain (vacuum truck).
- “STORMCEPTOR” is *clearly* marked on the access cover (excluding inlet designs).
- Relatively small footprint.
- 3rd Party tested and independently verified.
- Dedicated team of experts available to provide support.

Model Types:

- STC (Standard)
- STF (Fiberglass)
- EOS (Extended Oil Storage)
- OSR (Oil and Sand Removal)
- MAX (Custom designed unit, specific to site)

Configuration Types:

- Inlet unit (accommodates inlet flow entry, and multi-pipe entry)
- In-Line (accommodates multi-pipe entry)
- Submerged Unit (accommodates the site’s tailwater conditions)
- Series Unit (combines treatment in two systems)

Please Maintain Your Stormceptor

To ensure long-term environmental protection through continued performance as originally designed for your site, **Stormceptor must be maintained**, as any stormwater treatment practice does. The need for maintenance is determined through inspection of the Stormceptor. Procedures for inspection are provided within this document. Maintenance of the Stormceptor is performed from the surface via vacuum truck.

If you require information about Stormceptor, or assistance in finding resources to facilitate inspections or maintenance of your Stormceptor please call your local Stormceptor Licensee or Imbrium® Systems.

2 – Stormceptor Operation & Components

Stormceptor is a flexibly designed underground stormwater quality treatment device that is unparalleled in its effectiveness for pollutant capture and retention using patented flow separation technology.

Stormceptor creates a non-turbulent treatment environment below the insert platform within the system. The insert diverts water into the lower chamber, allowing free oils and debris to rise, and sediment to settle under relatively low velocity conditions. These pollutants are trapped and stored below the insert and protected from large runoff events for later removal during the maintenance procedure.

With thousands of units operating worldwide, Stormceptor delivers reliable protection every day, in every storm. The patented Stormceptor design prohibits the scour and release of captured pollutants, ensuring superior water quality treatment and protection during even the most extreme storm events. Stormceptor's proven performance is backed by the longest record of lab and field verification in the industry.

Stormceptor Schematic and Component Functions

Below are schematics of two common Stormceptor configurations with key components identified and their functions briefly described.

Figure 1.

Inline Stormceptor

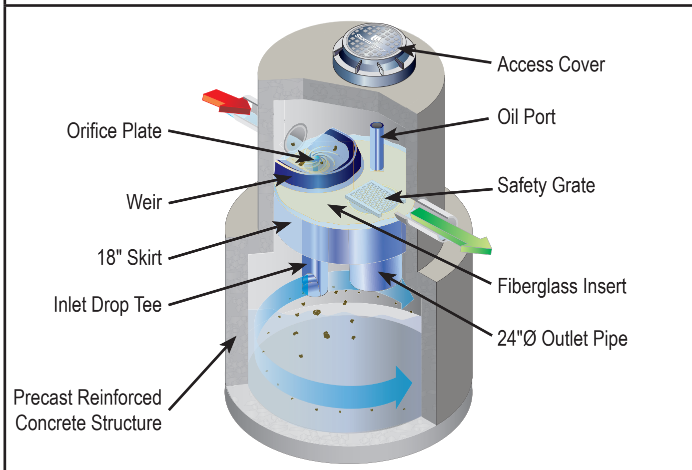
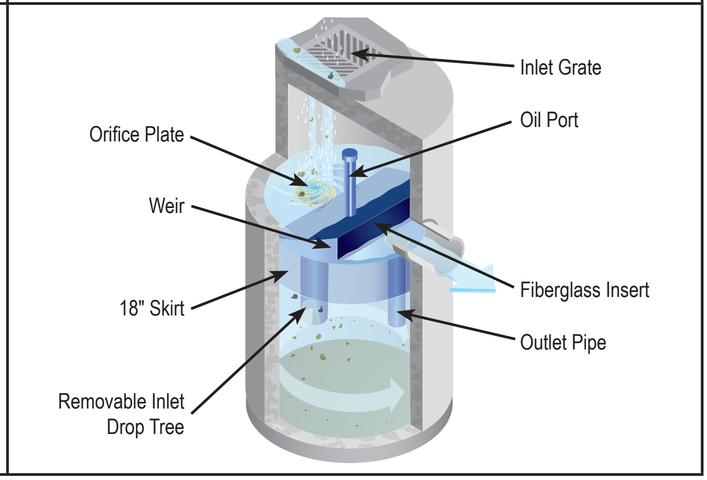


Figure 2.

Inlet Stormceptor



- **Manhole access cover** – provides access to the subsurface components
- **Precast reinforced concrete structure** – provides the vessel's watertight structural support
- **Fiberglass insert** – separates vessel into upper and lower chambers
- **Weir** – directs incoming stormwater and oil spills into the lower chamber
- **Orifice plate** – prevents scour of accumulated pollutants
- **Inlet drop tee** – conveys stormwater into the lower chamber
- **Fiberglass skirt** – provides double-wall containment of hydrocarbons
- **Outlet riser pipe** – conveys treated water to the upper chamber; primary vacuum line access port for sediment removal
- **Oil inspection port** – primary access for measuring oil depth and oil removal
- **Safety grate** – safety measure to cover riser pipe in the event of manned entry into vessel

3 – Stormceptor Identification

Stormceptor is available in both precast concrete and fiberglass vessels, with precast concrete often being the dominant material of construction.

In the Stormceptor, a patented, engineered fiberglass insert separates the structure into an upper chamber and lower chamber. The lower chamber will remain full of water, as this is where the pollutants are sequestered for later removal. Multiple Stormceptor model (STC, OSR, EOS, MAX and STF) configurations exist, each to be inspected and maintained in a similar fashion.

Each unit is easily identifiable as a Stormceptor by the trade name "Stormceptor" embossed on each access cover at the surface. To determine the location of "inlet" Stormceptor units with horizontal catch basin inlet, look down into the grate as the Stormceptor insert will be visible. The name "Stormceptor" is not embossed on inlet models due to the variability of inlet grates used/approved across North America.

Once the location of the Stormceptor is determined, the model number may be identified by comparing the measured depth from the fiberglass insert level at the outlet pipe's invert (water level) to the bottom of the tank using **Table 1**.

In addition, starting in 1996 a metal serial number tag containing the model number has been affixed to the inside of the unit, on the fiberglass insert. If the unit does not have a serial number, or if there is any uncertainty regarding the size of the unit using depth measurements, please contact your local Stormceptor Representative for assistance.

Sizes/Models

Typical general dimensions and capacities of the standard precast STC, EOS & OSR Stormceptor models in both USA and Canada/International (excluding South East Asia and Australia) are provided in **Tables 1 and 2**. Typical rim to invert measurements are provided later in this document. The total depth for cleaning will be the sum of the depth from outlet pipe invert (generally the water level) to rim (grade) and the depth from outlet pipe invert to the precast bottom of the unit. Note that depths and capacities may vary slightly between regions.

Table 1A. (US) Stormceptor Dimensions – Insert to Base of Structure

STC Model	Insert to Base (in.)	EOS Model	Insert to Base (in.)	OSR Model	Insert to Base (in.)	Typical STF m (in.)
450	60	4-175	60	65	60	1.5 (60)
900	55	9-365	55	140	55	1.5 (61)
1200	71	12-590	71			1.8 (73)
1800	105	18-1000	105			2.9 (115)
2400	94	24-1400	94	250	94	2.3 (89)
3600	134	36-1700	134			3.2 (127)
4800	128	48-2000	128	390	128	2.9 (113)
6000	150	60-2500	150			3.5 (138)
7200	134	72-3400	134	560	134	3.3 (128)
11000*	128	110-5000*	128	780*	128	
13000*	150	130-6000*	150			
16000*	134	160-7800*	134	1125*	134	

Notes:

1. *Depth Below Pipe Inlet Invert to the Bottom of Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

Table 1B. (CA & Int'l) Stormceptor Dimensions – Insert to Base of Structure

STC Model	Insert to Base (m)
300	1.5
750	1.5
1000	1.8
1500	2.8
2000	2.8
3000	3.7
4000	3.4
5000	4.0
6000	3.7
9000*	3.4
11000*	4.0
14000*	3.7

EOS Model	Insert to Base (m)
300	1.5
750	1.5
1000	1.8
2000	2.8
3000	3.7
4000	3.4
5000	4.0
6000	3.7
9000*	3.4
10000*	4.0
14000*	3.7

OSR Model	Insert to Base (m)
300	1.7
750	1.6
2000	2.6
4000	3.6
6000	3.7
9000*	3.6
14000*	3.7

Typical STF m (in.)
1.5 (60)
1.5 (61)
1.8 (73)
2.9 (115)
2.3 (89)
3.2 (127)
2.9 (113)
3.5 (138)
3.3 (128)

Notes:

1. *Depth Below Pipe Inlet Invert to the Bottom of Base Slab can vary slightly by manufacturing facility, and can be modified to accommodate specific site designs, pollutant loads or site conditions. Contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

Table 2A. (US) Storage Capacities

STC Model	Hydrocarbon Storage Capacity gal	Sediment Capacity ft^3	EOS Model	Hydrocarbon Storage Capacity gal	OSR Model	Hydrocarbon Storage Capacity gal	Sediment Capacity ft^3
450	86	46	**4-175**	175	**065**	115	46
900	251	89	**9-365**	365	**140**	233	58
1200	251	127	**12-590**	591			
1800	251	207	**18-1000**	1198			
2400	840	205	**24-1400**	1457	**250**	792	156
3600	840	373	**36-1700**	1773			
4800	909	543	**48-2000**	2005	**390**	1233	465
6000	909	687	**60-2500**	2514			
7200	1059	839	**72-3400**	3418	**560**	1384	690
11000*	2797	1089	**110-5000***	5023	**780***	2430	930
13000*	2797	1374	**130-6000***	6041			
16000*	3055	1677	**160-7800***	7850	**1125***	2689	1378

Notes:

1. *Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.*

   **Consist of two chamber structures in series.*

Table 2B. (CA & Int'l) Storage Capacities

STC Model	Hydrocarbon Storage Capacity L	Sediment Capacity L	EOS Model	Hydrocarbon Storage Capacity L	OSR Model	Hydrocarbon Storage Capacity L	Sediment Capacity L
300	300	1450	**300**	662	**300**	300	1500
750	915	3000	**750**	1380	**750**	900	3000
1000	915	3800	**1000**	2235			
1500	915	6205					
2000	2890	7700	**2000**	5515	**2000**	2790	7700
3000	2890	11965	**3000**	6710			
4000	3360	16490	**4000**	7585	**4000**	4700	22200
5000	3360	20940	**5000**	9515			
6000	3930	26945	**6000**	12940	**6000**	5200	26900
9000*	10555	32980	**9000***	19010	**9000***	9300	33000
11000*	10555	37415	**10000***	22865			
14000*	11700	53890	**14000***	29715	**14000***	10500	53900

Notes:

1. *Hydrocarbon & Sediment capacities can be modified to accommodate specific site design requirements, contact your local representative for assistance.*

**Consist of two chamber structures in series.*

4 – Stormceptor Inspection & Maintenance

Regular inspection and maintenance is a proven, cost-effective way to maximize water resource protection for all stormwater pollution control practices, and is required to insure proper functioning of the Stormceptor. Both inspection and maintenance of the Stormceptor is easily performed from the surface. Stormceptor's patented technology has no moving parts, simplifying the inspection and maintenance process.

Please refer to the following information and guidelines before conducting inspection and maintenance activities.

When is inspection needed?

- Post-construction inspection is required prior to putting the Stormceptor into service.
- Routine inspections are recommended during the first year of operation to accurately assess the sediment accumulation.
- Inspection frequency in subsequent years is based on the maintenance plan developed in the first year.
- Inspections should also be performed immediately after oil, fuel, or other chemical spills.

When is maintenance cleaning needed?

- For optimum performance, the unit should be cleaned out once the sediment depth reaches the recommended maintenance sediment depth, which is approximately 15% of the unit's total storage capacity (see **Table 2**). The frequency should be adjusted based on historical inspection results due to variable site pollutant loading.

- Sediment removal is easier when removed on a regular basis at or prior to the recommended maintenance sediment depths, as sediment build-up can compact making removal more difficult.
- The unit should be cleaned out immediately after an oil, fuel or chemical spill.

What conditions can compromise Stormceptor performance?

- If construction sediment and debris is not removed prior to activating the Stormceptor unit, maintenance frequency may be reduced.
- If the system is not maintained regularly and fills with sediment and debris beyond the capacity as indicated in **Table 2**, pollutant removal efficiency may be reduced.
- If an oil spill(s) exceeds the oil capacity of the system, subsequent spills may not be captured.
- If debris clogs the inlet of the system, removal efficiency of sediment and hydrocarbons may be reduced.
- If a downstream blockage occurs, a backwater condition may occur for the Stormceptor and removal efficiency of sediment and hydrocarbons may be reduced.

What training is required?

The Stormceptor is to be inspected and maintained by professional vacuum cleaning service providers with experience in the maintenance of underground tanks, sewers and catch basins. For typical inspection and maintenance activities, no specific supplemental training is required for the Stormceptor. Information provided within this Manual (provided to the site owner) contains sufficient guidance to maintain the system properly.

In unusual circumstances, such as if a damaged component needs replacement or some other condition requires manned entry into the vessel, confined space entry procedures must be followed. Only professional maintenance service providers trained in these procedures should enter the vessel. Service provider companies typically have personnel who are trained and certified in confined space entry procedures according to local, state, and federal standards.

What equipment is typically required for inspection?

- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones and caution tape
- Hard hat, safety shoes, safety glasses, and chemical-resistant gloves

Recommended Stormceptor Inspection Procedure:

- Stormceptor is to be inspected from grade through a standard surface manhole access cover.
- Sediment and oil depth inspections are performed with a sediment probe and oil dipstick.
- Oil depth is measured through the oil inspection port, either a 4-inch (100 mm) or 6-inch (150 mm) diameter port.
- Sediment depth can be measured through the oil inspection port or the 24-inch (610 mm) diameter outlet riser pipe.
- Inspections also involve a visual inspection of the internal components of the system.

Figure 3.

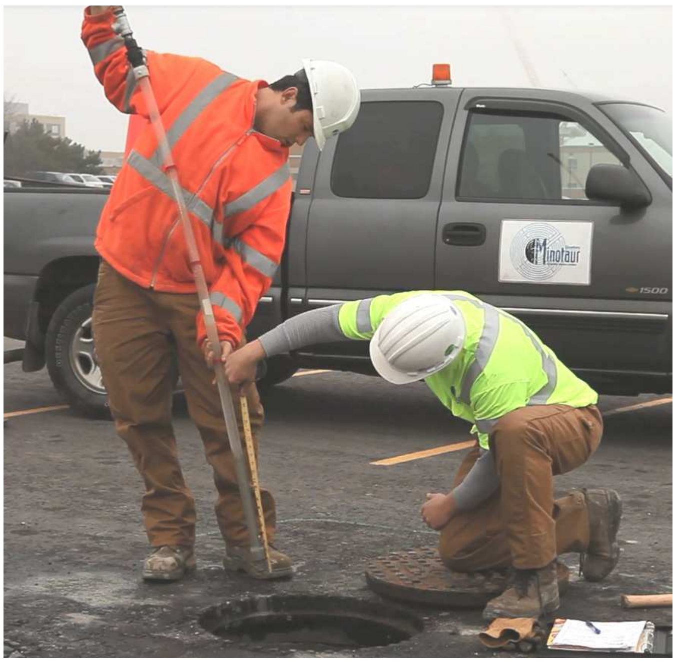
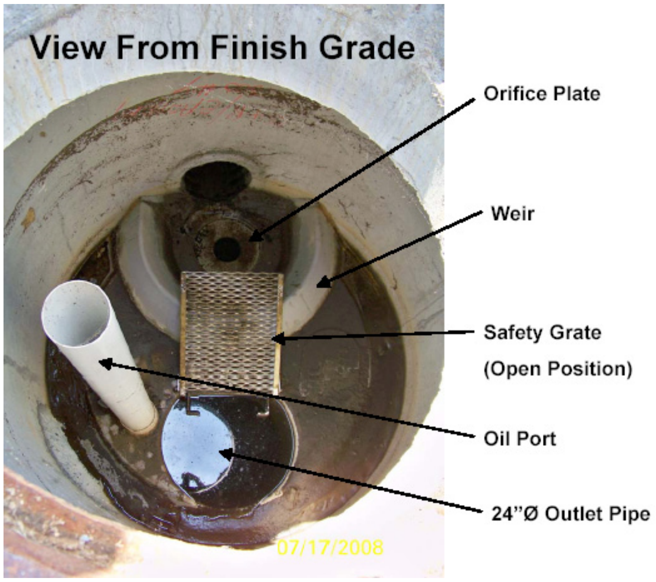


Figure 4.



What equipment is typically required for maintenance?

- Vacuum truck equipped with water hose and jet nozzle
- Small pump and tubing for oil removal
- Manhole access cover lifting tool
- Oil dipstick / Sediment probe with ball valve (typically ¾-inch to 1-inch diameter)
- Flashlight
- Camera
- Data log / Inspection Report
- Safety cones
- Hard hats, safety shoes, safety glasses, chemical-resistant gloves, and hearing protection for service providers
- Gas analyzer, respiratory gear, and safety harness for specially trained personnel if confined space entry is required

Recommended Stormceptor Maintenance Procedure

Maintenance of Stormceptor is performed using a vacuum truck.

No entry into the unit is required for maintenance. ***DO NOT ENTER THE STORMCEPTOR CHAMBER*** unless you have the proper personal safety equipment, have been trained and are qualified to enter a confined space, as identified by local Occupational Safety and Health Regulations (e.g. 29 CFR 1910.146 or Canada Occupational Safety and Health Regulations – SOR/86-304). Without the proper equipment, training and permit, entry into confined spaces can result in serious bodily harm and potentially death. Consult local, provincial, and/or state regulations to determine the requirements for confined space entry. Be aware, and take precaution that the Stormceptor fiberglass insert may be slippery. In addition, be aware that some units do not have a safety grate to cover the outlet riser pipe that leads to the submerged, lower chamber.

- Ideally maintenance should be conducted during dry weather conditions when no flow is entering the unit.
- Stormceptor is to be maintained through a standard surface manhole access cover.
- Insert the oil dipstick into the oil inspection port. If oil is present, pump off the oil layer into separate containment using a small pump and tubing.
- Maintenance cleaning of accumulated sediment is performed with a vacuum truck.
    - For 6-ft (1800 mm) diameter models and larger, the vacuum hose is inserted into the lower chamber via the 24-inch (610 mm) outlet riser pipe.
    - For 4-ft (1200 mm) diameter model, the removable drop tee is lifted out, and the vacuum hose is inserted into the lower chamber via the 12-inch (305 mm) drop tee hole.

Figure 5.

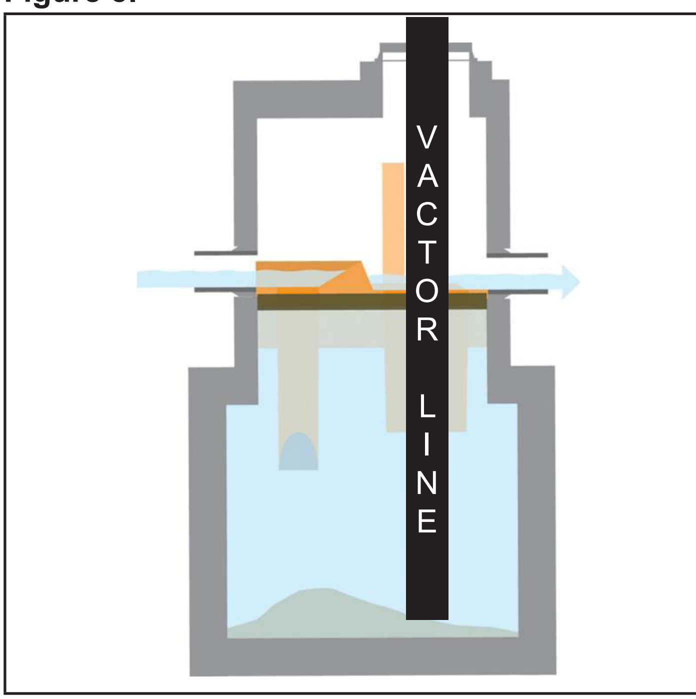
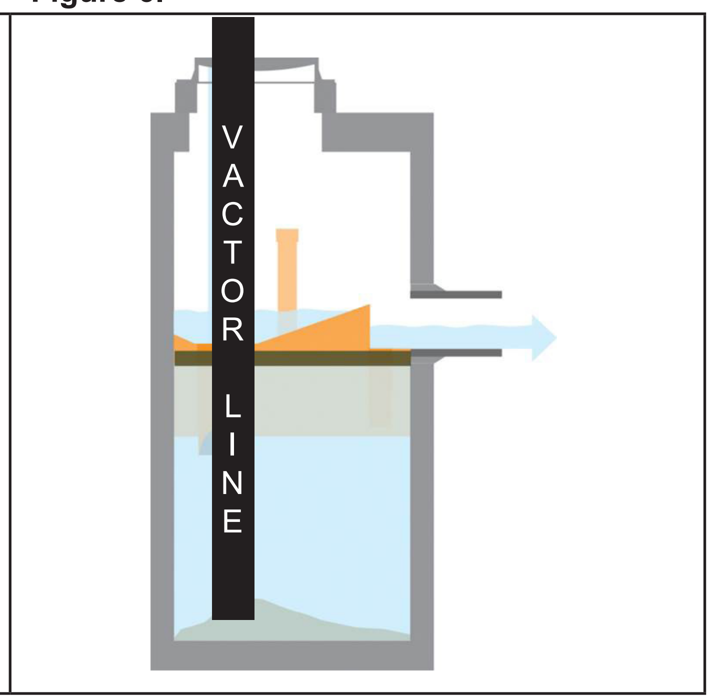


Figure 6.



- Using the vacuum hose, decant the water from the lower chamber into a separate containment tank or to the sanitary sewer, if permitted by the local regulating authority.
- Remove the sediment sludge from the bottom of the unit using the vacuum hose. For large Stormceptor units, a flexible hose is often connected to the primary vacuum line for ease of movement in the lower chamber.
- Units that have not been maintained regularly, have surpassed the maximum recommended sediment capacity, or contain damaged components may require manned entry by trained personnel using safe and proper confined space entry procedures.

Figure 7.

Figure 8.

A maintenance worker stationed at the above ground surface uses a vacuum hose to evacuate water, sediment, and debris from the system.

What is required for proper disposal?

The requirements for the disposal of material removed from Stormceptor units are similar to that of any other stormwater treatment Best Management Practices (BMP). Local guidelines should be consulted prior to disposal of the separator contents. In most areas the sediment, once dewatered, can be disposed of in a sanitary landfill. It is not anticipated that the sediment would be classified as hazardous waste. This could be site and pollutant dependent. In some cases, approval from the disposal facility operator/agency may be required.

What about oil spills?

Stormceptor is often implemented in areas where there is high potential for oil, fuel or other hydrocarbon or chemical spills. Stormceptor units should be cleaned immediately after a spill occurs by a licensed liquid waste hauler. You should also notify the appropriate regulatory agencies as required in the event of a spill.

What if I see an oil rainbow or sheen at the Stormceptor outlet?

With a steady influx of water with high concentrations of oil, a sheen may be noticeable at the Stormceptor outlet. This may occur because a hydrocarbon rainbow or sheen can be seen at very small oil concentrations (< 10 ppm). Stormceptor is effective at removing 95% of free oil, and the appearance of a sheen at the outlet with high influent oil concentrations does not mean that the unit is not working to this level of removal. In addition, if the influent oil is emulsified, the Stormceptor will not be able to remove it. The Stormceptor is designed for free oil removal and not emulsified or dissolved oil conditions.

What factors affect the costs involved with inspection/maintenance?
The Vacuum Service Industry for stormwater drainage and sewer systems is a well-established sector of the service industry that cleans underground tanks, sewers and catch basins. Costs to clean Stormceptor units will vary. Inspection and maintenance costs are most often based on unit size, the number of units on a site, sediment/oil/hazardous material loads, transportation distances, tipping fees, disposal requirements and other local regulations.

What factors predict maintenance frequency?
Maintenance frequency will vary with the amount of pollution on your site (number of hydrocarbon spills, amount of sediment, site activity and use, etc.). It is recommended that the frequency of maintenance be increased or reduced based on local conditions. If the sediment load is high from an unstable site or sediment loads transported from upstream catchments, maintenance may be required semi-annually. Conversely once a site has stabilized, maintenance may be required less frequently (for example: two to seven year, site and situation dependent). Maintenance should be performed immediately after an oil spill or once the sediment depth in Stormceptor reaches the value specified in **Table 3** based on the unit size.

Table 3A. (US) Recommended Sediment Depths Indicating Maintenance

STC Model	Maintenance Sediment depth (in)	EOS Model	Maintenance Sediment depth (in)	Oil Storage Depth (in)	OSR Model	Maintenance Sediment depth (in)
450	8	**4-175**	9	24	**065**	8
900	8	**9-365**	9	24	**140**	8
1200	10	**12-590**	11	39		
1800	15					
2400	12	**24-1400**	14	68	**250**	12
3600	17	**36-1700**	19	79		
4800	15	**48-2000**	16	68	**390**	17
6000	18	**60-2500**	20	79		
7200	15	**72-3400**	17	79	**560**	17
11000*	17	**110-5000***	16	68	**780***	17
13000*	20	**130-6000***	20	79		
16000*	17	**160-7800***	17	79	**1125***	17

Note:
1. *The values above are for typical standard units.*

   **Per structure.*

Table 3B. (CA & Int'l) Recommended Sediment Depths Indicating Maintenance

STC Model	Maintenance Sediment depth (mm)	EOS Model	Maintenance Sediment depth (mm)	Oil Storage Depth (mm)	OSR Model	Maintenance Sediment depth (mm)
300	225	**300**	225	610	**300**	200
750	230	**750**	230	610	**750**	200
1000	275	**1000**	275	990		
1500	400					
2000	350	**2000**	350	1727	**2000**	300
3000	475	**3000**	475	2006		
4000	400	**4000**	400	1727	**4000**	375
5000	500	**5000**	500	2006		
6000	425	**6000**	425	2006	**6000**	375
9000*	400	**9000***	400	1727	**9000***	425
11000*	500	**10000***	500	2006		
14000*	425	**14000***	425	2006	**14000***	425

Note:

1. *The values above are for typical standard units.*

   **Per structure.*

Replacement parts

Since there are no moving parts during operation in a Stormceptor, broken, damaged, or worn parts are not typically encountered. Therefore, inspection and maintenance activities are generally focused on pollutant removal. However, if replacements parts are necessary, they may be purchased by contacting your local Stormceptor Representative, or Imbrium Systems.

The benefits of regular inspection and maintenance are many – from ensuring maximum operation efficiency, to keeping maintenance costs low, to the continued protection of natural waterways – and provide the key to Stormceptor's long and effective service life.

Stormceptor Inspection and Maintenance Log

Stormceptor Model No: ______________________________

Allowable Sediment Depth: ______________________________

Serial Number: ______________________________

Installation Date: ______________________________

Location Description of Unit: ______________________________

Other Comments: ______________________________

Contact Information

Questions regarding the Stormceptor can be addressed by contacting your area Stormceptor Licensee, Imbrium Systems, or visit our website at www.stormceptor.com.

Stormceptor Licensees:

CANADA

Lafarge Canada Inc.	
www.lafargepipe.com	
403-292-9502 / 1-888-422-4022	Calgary, AB
780-468-5910	Edmonton, AB
204-958-6348	Winnipeg, MB, NW. ON, SK
Langley Concrete Group	
www.langleyconcretegroup.com	
604-502-5236	BC
Hanson Pipe & Precast Inc.	
www.hansonpipeandprecast.com	
519-622-7574 / 1-888-888-3222	ON
Lécuyer et Fils Ltée.	
www.lecuyerbeton.com	
450-454-3928 / 1-800-561-0970	QC
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Appendix D GEOTECHNICAL INVESTIGATION

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REPORT ON

GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
1994 ST. JOSEPH BOULEVARD, ORLEANS,
CITY OF OTTAWA, ONTARIO

Project # 190361

Submitted to:

M.J. Pulickal Holdings Inc.
1475 York Mills Drive
Ottawa, Ontario
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June 21, 2019

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June 21, 2019 190361

M.J. Pulickal Holdings Inc.
1475 York Mills Drive
Ottawa, Ontario
K4A 2N0

RE: GEOTECHNICAL INVESTIGATION
PROPOSED COMMERCIAL DEVELOPMENT
1994 ST. JOSEPH BOULEVARD
CITY OF OTTAWA, ONTARIO

Dear Sirs:

This report presents the results of a geotechnical investigation carried out for the above noted proposed commercial development. The purpose of the investigation was to identify the subsurface conditions at the site based on a limited number of boreholes. Based on the factual information obtained, Kollaard Associates Inc. was to provide recommendations and guidelines on the geotechnical engineering aspects of the project design; including construction considerations, which could influence design decisions.

BACKGROUND INFORMATION AND SITE GEOLOGY

The subject site for this assessment consists of a property located at civic address 1994 St. Joseph Boulevard, in the City of Ottawa, Ontario (see Key Plan, Figure 1). The site consists of about 0.14 hectares (0.36 acres) of land located on the south side of St. Joseph Boulevard, about 93 metres east of the intersection of Jeanne-d'Arc Boulevard South and St. Joseph Boulevard, in Orleans, City of Ottawa, Ontario.

It is understood that plans are being prepared to construct a commercial development at the site. It is understood that the proposed building will be two storey and will be of steel framed construction with a conventional cast in place concrete foundation and a floating slab. The proposed building will be serviced by municipal sewer and water supply. The proposed development will be accessed by local residential roadways. Surface drainage for the proposed development will be by means of swales, catch basins and storm sewers.

Surrounding land use is currently mixed residential and commercial development. The site is bordered on the north by St. Joseph Boulevard, on the east by a commercial development (Dairy Queen and Cash Money Mart), on the west by a Petro Canada Service Station and on the south by a multi-unit residential apartment building with an asphaltic surfaced parking lot.

Based on a review of the surficial geology map for the site area, it is expected that the site is underlain by fine textured glaciomarine deposits. Bedrock geology maps indicate that the bedrock underlying the site consists of limestone of the Ottawa Formation of dolomite and limestone of the Oxford Formation.

The local topography is mostly flat lying with a gentle slope from south to north across the property. The regional topography slopes north towards the Ottawa River located approximately 2.2 kilometres from the subject site.

Site Geology

Based on a review of the surficial geology map for the site area, it is expected that the site is underlain by fine textured glaciomarine deposits. Bedrock geology maps indicate that the bedrock underlying the site consists of limestone of the Ottawa Formation of dolomite and limestone of the Oxford Formation.

Based on a review of overburden thickness mapping for the site area, the overburden is estimated to be between about 55 to 61 metres in thickness above bedrock.

PROCEDURE

The field work for this investigation was carried out between June 6 and 7, 2019 in conjunction with an environmental site assessment at the site. The field work for the geotechnical report exclusive from the environmental assessment consisted of the placement of four boreholes, numbered BH1 to BH4 which were put down at the site using a rubber tire mounted drill rig equipped with a hollow stem auger owned and operated by CCC Group of Ottawa, Ontario.

Sampling of the overburden materials encountered at the borehole location was carried out at regular 0.75 metre depth intervals using a 50 millimetre diameter drive open conventional split spoon sampler in conjunction with standard penetration testing (ASTM D-1586 – Penetration Test and Split Barrel Sampling of Soils) and in situ vane shear testing (ASTM D-2573 Standard Test Method for Field Shear Test in Cohesive Soil). Each of the boreholes was advanced to depths of about 4.3 to 8.2 metres below the existing ground surface using 200 mm hollow stem augers. Borehole BH2 was continued to a depth of 33.5 metres below the existing ground surface as a probe hole using dynamic cone penetration testing. The soils were classified using the Unified Soil Classification System.

The subsurface soil conditions at the boreholes were identified based on visual examination of the samples recovered (ASTM D2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), and standard penetration tests (ASTM D-1586) as well as laboratory test results on select samples. Groundwater conditions at the borehole was noted at the time of drilling. Standpipes were installed at BH1 and BH3 for subsequent ground water level monitoring. The boreholes were loosely backfilled with the auger cuttings upon completion of drilling.

One soil sample was delivered to a chemical laboratory for testing for any indication of potential soil sulphate attack on concrete and corrosivity to buried steel.

One soil sample (BH3 – SS6 - 3.05 - 3.66) was submitted for Atterberg Limits (D4318) and Moisture Content (ASTM D2216). The soils were classified using the Unified Soil Classification System.

The field work was supervised throughout by a member of our engineering staff who located the boreholes in the field, logged the boreholes and cared for the samples obtained. A description of the subsurface conditions encountered at the boreholes are given in the attached Record of Borehole Sheets. The results of the laboratory testing of the soil samples are presented in the Laboratory Test Results section and Attachment A following the text in this report. The approximate location of the boreholes are shown on the attached Site Plan, Figure 2.

SUBSURFACE CONDITIONS

General

As previously indicated, a description of the subsurface conditions encountered at the boreholes is provided in the attached Record of Borehole Sheets following the text of this report. The borehole logs indicate the subsurface conditions at the specific drill locations only. Boundaries between zones on the logs are often not distinct, but rather are transitional and have been interpreted. Subsurface conditions at locations other than borehole locations may vary from the conditions encountered at the boreholes.

The soil descriptions in this report are based on commonly accepted methods of classification and identification employed in geotechnical practice. Classification was in general completed by visual-manual procedures in accordance with ASTM 2488 - Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) with select samples being classified by laboratory testing in accordance with ASTM 2487. Classification and identification of soil involves judgement and Kollaard Associates Inc. does not guarantee descriptions as exact, but infers accuracy to the extent that is common in current geotechnical practice.

The groundwater conditions described in this report refer only to those observed at the location and on the date the observations were noted in the report and on the borehole logs. Groundwater conditions may vary seasonally, or may be affected by construction activities on or in the vicinity of the site.

The following is a brief overview of the subsurface conditions encountered at the boreholes.

Fill

Beneath the asphaltic concrete at BH4 and from the surface at BH1, BH2 and BH3, a layer of grey crushed stone ranging in thickness from about 200 to 320 millimetres was encountered at the boreholes. Following the asphaltic concrete and grey crushed stone layers, fill materials consisting of grey silty sand, grey silty clay, yellow brown silty sand and yellow brown sand and gravel with a trace to some asphaltic concrete, organics, wood, concrete debris and glass was encountered. The fill materials ranged in thickness from about 0.48 to 3.15 metres and were encountered to depths of about 0.8 to 3.35 metres below the existing ground surface. The fill materials were fully penetrated at all borehole locations.

Topsoil

From the surface at borehole BH4, a layer of topsoil with a thickness of about 0.1 metres was encountered. The material was classified as topsoil based on the colour and the presence of organic materials. The identification of the topsoil layer is for geotechnical purposes only and does not constitute a statement as to the suitability of this layer for cultivation and sustainable plant growth.

Silty Clay

Beneath the fill materials and topsoil, a deposit of red brown and/or grey silty clay was encountered at all of the boreholes. In situ vane shear tests carried out in the silty clay deposit gave undrained shear strength values ranging from about 49 kilopascals to 63 kilopascals. The results of the in situ vane shear testing and tactile examination carried out for the silty clay material indicate that the silty clay is firm to stiff in consistency. Borehole BH2 was advanced through the silty clay by dynamic cone penetration testing to refusal at about 33.47 metres below the existing ground surface. Based on the increase in the standard cone penetration values in blow counts per 300 mm obtained at BH2 at a depth of about 30 metres below the existing ground surface, it is considered that the silty clay deposit layer is about 27.4 metres in thickness. Borehole BH2 was terminated on practical refusal to cone penetration on a boulder or cobbles at a depth of about 33.47 metres below the existing ground surface.

The results of Atterberg Limits tests and moisture content (ASTM D422) conducted on one soil sample (BH3 – SS6 - 3.05 - 3.65 metres) of the silty clay are presented in the following table and in Attachment A at the end of the report. The tested silty clay sample classifies as high plasticity in accordance with the Unified Soil Classification System. The results of the laboratory testing are located in Attachment A.

Table I – Atterberg Limit and Water Content Results

Sample	**Depth(metres)**	**LL (%)**	**PL (%)**	**PI (%)**	**W (%)**
BH3-SS6	3.05 - 3.65	72.2	28.3	43.9	83.1

LL: Liquid Limit PL: Plastic Limit PI: Plasticity Index w: water content
CH: Inorganic High Plastic Soils

Glacial Till

Borehole BH2 was advanced through the silty clay by dynamic cone penetration testing to refusal at about 33.47 metres below the existing ground surface. The dynamic cone penetration test at BH2 gave values ranging from WH to 93 blows per 0.3 metres. Based on the increase in the standard cone penetration values in blow counts per 300 mm obtained at BH2 at a depth of about 30 metres below the existing ground surface, it is considered that the silty clay deposit layer is about 27.4 metres in thickness. Borehole BH2 was terminated with practical refusal to cone penetration on either a boulder or cobbles at a depth of about 33.47 metres below the existing ground surface.

It is considered likely that the increase in blow count at about 8.2 metres depth indicates the possible presence of glacial till materials.

Groundwater

Groundwater seepage was encountered within each of the boreholes at the time of drilling at depths ranging between 1.2 and 2.1 metres below the existing ground surface. On June 10, 2019, groundwater was measured within standpipes installed within boreholes BH1 and BH3 at depths ranging between 1.2 to 3.2 metres below the existing ground surface. It should be noted that the groundwater levels may be higher during wet periods of the year such as the early spring.

Corrosivity on Reinforcement and Sulphate Attack on Portland Cement

The results of the laboratory testing of a soil sample for submitted for chemistry testing related to corrosivity is summarized in the following table.

Item	Threshold of Concern	Test Result	Comment
Chlorides (Cl)	Cl > 0.04 %	0.004	Negligible
pH	5.0 < pH	7.15	Basic Negligible concern
Resistivity	R < 20,000 ohm-cm	3180	Corrosive
Sulphates (SO_4)	SO_4 > 0.1%	0.0128	Negligible concern

The results were compared with Canadian Standards Association (CSA) Standards A23.1 for sulphate attack potential on concrete structures and posses a "negligible" risk for sulphate attack on concrete materials and accordingly, conventional GU or MS Portland cement may be used in the construction of the proposed concrete elements.

The pH value for the soil sample was reported to be at 7.15, indicating a durable condition against corrosion. This value was evaluated using Table 2 of Building Research Establishment (BRE) Digest 362 (July 1991).The pH is greater than 5.5 indicating the concrete will not be exposed to attack from acids.

The chloride content of the sample was also compared with the threshold level and present negligible concrete corrosion potential.

The results of the laboratory testing of a soil sample for resistivity and pH indicates the soil sample tested has an underground corrosion rate of about 0.75 loss-oz./ft^2/yr (3180 ohm-cm). Based on the findings of Fischer and Bue (1981) underground corrosion rates (loss-oz./ft^2/yr) of 0.30 and less are considered nonaggresive, from 0.30 to 0.75 the rate is considered slightly aggressive, from 0.75 to 2.0 the rate is considered aggressive and 2.0 and greater the rate is considered very aggressive. Accordingly, the above mentioned soil sample is considered to have a slightly to highly aggressive corrosion rate to reinforcement steel within below grade concrete walls. Based on the chemical test results, Type GU General use Hydraulic Cement may be used for this proposed development. Special protection is required for reinforcement steel within the concrete walls.

GEOTECHNICAL GUIDELINES AND RECOMMENDATIONS

General

This section of the report provides engineering guidelines on the geotechnical design aspects of the project based on our interpretation of the information from the test holes and the project requirements. It is stressed that the information in the following sections is provided for the guidance of the designers and is intended for this project only. Contractors bidding on or undertaking the works should examine the factual results of the investigation, satisfy themselves as to the adequacy of the information for construction, and make their own interpretation of the factual data as it affects their construction techniques, schedule, safety and equipment capabilities.

The professional services for this project include only the geotechnical aspects of the subsurface conditions at this site. The presence or implications of possible surface and/or subsurface contamination resulting from previous uses or activities at this site or adjacent properties, and/or resulting from the introduction onto the site of materials from offsite sources are outside the terms of reference for this report.

Foundation Excavation

Any excavation for the proposed structures will likely be carried out through fill material to bear on the native silty clay subgrade. The sides of the excavation should be sloped in accordance with the requirements of Ontario Regulation 213/91, s. 226 under the Occupational Health and Safety Act. According to the Act, the native soils at the site can be classified as Type 2 soil, however this classification should be confirmed by qualified individuals as the site is excavated and if necessary, adjusted.

It is expected that the side slopes of the excavation will be stable in the short term provided the walls are sloped at 1H:1V through the fill materials to 1.2 metres or less from the bottom of the excavation and provided no excavated materials are stockpiled within 3 metres of the top of the excavation.

Effect of Foundation Excavation on Adjacent Structures and City of Ottawa Services

As previously indicated, the proposed foundation excavation will be carried out through fill, topsoil and native silty clay. There will be no bedrock excavation or removal. As such, there will be no excavation processes which could contribute to vibration which could potentially damage adjacent City of Ottawa Services.

Ground Water in Excavation and Construction Dewatering

Groundwater inflow from the native soils into the excavations during construction, if any should be handled by pumping from sumps within the excavation.

Ground water was observed at between about 1.0 and 3.2 metres below the ground surface at time of drilling and measured at 1.2 and 3.2 metres below the ground surface in the stand pipes installed within the boreholes. It is considered that the groundwater level at 1.0 to 1.2 metres may be trapped water within fill materials or the native soils at the site and that the groundwater level measured at 3.2 metres below the existing ground surface is reflective of the native conditions. It is considered that the excavation for the new building at the site should not extend below the ground water level. As such a permit to take water is will not be required prior to excavation.

Effect of Dewatering of Foundation or Site Services Excavations on Adjacent Structures

Since the existing ground water level at the site is will be below the expected underside of footing elevation, dewatering of the excavation will not remove water from historically saturated soils. The closest building is located about 10 metres east of the subject site. As such dewatering of the foundation or site services excavations, if required, will not have a detrimental impact on the adjacent structures.

Foundation for Proposed Commercial Building

Foundation Design and Bearing Capacity

As previously indicated, the subsurface conditions at the site encountered at the boreholes advanced during the investigation consisted of asphaltic concrete, crushed stone and deleterious fill materials, silty sand followed by native silty clay. With the exception of the fill materials, the subsurface conditions encountered at the test holes advanced during the investigation are suitable for the support of the proposed building on conventional spread footing foundations placed on a native subgrade or on engineered fill placed on the native subgrade. The excavations for the foundation should be taken through any topsoil or otherwise deleterious material to expose the native, undisturbed silty clay. It is suggested that the building be founded either directly on the underlying silty clay or on engineered fill placed on the silty clay.

The allowable bearing pressure for any footings depends on the depth of the footings below original ground surface, the width of the footings, and the height above the original ground surface of any landscape grade raise adjacent to the building foundation.

For predictable performance of the proposed foundations, all existing fill materials and any deleterious materials should be removed from within the proposed foundation areas to expose the native silty clay.

Strip and pad footings, a minimum 0.5 metres in width bearing on the native undisturbed silty clays at a founding depth of a minimum of 1.8 metres below the original ground surface and above the groundwater level may be designed using a maximum allowable bearing pressure of 100 kilopascals for serviceability limit states and 250 kilopascals for the factored ultimate bearing resistance for the design of conventional strip footings or pad footings, founded on native silty clay or on a suitably constructed engineered pad placed on the native silty clay.

The above allowable bearing pressure is subject to a maximum grade raise of 0.5 metres above the existing ground surface and to maximum strip and pad footing widths of 1.5 metres.

Provided that any loose and disturbed soil is removed from the bearing surfaces prior to pouring concrete, the total and differential settlement of the footings should be less than 25 millimetres and 20 millimetres, respectively.

Engineered Fill

Any fill required to raise the footings for the proposed building to founding level should consist of imported granular material (engineered fill). The engineered fill should consist of granular material meeting Ontario Provincial Standards Specifications (OPSS) requirements for Granular A or Granular B Type II and should be compacted in maximum 300 millimetre thick loose lifts to at least 98 percent of the standard Proctor maximum dry density. It is considered that the engineered fill should be compacted using dynamic compaction with a large diameter vibratory steel drum roller or diesel plate compactor. If a diesel plate compactor is used, the lift thickness may need to be restricted to less than 300 mm to achieve proper compaction. Compaction should be verified by a suitable field compaction test method.

To allow the spread of load beneath the footings, the engineered fill should extend out 0.5 metres horizontally from the edges of the footing then down and out at 1 horizontal to 1 vertical, or flatter. The excavations for the proposed residential building should be sized to accommodate this fill placement.

The first lift of engineered fill material should have a thickness of 300 millimetres in order to protect the subgrade during compaction. It is considered that the placement of a geotextile fabric between the engineered fill and the subgrade is not necessary where granular materials meeting the grading requirements for OPSS Granular B Type II or OPSS Granular A are placed on a silty clay subgrade above the normal ground water level. It is recommended that trucks are not used to place the engineered fill on the subgrade. The fill should be dumped at the edge of the excavation and moved into place with a tracked bulldozer or excavator.

The native silty clay soils at this site will be sensitive to disturbance from construction operations and from rainwater or snowmelt, and frost. In order to minimize disturbance, construction traffic operating directly on the subgrade should be kept to an absolute minimum and the subgrade should be protected from below freezing temperatures.

Frost Protection

In general, all exterior foundation elements and those in any unheated parts of the proposed buildings should be provided with at least 1.5 metres of earth cover for frost protection purposes. Isolated, unheated foundation elements adjacent to surfaces, which are cleared of snow cover during winter months should be provided with a minimum 1.8 metres of earth cover for frost protection purposes.

Foundation Wall Backfill and Drainage

The native soils encountered at this site are considered to be frost susceptible. As such, to prevent possible foundation frost jacking due to frost adhesion, the backfill against any unheated or insulated walls or isolated walls or piers should consist of free draining, non-frost susceptible material. If imported material is required, it should consist of sand or sand and gravel meeting OPSS Granular B Type I grading requirements. Alternatively, foundations could be backfilled with native material in conjunction with the use of an approved proprietary drainage layer system such as "System Platon" against the foundation wall. It is pointed out that there is potential for possible frost jacking of the upper portion of some types of these drainage layer systems if frost susceptible material is used as backfill. This could be mitigated by backfilling the upper approximately 0.6 metres with non-frost susceptible granular material.

Where the backfill material will ultimately support a pavement structure or walkway, it is suggested that the foundation wall backfill material be compacted in 250 millimetre thick lifts to 95 percent of the standard Proctor dry density value. In that case any native material proposed for foundation backfill should be inspected and approved by the geotechnical engineer.

Provided the proposed finished floor surfaces are everywhere above the exterior finished grade, the granular materials beneath the proposed floor slab are properly compacted and provided the exterior grade is adequately sloped away from the proposed building, no perimeter foundation drainage system is required.

Slab on Grade Support

As stated above, it is expected that the proposed building will be founded on native silty clay or on an engineered pad placed on the native subgrade. For predictable performance of the proposed concrete floor slab all existing fill material, topsoil and any otherwise deleterious material should be removed from below the proposed floor slab area. The exposed native subgrade surface should then be inspected and approved by geotechnical personnel. Any soft areas evident should be subexcavated and replaced with suitable engineered fill. Any fill materials consisting of granular material, removed from the proposed concrete floor slab area, could be stockpiled for possible reuse with approval from the geotechnical engineer.

The fill materials beneath the proposed concrete floor slab on grade should consist of a minimum of 150 millimetre thickness of crushed stone meeting OPSS Granular A immediately beneath the concrete floor slab followed by sand, or sand and gravel meeting the OPSS for Granular B Type I, or crushed stone meeting OPSS grading requirements for Granular B Type II, or other material approved by the Geotechnical Engineer. The fill materials should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density.

The slab should be structurally independent from walls and columns, which are supported by the foundations. This is to reduce any structural distress that may occur as a result of differential soil movement. If it is intended to place any internal non-load bearing partitions directly on the slab-on-grade, such walls should also be structurally independent from other elements of the building founded on the conventional foundation system so that some relative vertical movement between the floor slab and foundation can occur freely.

The concrete floor slab should be saw cut at regular intervals to minimize random cracking of the slab due to shrinkage of the concrete. The saw cut depth should be about one quarter of the thickness of the slab. The crack control cuts should be placed at a grid spacing not exceeding the lesser of 25 times the slab thickness or 4.5 metres. The slab should be cut as soon as it is possible to work on the slab without damaging the surface of the slab.

Under slab drainage is not considered necessary provided that the floor slab level is everywhere above the finished exterior ground surface level. If any areas of the proposed building are to remain unheated during the winter period or under slab insulation is to be used, thermal protection of the foundation may be required. Further details on the insulation requirements could be provided, if necessary.

Seismic Design for the Proposed Residential Building

For seismic design purposes, in accordance with the 2012 OBC Section 4.1.8.4, Table 4.1.8.4.A., the site classification for seismic site response is Site Class D.

Borehole 1 & 2					
Layer	Description	Depth (m)	d_i (m)	S_{ui} (kPa)	d_i/S_{ui} (m/kPa)
1	USF	1.5			
2	Silty Clay	1.5	28.5	56.3	0.5
3	Glacial Till	30	1.5	N/A	
	$d_c/(\text{sum}(d_i/S_{ui}))$				56.3

Since S_u = 50 < 56.3 < 100 kPa the seismic site response is Site Class D.

Potential for Soil Liquefaction

As indicated above, the results of the boreholes and information from geological maps indicate that the native deposits underlying the site consist of a stiff silty clay crust followed by glacial till then bedrock.

C.F.E.M. section 6.6.3.2 (6) recommends that the Bray et al. (2004) criteria be used to determine liquefaction susceptibility of fine-grained soils:

That is fine-grained soils with PI ≤ 12 and W_c > 0.85LL are susceptible to liquefaction, soils with 12 ≤ PI ≤ 20 and W_c > 0.8LL are moderately susceptible to liquefaction and soils with PI > 20 and W_c < 0.8LL are not susceptible to liquefaction.

Seed et al. (2003) proposed liquefaction susceptibility criteria that are similar to those by Bray et al. (2004) except that they include slightly different Wc / LL ratios and include constraints on LL. The criteria by Seed et al. (2003) are described by three zones on the Atterberg limits chart, which are bounded by the following PI and LL values: Zone A soils have PI ≤ 12 and LL ≤ 37 and are considered potentially susceptible to "classic cyclically induced liquefaction" if the water content is greater than 80% of the LL; Zone B soils have PI ≤ 20 and LL ≤ 47 and are considered potentially liquefiable with detailed laboratory testing recommended if the water content is greater than 85% of the LL; and Zone C soils with PI > 20 or LL >47 are considered generally not susceptible to classic cyclic liquefaction, although they should be checked for potential sensitivity.

From the laboratory test results, the silty has a plasticity index PI = of 43.9 and a liquid limit of 72.2 indicating an inorganic highly plastic clay. As such the silty clay is not prone to liquefaction.

National Building Code Seismic Hazard Calculation

The design Peak Ground Acceleration (PGA) for the site was calculated as 0.300 with a 2% probability of exceedance in 50 years based on the interpolation of the 2015 National Building Code Seismic Hazard calculation. The results of the test are attached following the text of this report.

SITE SERVICES

Excavation

The excavations for the site services will be carried out through fill materials and silty clay. For the purposes of Ontario Regulation 213/91 the soils at the site can be considered to be Type 2 soil. The sides of the excavations in overburden materials should be sloped in accordance with the requirements in Ontario Regulation 213/91 under the Ontario Occupational Health and Safety Act. That is, open cut excavations with overburden deposits should be carried out with side slopes of 1 horizontal to 1 vertical, or flatter. Where space constraints dictate, the excavation and backfilling operations should be carried out within a tightly fitting, braced steel trench box.

Based on the depths at which groundwater was measured within the standpipe installed in boreholes BH1 and BH3, significant groundwater flow into any excavation is unlikely. Any groundwater inflow into the service trenches should be handled by pumping from sumps from within the excavations.

Pipe Bedding and Cover Materials

It is suggested that the service pipe bedding material consist of at least 150 millimetres of granular material meeting OPSS requirements for Granular A. A provisional allowance should, however, be made for sub-excavation of any existing fill or disturbed material encountered at subgrade level. Granular material meeting OPSS specifications for Granular B Type II could be used as a sub-bedding material. The use of clear crushed stone as bedding or sub-bedding material should not be permitted.

Cover material, from pipe spring line to at least 300 millimetres above the top of the pipe, should consist of granular material, such as OPSS Granular A or Granular B Type I (with a maximum particle size of 25 millimetres).

The sub-bedding, bedding and cover materials should be compacted in maximum 200 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density using suitable vibratory compaction equipment.

Trench Backfill

The general backfilling procedures should be carried out in a manner that is compatible with the future use of the area above the service trenches.

In areas where the service trench will be located below or in close proximity to existing or future pavement areas, acceptable native materials should be used as backfill between the pavement subgrade level and the depth of seasonal frost penetration (i.e. 1.8 metres below finished grade) in order to reduce the potential for differential frost heaving between the area over the trench and the adjacent section of roadway.

Where native backfill is used, it should match the native materials exposed on the trench walls. Some of the native materials from the lower part of the trench excavations may be wet of optimum for compaction. Depending on the weather conditions encountered during construction, some drying of materials and/or recompaction may be required. Any wet materials that cannot be compacted to the required density should either be wasted from the site or should be used outside of existing or future driveway areas. Backfill below the zone of seasonal frost penetration could consist of either acceptable native material or imported granular material conforming to OPSS Granular B Type I. If the native material is not suitable for backfill, imported granular material may have to be used. If imported granular materials are used, suitable frost tapers should be used OPSD 802.013.

To minimize future settlement of the backfill and achieve an acceptable subgrade for the parking areas, sidewalks, etc., the trench should be compacted in maximum 300 millimetre thick lifts to at least 95 percent of the standard Proctor maximum dry density. The specified density may be reduced to 90 percent where the trench backfill is not located or in close proximity to existing or future roadways, driveways, sidewalks, or any other type of permanent structure.

ACCESS ROADWAY PAVEMENTS

Based on the results of the boreholes, the subsurface conditions in the access roadway and parking areas consist of existing asphaltic concrete followed by grey crushed stone overlying silty sand/silty clay fill materials overlying native silty clay. For predictable performance of the pavement structures, it is considered that all of the existing asphaltic concrete will have to be removed in preparation for pavement construction at this site. It is considered that any granular crushed stone fill material that is free of topsoil or organic debris may be stockpiled and upon approval by the engineer used to raise the subgrade of the access roadway and parking areas to the proposed underside of access roadway and subbase elevation of the parking lot.

Once existing asphaltic concrete and granular crushed stone and any deleterious material has been removed, the exposed sub-grade should be inspected and approved by geotechnical personnel and any soft areas evident should be sub-excavated and replaced with suitable earth borrow or granular crushed stone approved by the geotechnical engineer. The sub-grade should be shaped and crowned to promote drainage of the roadway area granular. Following approval of the preparation of the sub-grade, the pavement granulars may be placed.

For any areas of the site that require the sub-grade to be raised to proposed pavement sub-grade level, the material used should consist of OPSS select sub-grade material or OPSS Granular B Type I or Type II. Recycled crushed concrete meeting the grading specifications for Granular B Type II could also be used. Materials used for raising the sub-grade to proposed roadway area sub-grade level should be placed in maximum 300 millimetre thick loose lifts and be compacted to at least 95 percent of the standard Proctor maximum dry density using suitable compaction equipment.

For pavement areas subject to cars and light trucks the pavement should consist of:

50 millimetres of Superpave 12.5 asphaltic concrete over
150 millimetres of OPSS Granular A base over
300 millimetres of OPSS Granular B, Type II subbase over
(50 or 100 millimetre minus crushed stone)
Non-woven geotextile fabric (4 oz/sy) such as Terrafix 270R or Thrace-Ling 130EX or approved alternative.

Performance grade PG 58-34 asphaltic concrete should be specified. Compaction of the granular pavement materials should be carried out in maximum 300 millimetre thick loose lifts to 100 percent of the standard Proctor maximum dry density value using suitable vibratory compaction equipment.

The above pavement structures will be adequate on an acceptable sub-grade, that is, one where any roadway fill and service trench backfill has been adequately compacted. If the roadway sub-grade is disturbed or wetted due to construction operations or precipitation, the granular thicknesses given above may not be adequate and it may be necessary to increase the thickness of the Granular B Type II subbase and/or incorporate a non-woven geotextile separator between the roadway subgrade surface and the granular subbase material. The adequacy of the design of the pavement thickness should be assessed by the geotechnical personnel at the time of construction.

CONSTRUCTION CONSIDERATIONS

It is suggested that the final design drawings for the project, including the proposed site grading plan, be reviewed by the geotechnical engineer to ensure that the guidelines provided in this report have been interpreted as intended and to re-evaluate the guidelines provided in the report with respect to the actual project plans. Items such as actual foundation wall/column loads, etc could have significant impacts on foundation type, frost protection requirements, etc.

The engagement of the services of the geotechnical consultant during construction is recommended to confirm that the subsurface conditions throughout the proposed development do not materially differ from those given in the report and that the construction activities do not adversely affect the intent of the design.

All foundation areas and any engineered fill areas for the proposed commercial building should be inspected by Kollaard Associates Inc. to ensure that a suitable subgrade has been reached and properly prepared. The placing and compaction of any granular materials beneath the foundations should be inspected to ensure that the materials used conform to the grading and compaction specifications.

The subgrade for the site services, access roadways and driveway should be inspected and approved by geotechnical personnel. In situ density testing should be carried out on the service pipe bedding and backfill and the pavement granular materials to ensure the materials meet the specifications from a compaction point of view.

The native silty clay deposits at this site will be sensitive to disturbance from construction operations, from rainwater or snow melt, and frost. In order to minimize disturbance, construction traffic operating directly on the subgrade should be kept to an absolute minimum and the subgrade should be protected from below freezing temperatures.

We trust this report provides sufficient information for your present purposes. If you have any questions concerning this report or if we may be of further services to you, please do not hesitate to contact our office.

Regards,
Kollaard Associates Inc.

LICENSED PROFESSIONAL ENGINEER
June 21, 2019
S.E. deWit
100079612
PROVINCE OF ONTARIO

Dean Tataryn, B.E.S., EP.

Steve DeWit, P.Eng.

Attachments:
- Table I - Record of Boreholes
- Key Plan, Figure 1
- Site Plan, Figure 2
- Laboratory Test Results for Sulphate, Resistivity and pH
- Attachment A – Stantec Laboratory Test Results for Soils
- Attachment B - National Building Code Seismic Hazard Calculation

APPENDIX A – SUMMARY OF GEOTECHNICAL RECOMMENDATIONS

This report provides geotechnical recommendations under the Headings: Geotechnical Guidelines and Recommendations; Foundation For Proposed Residential Building; Site Services; Access Roadway Pavements; Construction Considerations:

These geotechnical recommendations include:
Foundation Design
Allowable Bearing Capacity
Settlement
Subgrade preparation
Engineered Fill and Compaction
Frost Protection
Foundation Drainage
Foundation Backfill
Floor Slab
Seismic Design
Excavation for Services and Sewers
Bedding and Cover
Trench Backfill
Subgrade Preparation for Pavements
Pavement Structures
Pavement Placement and compaction
Inspection Requirements.

RECORD OF BOREHOLE BH1

PROJECT: Proposed Commercial Development
CLIENT: M.J. Pulickal Holdings Inc.
LOCATION: 1994 St. Joseph Boulevard, Ottawa, Ontario
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 190361
DATE OF BORING: June 7, 2019
SHEET 1 of 1
DATUM: LOCAL

Depth Scale (meters)	Soil Profile: Description	Elev. / Depth (M)	Sample Number	Type	Blows/0.3m
	Ground Surface	500.04			
0	Grey crushed stone (FILL)	0.00			
	Yellow brown silty sand (FILL)	499.84 / 0.20	1	SS	7
			2	SS	7
1	Grey silty sand, trace gravel, glass, organics (FILL)	498.84 / 1.20	3	SS	2
2			4	SS	WH
	Grey silty clay, trace organics and wood (FILL)	497.56 / 2.48	5	SS	2
3	Firm grey SILTY CLAY	496.69 / 3.35	6	SS	WH
4			7	SS	WH
			8	SS	WH
5	End of Borehole	495.17 / 4.87			

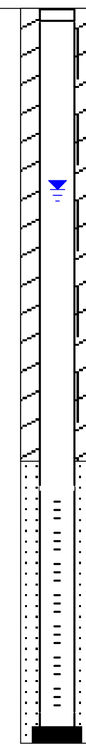
UNDIST. SHEAR STRENGTH × Cu, kPa × 20 40 60 80

REM. SHEAR STRENGTH ○ Cu, kPa ○ 20 40 60 80

DYNAMIC CONE PENETRATION TEST blows/300 mm 10 30 50 70 90

ADDITIONAL LAB TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



Water observed in borehole at approximately 1.2 metres below the existing ground surface on June 7, 2019. Water measured in the standpipe at about 1.2 metres below the existing ground surface, June 10, 2019.

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

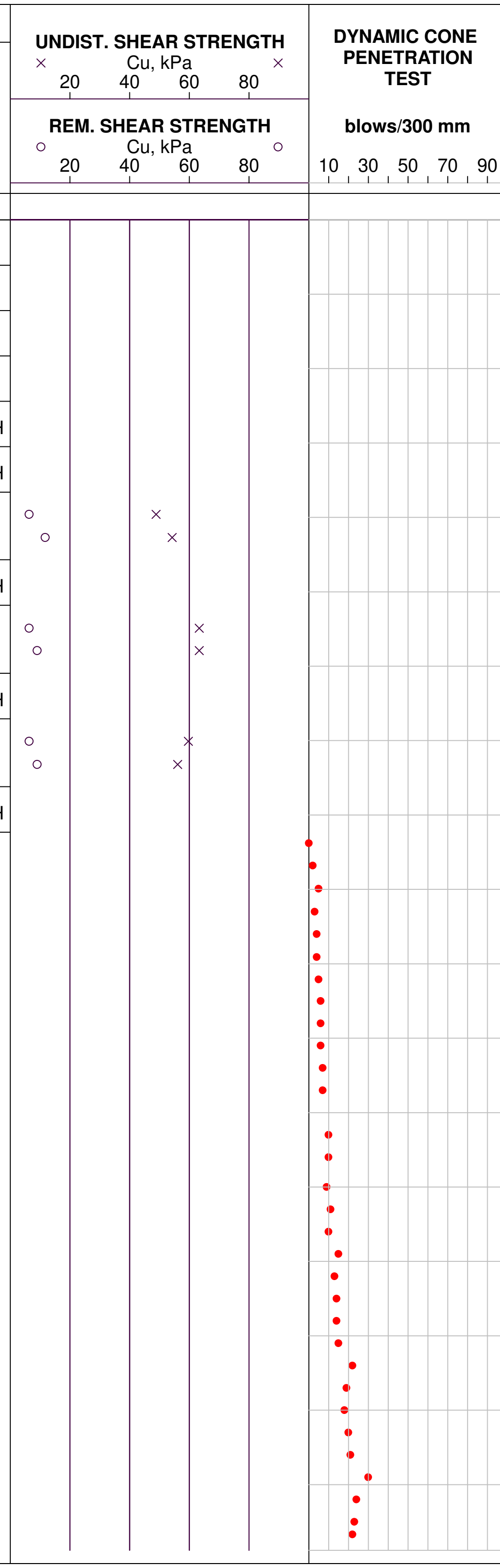
RECORD OF BOREHOLE BH2

PROJECT: Proposed Commercial Development
CLIENT: M.J. Pulickal Holdings Inc.
LOCATION: 1994 St. Joseph Boulevard, Ottawa, Ontario
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 190361
DATE OF BORING: June 6, 2019
SHEET 1 of 2
DATUM: LOCAL

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	ELEV. / DEPTH (M)
	Ground Surface	500.11
0	Grey crushed stone (FILL)	0.00
	Yellow brown silty sand, trace organics, clay and wood (FILL)	497.48 / 2.63
	Firm grey brown SILTY CLAY	497.06 / 3.05
	Grey SILTY CLAY	491.88 / 8.23
	Borehole continued as Probe Hole, probably grey SILTY CLAY	

SAMPLES: NUMBER	TYPE	BLOWS/0.3m
1	SS	5
2	SS	5
3	SS	2
4	SS	3
5	SS	WH
6	SS	WH
7	SS	WH
8	SS	WH
9	SS	WH



ADDITIONAL LAB TESTING

PIEZOMETER OR STANDPIPE INSTALLATION

Water observed in borehole at approximately 1.4 metres below the existing ground surface on June 6, 2019.

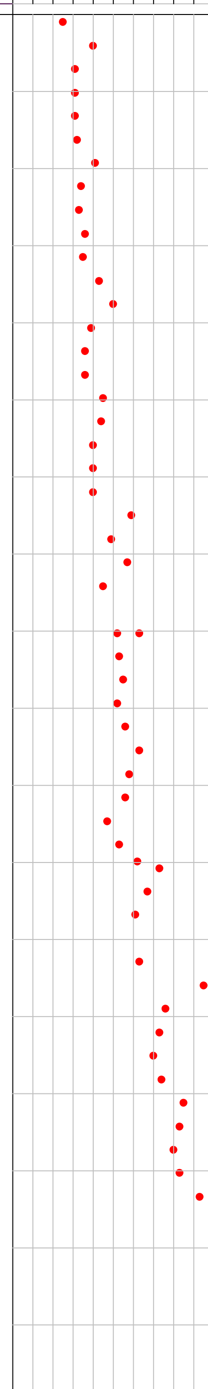
DEPTH SCALE: 1 to 100
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH2

PROJECT: Proposed Commercial Development
CLIENT: M.J. Pulickal Holdings Inc.
LOCATION: 1994 St. Joseph Boulevard, Ottawa, Ontario
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 190361
DATE OF BORING: June 6, 2019
SHEET 2 of 2
DATUM: LOCAL

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	SOIL PROFILE: STRATA PLOT	SOIL PROFILE: ELEV. DEPTH (M)	SAMPLES: NUMBER	SAMPLES: TYPE	SAMPLES: BLOWS/0.3m	UNDIST. SHEAR STRENGTH × Cu, kPa (20, 40, 60, 80) / REM. SHEAR STRENGTH ○ Cu, kPa (20, 40, 60, 80)	DYNAMIC CONE PENETRATION TEST blows/300 mm (10, 30, 50, 70, 90)	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
18–30			470.11							
30	Probably grey silty sand, some gravel, cobbles and boulders, trace clay (GLACIAL TILL)		30.00							
			466.64							
33.47	End of Borehole, refusal on large boulder or bedrock		33.47							



DEPTH SCALE: 1 to 100
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

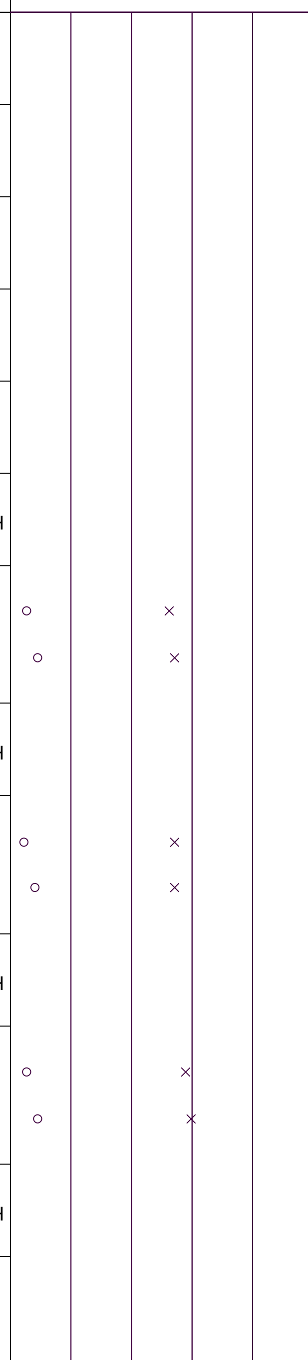
RECORD OF BOREHOLE BH3

PROJECT: Proposed Commercial Development
CLIENT: M.J. Pulickal Holdings Inc.
LOCATION: 1994 St. Joseph Boulevard, Ottawa, Ontario
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 190361
DATE OF BORING: June 6, 2019
SHEET 1 of 1
DATUM: LOCAL

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	ELEV. DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m
	Ground Surface	500.19			
0	Grey crushed stone, trace organics (FILL)	0.00			
	Grey silty clay, trace gravel and wood (FILL)	499.89 0.30	1	SS	10
1			2	SS	3
			3	SS	19
2	Yellow brown sand and gravel, trace organics (FILL)	498.39 1.80	4	SS	15
	Grey SILTY CLAY	497.69 2.50	5	SS	2
3			6	SS	WH
4					
5			7	SS	WH
6			8	SS	WH
7					
8			9	SS	WH
	End of Borehole	491.97 8.22			

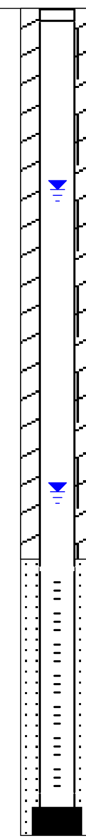
UNDIST. SHEAR STRENGTH × Cu, kPa 20 40 60 80
REM. SHEAR STRENGTH ○ Cu, kPa 20 40 60 80



DYNAMIC CONE PENETRATION TEST blows/300 mm 10 30 50 70 90

ADDITIONAL LAB TESTING

PIEZOMETER OR STANDPIPE INSTALLATION



Water observed in borehole at approximately 1.2 metres below the existing ground surface on June 6, 2019. Water measured in the standpipe at about 3.2 metres below the existing ground surface, June 10, 2019.

DEPTH SCALE: 1 to 50
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

RECORD OF BOREHOLE BH4

PROJECT: Proposed Commercial Development
CLIENT: M.J. Pulickal Holdings Inc.
LOCATION: 1994 St. Joseph Boulevard, Ottawa, Ontario
PENETRATION TEST HAMMER: 63.5kg, Drop, 0.76mm

PROJECT NUMBER: 190361
DATE OF BORING: June 7, 2019
SHEET 1 of 1
DATUM: LOCAL

DEPTH SCALE (meters)	SOIL PROFILE: DESCRIPTION	STRATA PLOT	ELEV. DEPTH (M)	SAMPLES: NUMBER	TYPE	BLOWS/0.3m	UNDIST. SHEAR STRENGTH × Cu, kPa 20 40 60 80 / REM. SHEAR STRENGTH ○ Cu, kPa 20 40 60 80	DYNAMIC CONE PENETRATION TEST blows/300 mm 10 30 50 70 90	ADDITIONAL LAB TESTING	PIEZOMETER OR STANDPIPE INSTALLATION
	Ground Surface		500.23							
0	TOPSOIL		0.00 500.13							
	Red brown SILTY CLAY		0.10	1	SS	2				
				2	SS	8				
1	Firm grey SILTY CLAY		499.21 1.02							Water observed in borehole at approximately 1.0 metres below the existing ground surface on June 7, 2019.
				3	SS	WH				
2				4	SS	WH				
				5	SS	WH				
3				6	SS	2				
4				7	SS	WH				
	End of Borehole		495.96 4.27							

DEPTH SCALE: 1 to 25
BORING METHOD: Power Auger
AUGER TYPE: 200 mm Hollow Stem
LOGGED: DT
CHECKED: SD

LIST OF ABBREVIATIONS AND TERMINOLOGY

SAMPLE TYPES

AS auger sample
CS chunk sample
DO drive open
MS manual sample
RC rock core
ST slotted tube .
TO thin-walled open Shelby tube
TP thin-walled piston Shelby tube
WS wash sample

PENETRATION RESISTANCE

Standard Penetration Resistance, N
The number of blows by a 63.5 kg hammer dropped 760 millimeter required to drive a 50 mm drive open sampler for a distance of 300 mm. For split spoon samples where less than 300 mm of penetration was achieved, the number of blows is reported over the sampler penetration in mm.

Dynamic Penetration Resistance
The number of blows by a 63.5 kg hammer dropped 760 mm to drive a 50 mm diameter, 60° cone attached to 'A' size drill rods for a distance of 300 mm.

WH
Sampler advanced by static weight of hammer and drill rods.

WR
Sampler advanced by static weight of drill rods.

PH
Sampler advanced by hydraulic pressure from drih rig.

PM
Sampler advanced by manual pressure.

SOIL TESTS

C consolidation test
H hydrometer analysis
M sieve analysis
MH sieve and hydrometer analysis
U unconfined compression test
Q undrained triaxial test
V field vane, undisturbed and remolded shear strength

SOIL DESCRIPTIONS

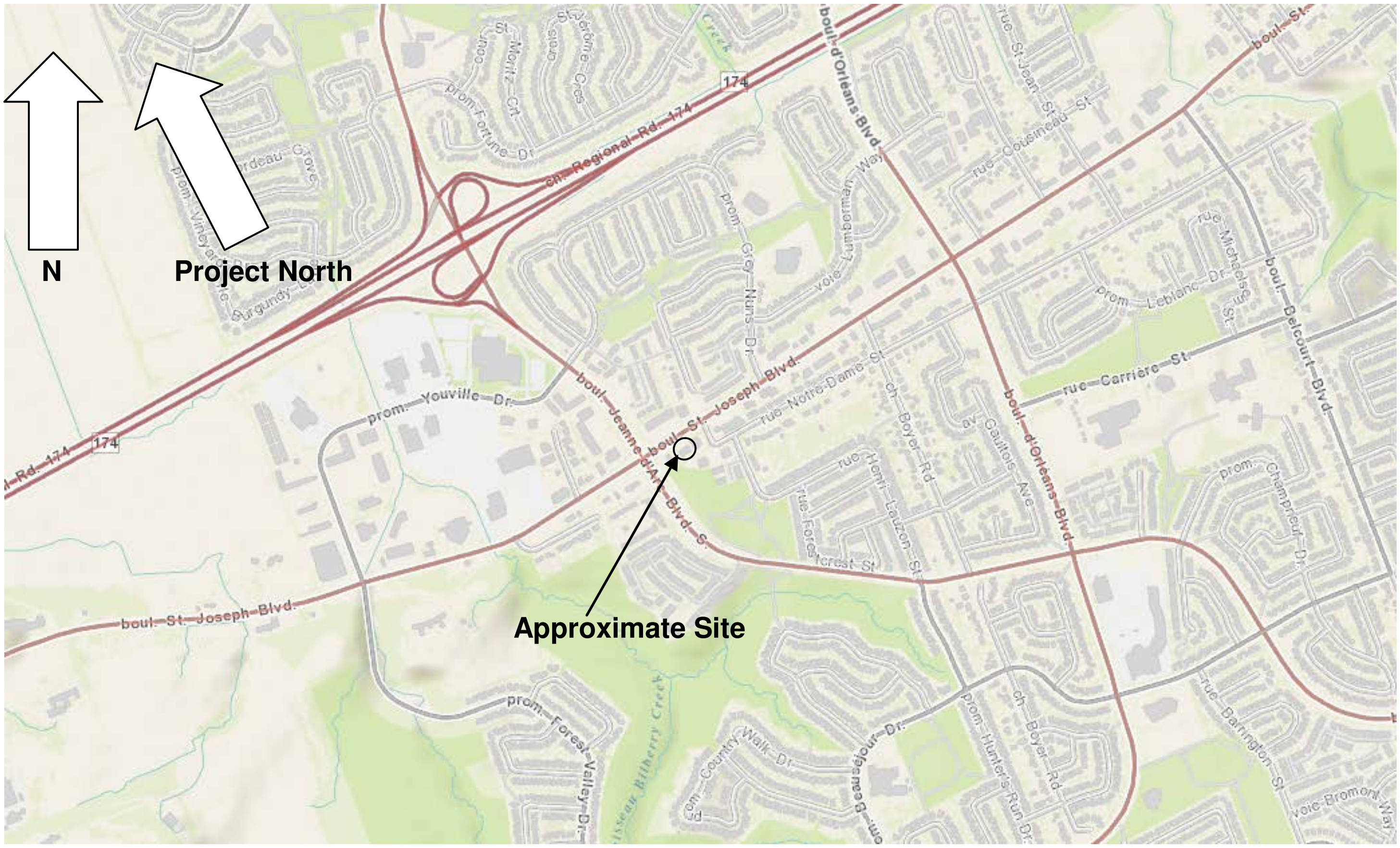
Relative Density	'N' Value
Very Loose	0 to 4
Loose	4 to 10
Compact	10 to 30
Dense	30 to 50
Very Dense	over 50

Consistency	Undrained Shear Strength (kPa)
Very soft	0 to 12
Soft	12 to 25
Firm	25 to 50
Stiff	50 to 100
Very Stiff	over 100

LIST OF COMMON SYMBOLS

c_u undrained shear strength
e void ratio
C_c compression index
C_v coefficient of consolidation
k coefficient of permeability
I_p plasticity index
n porosity
u pore pressure
w moisture content
w_L liquid limit
w_p plastic limit
ϕ^1 effective angle of friction
γ unit weight of soil
γ^1 unit weight of submerged soil
σ normal stress

KEY PLAN	FIGURE 1



NOT TO SCALE

Kollaard Associates Engineers

Project No. 190361

Date June 2019

DRAWING NUMBER:
SITE PLAN, FIGURE 2

LEGEND:

BH1 APPROXIMATE BOREHOLE LOCATION

REFERENCE: PLAN SUPPLIED BY CITY OF OTTAWA EMAPS.

SPECIAL NOTE: THIS DRAWING TO BE READ IN CONJUNCTION WITH THE ACCOMPANYING REPORT.

REV.	NAME	DATE	DESCRIPTION

Kollaard Associates
Engineers
PO, BOX 189, 210 PRESCOTT ST
KEMPTVILLE ONTARIO
K0G 1J0 FAX (613) 258-0475
http://www.kollaard.ca
(613) 860-0923
info@kollaard.ca

CLIENT:
M.J. PULICKAL HOLDINGS INC.

PROJECT:
GEOTECHNICAL INVESTIGATION FOR PROPOSED COMMERCIAL DEVELOPMENT

LOCATION:
1994 ST. JOSEPH BOULEVARD
CITY OF OTTAWA, ONTARIO

DESIGNED BY: --	DATE: MAY 10, 2019
DRAWN BY: DT	SCALE: N.T.S
KOLLAARD FILE NUMBER: 190361	

Laboratory Test Results for Chemical Properties

Kollaard Associates (Kemptville)
ATTN: Dean Tataryn
210 Prescott Street Unit 1
P.O. Box 189
Kemptville ON K0G 1J0

Date Received: 10-JUN-19
Report Date: 17-JUN-19 14:33 (MT)
Version: FINAL

Client Phone: 613-860-0923

Certificate of Analysis

Lab Work Order #: L2289192

Project P.O. #: NOT SUBMITTED
Job Reference: 190361
C of C Numbers:
Legal Site Desc:

Melanie Moshi
Account Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2289192-1 BH5 SS3 4'-6' Sampled By: CLIENT on 07-JUN-19 Matrix: SOIL							
Physical Tests							
Conductivity	0.314		0.0040	mS/cm		13-JUN-19	R4667870
% Moisture	26.0		0.10	%	11-JUN-19	12-JUN-19	R4664114
pH	7.15		0.10	pH units		13-JUN-19	R4669029
Resistivity	3180		1.0	ohm*cm		13-JUN-19	
Leachable Anions & Nutrients							
Chloride	0.00425		0.00050	%	12-JUN-19	12-JUN-19	R4667967
Anions and Nutrients							
Sulphate	0.0128		0.0020	%	11-JUN-19	12-JUN-19	R4667967

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

QC Samples with Qualifiers & Comments:

QC Type Description	Parameter	Qualifier	Applies to Sample Number(s)

Sample Parameter Qualifier key listed:

Qualifier	Description

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
CL-R511-WT	Soil	Chloride-O.Reg 153/04 (July 2011)	EPA 300.0

5 grams of dried soil is mixed with 10 grams of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

EC-WT	Soil	Conductivity (EC)	MOEE E3138

A representative subsample is tumbled with de-ionized (DI) water. The ratio of water to soil is 2:1 v/w. After tumbling the sample is then analyzed by a conductivity meter.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

MOISTURE-WT	Soil	% Moisture	CCME PHC in Soil - Tier 1 (mod)
PH-WT	Soil	pH	MOEE E3137A

A minimum 10g portion of the sample is extracted with 20mL of 0.01M calcium chloride solution by shaking for at least 30 minutes. The aqueous layer is separated from the soil and then analyzed using a pH meter and electrode.

Analysis conducted in accordance with the Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act (July 1, 2011).

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	APHA 2510 B

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

RESISTIVITY-CALC-WT	Soil	Resistivity Calculation	MOECC E3138

Resistivity are calculated based on the conductivity using APHA 2510B where Conductivity is the inverse of Resistivity.

SO4-WT	Soil	Sulphate	EPA 300.0

5 grams of soil is mixed with 50 mL of distilled water for a minimum of 30 minutes. The extract is filtered and analyzed by ion chromatography.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
WT	ALS ENVIRONMENTAL - WATERLOO, ONTARIO, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid weight of sample
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Laboratory Test Results for Physical Properties

Stantec Consulting Ltd
2781 Lancaster Rd, Suite 100 A&B
Ottawa, ON K1B 1A7
Tel: (613) 738-6075
Fax: (613) 722-2799

Stantec

June 24, 2019
File: 122410003

Attention: **Dean Tataryn, Kollaard Associates Engineers**

Reference: **Kollaard File #190361, ASTM D4318 Atterberg Limit & ASTM D2216 Moisture Content**

The following table summarizes test results for BH-3 SS-6.

Source	Depth	Natural Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index
BH-3 SS-6	10'-12'	83.1%	72.2	28.3	43.9

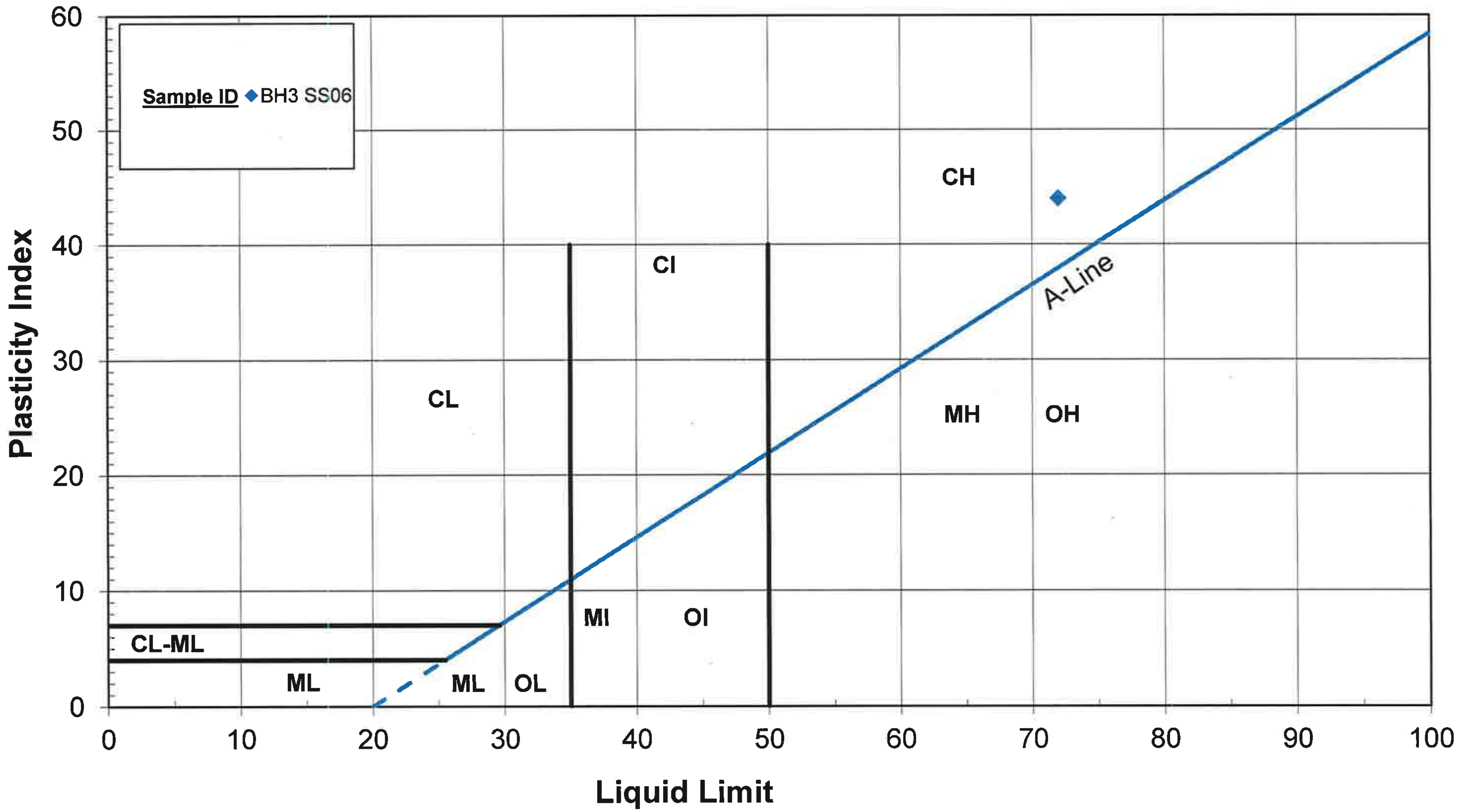
Sincerely,

Stantec Consulting Ltd

Brian Prevost

Brian Prevost
Laboratory Supervisor
Tel: 613-738-6075
Fax: 613-722-2799
brian.prevost@stantec.com

Attachments: Atterberg Limit Plasticity Chart



Kollard Associates, File# 190361

1994 St Joseph, Ottawa, ON

PLASTICITY CHART

Figure No.

Project No. 122410003

National Building Code Seismic Hazard Calculation

2015 National Building Code Seismic Hazard Calculation

INFORMATION: Eastern Canada English (613) 995-5548 français (613) 995-0600 Facsimile (613) 992-8836
Western Canada English (250) 363-6500 Facsimile (250) 363-6565

Site: 45.464N 75.539W **User File Reference:** 1994 St. Joseph Boulevard 2019-06-20 18:45 UT

Probability of exceedance per annum	0.000404	0.001	0.0021	0.01
Probability of exceedance in 50 years	2 %	5 %	10 %	40 %
Sa (0.05)	0.484	0.269	0.161	0.047
Sa (0.1)	0.563	0.323	0.201	0.065
Sa (0.2)	0.468	0.272	0.172	0.058
Sa (0.3)	0.354	0.207	0.131	0.045
Sa (0.5)	0.249	0.145	0.092	0.032
Sa (1.0)	0.123	0.072	0.046	0.016
Sa (2.0)	0.058	0.034	0.021	0.006
Sa (5.0)	0.015	0.008	0.005	0.001
Sa (10.0)	0.005	0.003	0.002	0.001
PGA (g)	0.300	0.175	0.109	0.035
PGV (m/s)	0.207	0.116	0.071	0.022

Notes: Spectral (Sa(T), where T is the period in seconds) and peak ground acceleration (PGA) values are given in units of g (9.81 m/s^2). Peak ground velocity is given in m/s. Values are for "firm ground" (NBCC2015 Site Class C, average shear wave velocity 450 m/s). NBCC2015 and CSAS6-14 values are highlighted in yellow. Three additional periods are provided - their use is discussed in the NBCC2015 Commentary. Only 2 significant figures are to be used. **These values have been interpolated from a 10-km-spaced grid of points. Depending on the gradient of the nearby points, values at this location calculated directly from the hazard program may vary. More than 95 percent of interpolated values are within 2 percent of the directly calculated values.**

References

National Building Code of Canada 2015 NRCC no. 56190; Appendix C: Table C-3, Seismic Design Data for Selected Locations in Canada

Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B)
Commentary J: Design for Seismic Effects

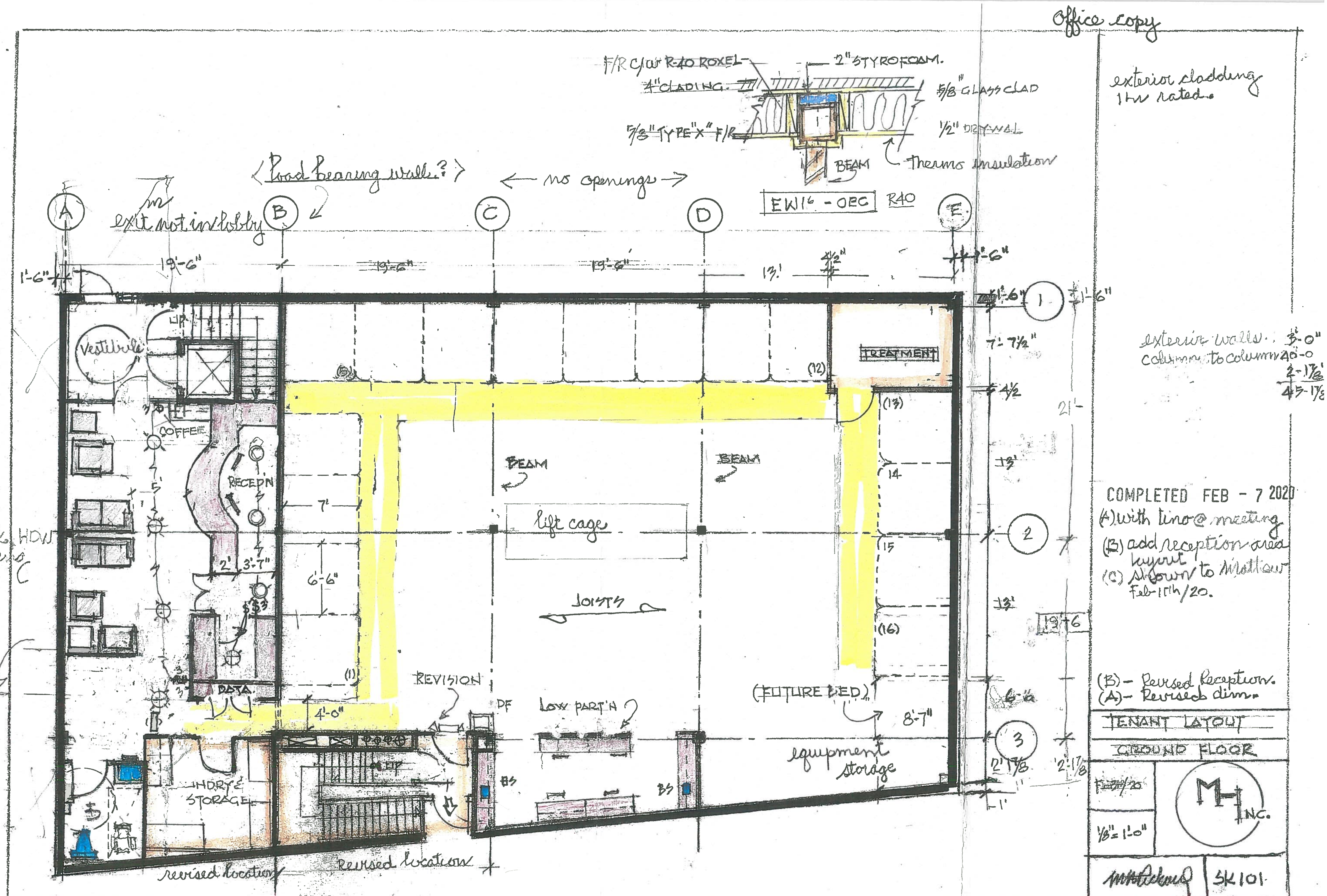
Geological Survey of Canada Open File 7893 Fifth Generation Seismic Hazard Model for Canada: Grid values of mean hazard to be used with the 2015 National Building Code of Canada

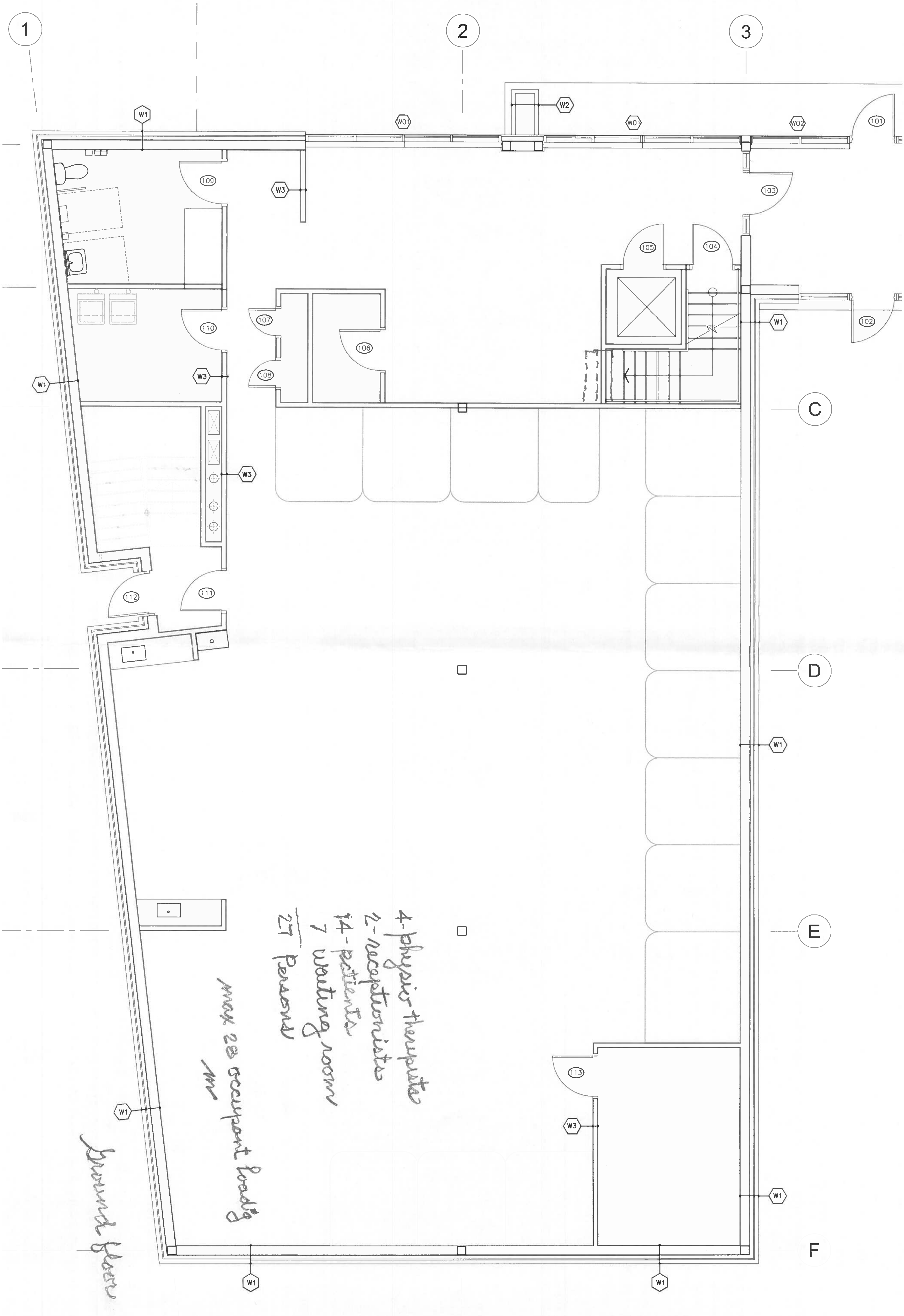
See the websites www.EarthquakesCanada.ca and www.nationalcodes.ca for more information

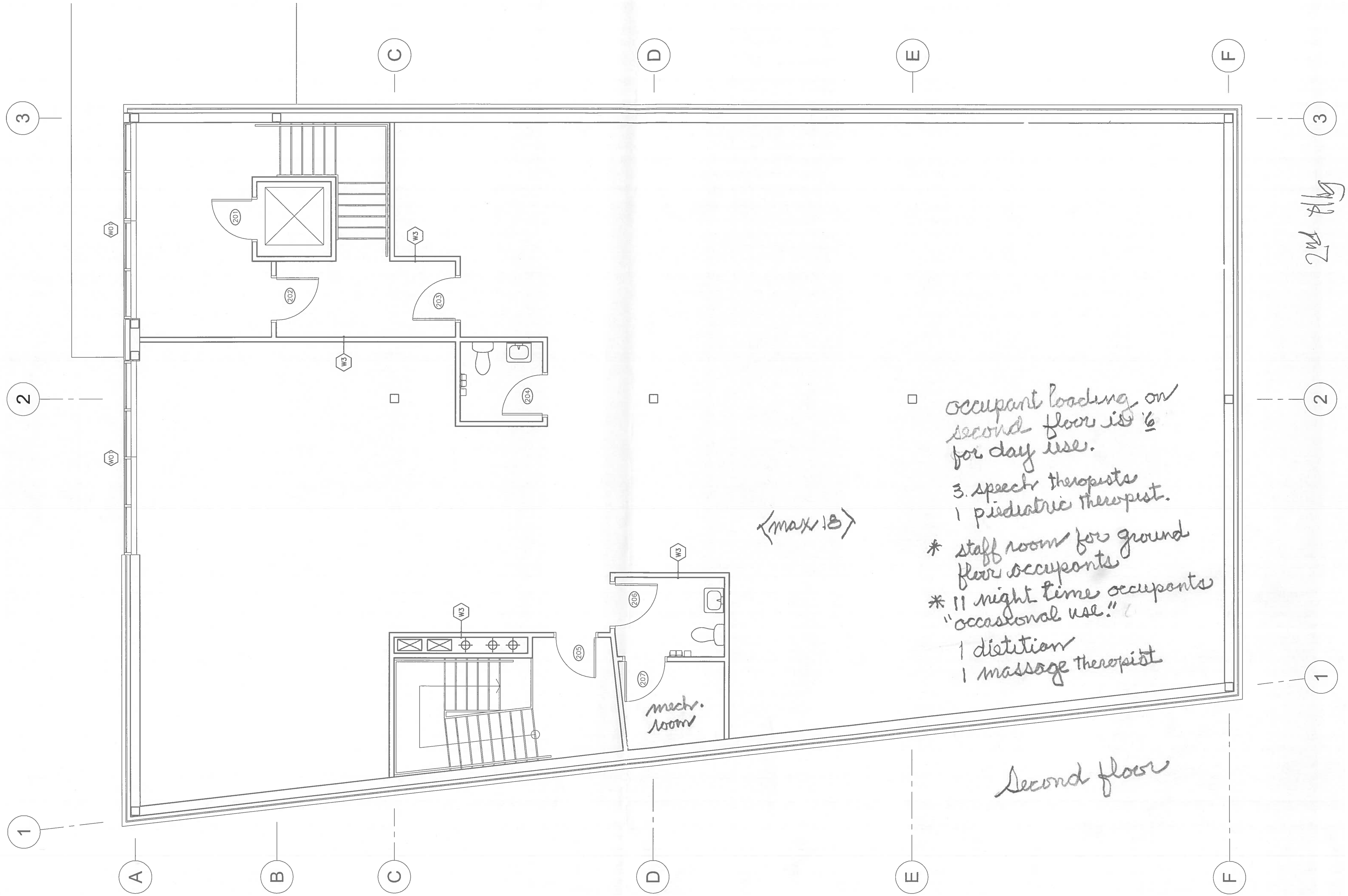
Natural Resources Canada Ressources naturelles Canada

Canada

Appendix E SITE PLAN


Office copy
exterior cladding 1hr rated.
F/R c/w R-40 ROXEL
4" CLADING
2" STYROFOAM.
5/8" GLASS CLAD
5/8" TYPE "X" F/R
1/2" DRYWAL
BEAM
Thermo insulation
EW16 - OEC R40
<Load bearing walls? >
← no openings →
exit not in lobby
Vestibule
UP
COFFEE
RECEP'N
DATA
LNDRY & STORAGE
REVISION
DF
LOW PART'N
BEAM
lift cage
JOISTS
TREATMENT
(FUTURE BED)
equipment storage
revised location
Revised location
Plank HDW flooring
exterior walls. 3'-0"
column to column 40'-0
COMPLETED FEB - 7 2020
(A) with Lino @ meeting
(B) add reception area layout
(C) shown to Matthew Feb-11th/20.
(B) - Revised Reception.
(A) - Revised dim.
TENANT LAYOUT
GROUND FLOOR
1/8" = 1'-0"
M-H INC.
SK101


1
2
3
C
D
E
F
W1
W2
W3
W01
W02
101
102
103
104
105
106
107
108
109
110
111
112
113
4-physio therapists
2-receptionists
14-patients
7 waiting room
27 Persons
max 28 occupant loading
Ground floor


occupant loading on second floor is 6 for day use.
3. speech therapists
1 piediatric therapist.
* staff room for ground floor occupants
* 11 night time occupants "occasional use."
1 dietitian
1 massage therapist
(max 18)
mech. room
Second floor
2nd Flr

Appendix F SITE SERVICING STUDY CHECKLIST

Development Servicing Study Checklist

Job#: 160401518

4.1 General Content	Addressed (Y/N/NA)	Section	Comments
Executive Summary (for larger reports only).	N/A	-	Introduction
Date and revision number of the report.	Y	-	
Location map and plan showing municipal address, boundary, and layout of proposed development.	Y	1.0	Report and drawings
Plan showing the site and location of all existing services.	Y		Existing Condtions and removals Plan
Development statistics, land use, density, adherence to zoning and official plan, and reference to applicable subwatershed and watershed plans that provide context to which individual developments must adhere.	Y	1	Section 1.0 of report
Summary of Pre-consultation Meetings with City and other approval agencies.	N/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.	N/A		
Statement of objectives and servicing criteria.	Y		In each section
Identification of existing and proposed infrastructure available in the immediate area.	Y		In each section
Identification of Environmentally Significant Areas, watercourses and Municipal Drains potentially impacted by the proposed development (Reference can be made to the Natural Heritage Studies, if available).	N/A		
Concept level master grading plan to confirm existing and proposed grades in the development. This is required to confirm the feasibility of proposed stormwater management and drainage, soil removal and fill constraints, and potential impacts to neighbouring properties. This is also required to confirm that the proposed grading will not impede existing major system flow paths.	N/A		
Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to addresspotential impacts.	N/A		
Proposed phasing of the development, if applicable.	N/A		
Reference to geotechnical studies and recommendations concerning servicing.	Y	10.0	Report and Appendix
All preliminary and formal site plan submissions should have the following information:			
Metric scale	Y		Appendix H Drawings
North arrow (including construction North)	N/A		Appendix H Drawings
Key plan	Y		Appendix H Drawings
Name and contact information of applicant and property owner	Y		Appendix H Drawings
Property limits including bearings and dimensions	Y		Appendix H Drawings
Existing and proposed structures and parking areas	Y		Appendix H Drawings
Easements, road widening and rights-of-way	Y		Appendix H Drawings
Adjacent street names	Y		Appendix H Drawings

4.2 Water	Addressed (Y/N/NA)	Section	Comments
Confirm consistency with Master Servicing Study, if available	N/A	3.0	
Availability of public infrastructure to service proposed development	Y	3.0	
Identification of system constraints	Y	3.0	
Identify boundary conditions	Y	3.0	
Confirmation of adequate domestic supply and pressure	Y	3.0	
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.		3.0	Appendix A
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.	Y	3.0	
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	Y	3.0	
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.	Y	3.0	
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.	Y	3.0	
Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.	N/A		

4.3 Wastewater	Addressed (Y/N/NA)	Section	Comments
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).	Y	4.0	
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.	Y	4.0	
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 MECP sanitary sewer design table (Appendix 'C') format.	Y	4.0	Appendix B
Description of proposed sewer network including sewers, pumping stations, and forcemains.	Y	4.0	
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		

4.4 Stormwater	Addressed (Y/N/NA)	Section	Comments
Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)	Y	5.0	
Analysis of available capacity in existing public infrastructure.	N		
A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.	Y		Existing Conditions and Removals Plan
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.	Y	5.0	Appendix C
Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.	y	5.0	Appendix C
Description of the stormwater management concept with facility locations and descriptions with references and supporting information.	Y	5.0	Appendix C
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.	Y		Appendix C
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 (1:2 year return period) and major events (1:100 year return period).	Y	5.0	Appendix C
Identification of watercourses within the proposed development and how watercourses will be protected, or, if necessary, altered by the proposed development with applicable approvals.	N		
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.	Y	5.0	Appendix C
Any proposed diversion of drainage catchment areas from one outlet to another.	N/A		
Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.	N/A		
If quantity control is not proposed, demonstration that downstream system has adequate capacity for the post-development flows up to and including the 100-year return period storm event.	N/A		
Identification of potential impacts to receiving watercourses	N/A		
Identification of municipal drains and related approval requirements.	N/A		
Descriptions of how the conveyance and storage capacity will be achieved for the development.	Y	5.0	Appendix C
100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.	N		
Inclusion of hydraulic analysis including hydraulic grade line elevations.	N		
Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.	Y	9.0	
Identification of floodplains – proponent to obtain relevant floodplain information from the appropriate Conservation Authority. The proponent may be required to delineate floodplain elevations to the satisfaction of the Conservation Authority if such information is not available or if information does not match current conditions.	N/A		
Identification of fill constraints related to floodplain and geotechnical investigation.	N/A		

4.5 Approval and Permit Requirements	Addressed (Y/N/NA)	Section	Comments
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	Addressed (Y/N/NA)	Section	Comments
Clearly stated conclusions and recommendations	Y	11.0	
Comments received from review agencies including the City of Ottawa and information on how the comments were addressed. Final sign-off from the responsible reviewing agency.	N/A		
All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario	Y		

Appendix G PRE-CONSULTATION MEETING MEMO

SERVICING MEMO

Date:	January 20, 2020
To / Destinataire	Shoma Murshid Planner, Development Review East
From / Expéditeur	Sara Mashaie, P.Eng. Project Manager, Infrastructure Approvals, Development Review East
Subject / Objet	**Pre-Application Consultation** **1994 St. Joseph Blvd., Ward 2 – Innes** *Two-storey “personal service” (physiotherapy) building with 25 on-grade parking spaces* File No. PC2020-0013

Please note the following information regarding the engineering design submission for the above noted site:

****Note:** Some items may not be required as part of your submission and are for informational purposes.

1. The Servicing Study Guidelines for Development Applications are available at the following address: https://ottawa.ca/en/city-hall/planning-and-development/information-developers/development-application-review-process/development-application-submission/guide-preparing-studies-and-plans#servicing-study-guidelines-development-applications

2. The following Engineering plans and reports are requested for the submission:

   a. Site Servicing Plan

   b. Site Servicing Report

   c. Stormwater Management Report (can be combined with the Site Servicing Report)

   d. Grade Control and Drainage Plan

   e. Erosion and Sediment Control Plan (can be combined with the Grade Control and Drainage Plan)

   f. Geotechnical Report

3. Plans are to be submitted on standard **A1 size** (594mm x 841mm) sheets, utilizing an appropriate Metric scale (1:200, 1:250, 1:300, 1:400, or 1:500). With all submitted plans and reports, please provide an individual PDF format of the files.

4. Servicing and site works shall be in accordance with the following documents:

   ⇨ Ottawa Sewer Design Guidelines (October 2012)

   ⇨ Ottawa Design Guidelines – Water Distribution (2010)

   ⇨ Geotechnical Investigation and Reporting Guidelines for Development Applications in the City of Ottawa (2007)

   ⇨ City of Ottawa Slope Stability Guidelines for Development Applications (revised 2012)

   ⇨ City of Ottawa Environmental Noise Control Guidelines (January, 2016)

   ⇨ City of Ottawa Park and Pathway Development Manual (2012)

   ⇨ City of Ottawa Accessibility Design Standards (2012)

   ⇨ Ottawa Standard Tender Documents (latest version)

   ⇨ Ontario Provincial Standards for Roads & Public Works (2013)

5. Record drawings and utility plans are also available for purchase from the City (Contact the City's Information Centre by email at InformationCentre@ottawa.ca or by phone at (613) 580-2424 x.44455).

6. The Stormwater Management Criteria, for the subject site, is to be based on the following:

   i. The 5-yr storm event using the IDF information derived from the Meteorological Services of Canada rainfall data, taken from the MacDonald Cartier Airport, collected 1966 to 1997.

   ii. For separated sewer system built pre-1970 the design of the storm sewers are based on a 2 year storm.

   iii. The pre-development runoff coefficient or a maximum equivalent 'C' of 0.5, whichever is less (§ 8.3.7.3).

iv. A calculated time of concentration (Cannot be less than 10 minutes).

v. Flows to the storm sewer in excess of the 5-year storm release rate, up to and including the 100-year storm event, must be detained on site.

vi. For a combined sewer system the maximum C= 0.4 or the pre-development C value, whichever is less. In the absence of other information the allowable release rate shall be based on a 2 year storm event.

Note: There may be area specific SWM Criteria that may apply. Check for any related SWM &/or Sub-watershed studies that may have been completed.

7. Deep Services (Storm, Sanitary & Water Supply)

i. Provide existing servicing information and the recommended location for the proposed connections. Services should ideally be grouped in a common trench to minimize the number of road cuts.

ii. Connections to trunk sewers and easement sewers are typically not permitted.

iii. Provide information on the monitoring manhole requirements – should be located in an accessible location on private property near the property line (ie. Not in a parking area).

iv. Review provision of a high-level sewer.

v. Provide information on the type of connection permitted

Sewer connections to be made above the springline of the sewermain as per:

a. Std Dwg S11.1 for flexible main sewers – *connections made using approved tee or wye fittings.*

b. Std Dwg S11 (For rigid main sewers) – *lateral must be less that 50% the diameter of the sewermain,*

c. Std Dwg S11.2 (for rigid main sewers using bell end insert method) – *for larger diameter laterals where manufactured inserts are not available; lateral must be less that 50% the diameter of the sewermain,* *d.* Connections to manholes permitted when the connection is to rigid main sewers where the lateral exceeds 50% the diameter of the sewermain. – Connect obvert to obvert with the outlet pipe unless pipes are a similar size.

e. No submerged outlet connections.

8. Water Boundary condition requests must include the location of the service and the expected loads required by the proposed development. Please provide the following information:

   i. Location of service

   ii. Type of development and the amount of fire flow required (as per FUS, 1999).

   iii. Average daily demand: ___ l/s.

   iv. Maximum daily demand: ___l/s.

   v. Maximum hourly daily demand: ___ l/s.

9. All development application should be considered for an ECA by the MOECC.

   a. Consultant determines if an approval for sewage works under Section 53 of OWRA is required. Consultant determines what type of application is required and the City's project manager confirms. (If the consultant is not clear if an ECA is required, they will work with the City to determine what is required. If the consultant is still unclear or there is a difference of opinion only then will they approach the MOECC).
   b. The project will be either transfer of review (standard), transfer of review (additional), direct submission, or exempt as per O. Reg. 525/98.
   c. Pre-consultation is not required if applying for standard works (schedule A of the Agreement) under Transfer Review.
   d. Mandatory pre-consultation is required if applying for additional works (schedule A of the Agreement) under Transfer Review.
   e. Pre-consultation with local District office of MOECC is recommended for direct submission.
   f. Consultant completes an MOECC request form for a pre-consultation. Send request to moeccottawasewage@ontario.ca.

10. Phase 1 ESAs and Phase 2 ESAs must conform to clause 4.8.4 of the Official Plan that requires that development applications conform to Ontario Regulation 153/04.

Should you have any questions or require additional information, please contact me directly at (613) 580-2424, ext. 27885 or by email at sara.mashaie@ottawa.ca.

Appendix H DRAWINGS