PYE & RICHARDS ARCHITECTS INC

NEW 2-STOREY OFFICE BUILDING WITH BASEMENT PARKING GARAGE 56 STEACIE DRIVE, OTTAWA, ON

SERVICING AND STORMWATER MANAGEMENT REPORT

REVISION 1 - APRIL 3, 2019

P&R

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NEW 2-STOREY OFFICE BUILDING WITH BASEMENT PARKING GARAGE
56 STEACIE DRIVE, OTTAWA, ON

SERVICING AND STORMWATER MANAGEMENT REPORT

PYE & RICHARDS ARCHITECTS INC

SITE PLAN APPLICATION (2^{ND} SUBMISSION)

PROJECT NO.: 18M-01672-00
DATE: APRIL 2019

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April 3, 2019

Pye & Richards Architects Inc
200-824 Meath Street
Ottawa, ON K1Z 6E8

Attention: Scott Hayward, Principal

Dear Sir:

Subject: 56 Steacie Drive - Servicing and Stormwater Management Report

Please find attached our updated servicing and stormwater management report, revised to respond to the City of Ottawa review comments dated March 15, 2019.

Yours sincerely,

Ding Bang (Winston) Yang, P.Eng.
Project Engineer

WSP ref.: 18M-01672-00

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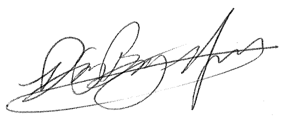
QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Issued for Site Plan Application	Submission No. 2		
Date	January 23, 2019	April 03, 2019		
Prepared by	Ding Bang (Winston) Yang	Ding Bang (Winston) Yang		
Signature				
Checked by	James (Jim) Johnston	James (Jim) Johnston		
Signature				
Project number	18M-01672-00	18M-01672-00		

SIGNATURES

PREPARED BY



Ding Bang (Winston) Yang, P.Eng
Project Engineer

REVIEWED BY

James (Jim) Johnston, P.Eng., MBA, M.Sc., LEED AP BD+C
Senior Project Manager

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1 GENERAL

1.1 EXECUTIVE SUMMARY

WSP was retained by Pye & Richards Architects Inc to provide servicing, grading and stormwater management design services for the proposed new 2-storey office building with basement parking garage, located at 56 Steacie Drive, south west of Carling Ave and March Road. This report outlines findings and calculations pertaining to the servicing of the proposed 1628 square metre building.

The subject site is 0.54 ha in size. The site is bounded by commercial development to the east, west and north, and recreational park to the south. It is part of lot 6 Concession 3, Geographic Township of March, now City of Ottawa (refer to Appendix D for the Topographical Survey Plan by Fairhall, Moffatt & Woodland Limited) Currently, the site is vacant and consists primarily of grassed area. Based on the topographic survey, the overall topography of the site is relatively flat with a slope towards the existing ditch located north of the property. The existing ditch currently flows from the west to the east.

As established at the pre-consultation meeting, stormwater quantity control is required for the impacted areas of the site in order that post-construction runoff rates do not exceed existing rates for the 5 year and 100 year storm events. The proposed development will increase the runoff coefficient as a result of the increase in impervious areas, thus stormwater quantity control will be provided for this development. Neither of the proposed controlled areas receive any drainage contribution from adjacent lands.

Stormwater quality control has been requested by the Mississippi Valley Conservation Authority, and will be accommodated with an oil and grit separator to be installed on the outlet storm sewer from the development site.

This report was prepared utilizing servicing design criteria obtained from available sources and outlines the design for water, sanitary wastewater, and stormwater facilities, including stormwater management.

The format of this report matches that of the servicing study checklist found in section 4 of the City of Ottawa's Servicing Study Guidelines for Development Applications, November 2009.

The following municipal services are available within Steacie Drive adjacent to the development as recorded from the following as-built drawings received from the City of Ottawa registry:

Steacie Drive:

- 200 mm watermain, 250 mm sanitary sewer.

City Registry drawings: 8" water main, 10" sanitary sewer Plan No. 12848pp1 and 12848pp2

It is presently anticipated that:

- On-site stormwater management systems, employing surface storage will be provided to attenuate flow rates leaving the new parking lot and new building roof. Existing drainage patterns will be maintained.

1.2 DATE AND REVISION NUMBER

This version of the report is the second issue, dated April 03, 2019, revised to respond to City of Ottawa review comments dated March 15, 2019.

1.3 LOCATION MAP AND PLAN

The proposed commercial development located at 56 Steacie Drive, in the City of Ottawa is shown in Figure 1-1 below.

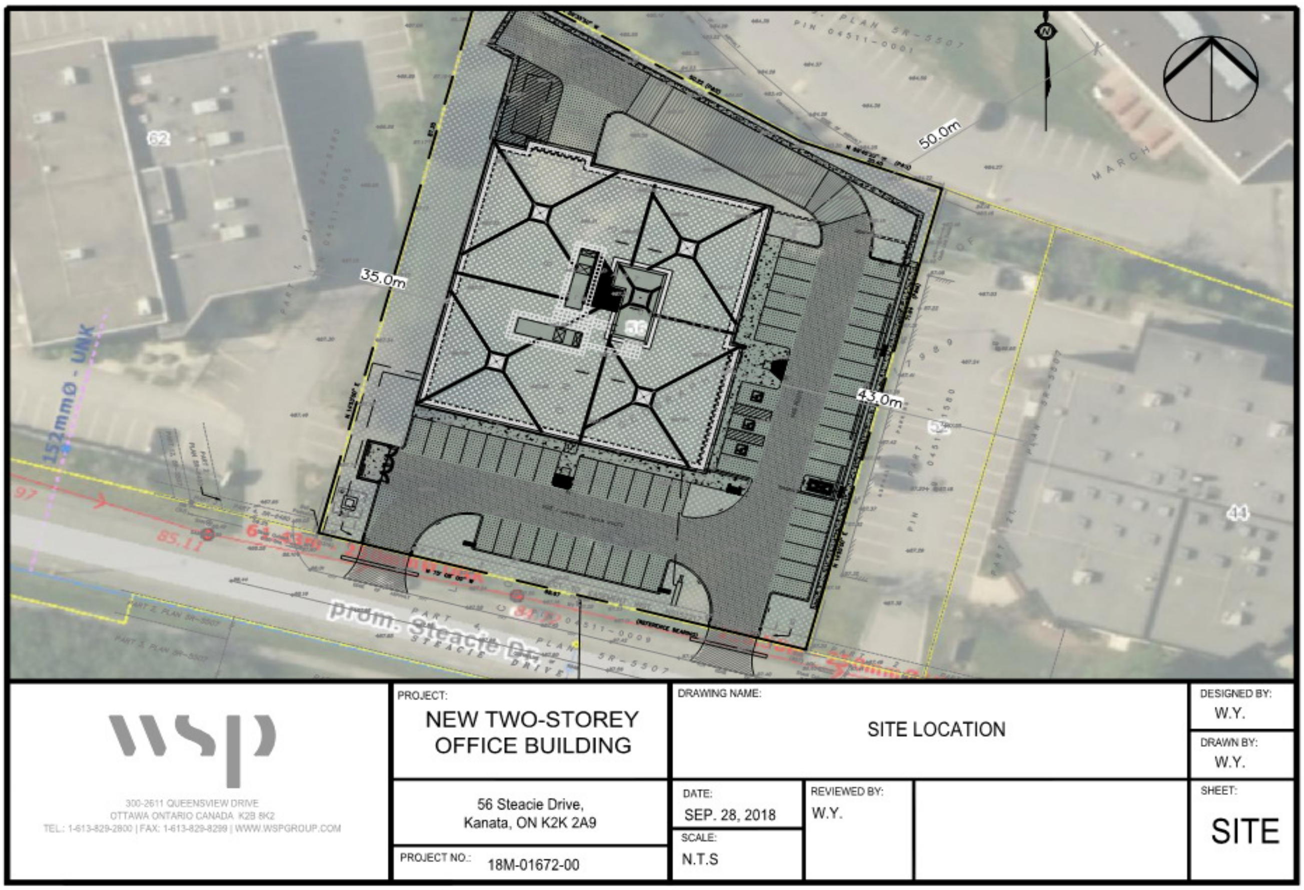


Figure 1-1 Site Location

1.4 ADHERENCE TO ZONING AND RELATED REQUIREMENTS

The proposed property use will be in conformance with zoning and related requirements prior to approval and construction, and is understood to be in conformance with current zoning.

1.5 PRE-CONSULTATION MEETINGS

A pre-consultation meeting was held with the City of Ottawa on October 11, 2018.

1.6 HIGHER LEVEL STUDIES

The review for servicing has been undertaken in conformance with, and utilizing information from, the following documents:

- Ottawa Sewer Design Guidelines, Second Edition, Document SDG002, October 2012, City of Ottawa including:
  - Technical Bulletin ISDTB-2012-4 (20 June 2012)
  - Technical Bulletin ISDTB-2014-01 (05 February 2014)
  - Technical Bulletin PIEDTB-2016-01 (September 6, 2018)
  - Technical Bulletin ISDTB-2018-01 (21 March 2018)
  - Technical Bulletin ISDTB-2018-04 (27 June 2018)
- Ottawa Design Guidelines – Water Distribution, July 2010 (WDG001), including:
  - Technical Bulletin ISDTB-2014-02 (May 27, 2014)
  - Technical Bulletin ISTB-2018-02 (21 March 2018)
- Stormwater Management Planning and Design Manual, Ontario Ministry of the Environment and Climate Change, March 2003 (SMPDM).
- Design Guidelines for Drinking-Water Systems, Ontario Ministry of the Environment and Climate Change, 2008 (GDWS).
- Fire Underwriters Survey, Water Supply for Public Fire Protection (FUS), 1999.

1.7 STATEMENT OF OBJECTIVES AND SERVICING CRITERIA

The objective of the site servicing is to meet the requirements for the proposed modification of the site while adhering to the stipulations of the applicable higher-level studies and City of Ottawa servicing design guidelines.

1.8 AVAILABLE EXISTING AND PROPOSED INFRASTRUCTURE

A municipal sanitary sewer and a watermain are located within the Steacie Drive right of way along the frontage of the site. A new sanitary service and a new water service will extend from Steacie Drive to the proposed building. The proposed on-site storm sewer network will surround the proposed building, and discharge to the existing ditch to the north. The ditch travels a short distance prior to discharging into a municipal storm sewer at March Road. Ultimately, the storm flows from the ditch (which services the proposed site and adjacent properties) is directed to the Kizell Drain system. Quality control is required on the site to normal level (70% TSS removal) required for the Kizell Drain watershed, and quantity control is required to restrict the discharge for all events up to a 100 year event to the 5 year pre-development flow rate.
Site access for vehicles will be provided from Steacie Drive. The driveways being provided are each two-way entrance and exit.

1.9 ENVIRONMENTALLY SIGNIFICANT AREAS, WATERCOURSE AND MUNICPAL DRAINS

The proposed development site is bordered by parkland to the south, and by commercial land to the east, west and north. There are no environmentally significant areas, water courses or municipal drains identified at or in close proximity to the site. The ditch to the north conveys surface drainage from this and the neighbouring properties to the storm sewer, but is not classified as a watercourse or municipal drain. The drainage from the site and downstream storm sewer network discharges to the Kizell Drain.

1.10 CONCEPT LEVEL MASTER GRADING PLAN

A detailed grading plan for the site has been developed, matching the existing pattern of directing drainage to the existing ditch at the northeast corner, both via the proposed storm sewer system and overland flow. The site topographic survey, included in Appendix D, provides evidence of direction of overland flow in the north section of the site from west to east.

Due to the existing grade difference north of the building, it will be necessary to construct a retaining wall on the north side of the ramp to the below grade parking level. As the maximum height of the wall will be 3.50m, the wall has been designed by a professional engineer, and is provided on a separate drawing prepared by the Paterson Group, which is referenced on the grading drawing for the north section of the site.

Grading will employ terraced slopes of 3H:1V to provide transitions from the new work areas to existing grades. No changes will be made to grades at the property perimeter except at the access driveway for the new parking lot, where a minor grade raise will be required to install a new culvert.

The geotechnical study (see Section 1.13 below) recommended a maximum grade raise of 1.5 metres for the site. There is one section of the proposed new north access road which will have a grade raise exceeding this amount. Direction has been received from the geotechnical engineer on requirements for fill in this area. The geotechnical engineer is also responsible for the design of the proposed retaining wall in the north area.

1.11 IMPACTS ON PRIVATE SERVICES

There are no existing domestic private services (septic system and well) located on the site. There are no neighbouring properties using private services.

1.12 DEVELOPMENT PHASING

No development phasing is expected for the current proposal.

1.13 GEOTECHNICAL SUTDY

A geotechnical investigation report has been prepared by the Paterson Group (Report PG4481-1, August 14, 2018), and its recommendations taken into account in developing the engineering specifications, including specific measures for dealing with isolated areas where the grade will be raised higher than the recommended 1.5 metre limit. Paterson Group has confirmed that the maximum grade raise of approximately 2.1m at the north-east corner is considered acceptable from a geotechnical perspective via email on January 10, 2019. A copy of the email can be found in Appendix B.

1.14 DRAWING REQUIREMENT

The engineering plans submitted for site plan approval will be in compliance with City requirements.

2 WATER DISTRIBUTION

2.1 CONSISTENCY WITH MASTER SERVICING STUDY AND AVAILABILITY OF PUBLIC INFRASTRUCTURE

There is an existing 200mm diameter municipal watermain on Steacie Drive providing water to adjacent properties. The new two-storey office will be sprinklered, and will require a 150mm diameter water service. No changes are required to the existing City water distribution system to allow servicing for this property.

2.2 SYSTEM CONSTRAINTS AND BOUNDARY CONDITIONS

Boundary conditions have been provided by the City of Ottawa at the 203 mm diameter watermain on Steacie Drive for the development, and are included in Appendix A. A fire flow of 150 l/s (9,000 l/min) was used for the development which was calculated in Section 2.4. The boundary conditions were based on fire flows and domestic demands estimated for the proposed two-storey office as supplied by the City of Ottawa and summarized as follows:

Table 2-1: Boundary Conditions

BOUNDARY CONDITIONS	
SCENARIO	HGL (m)
Maximum HGL	131.7
Minimum HGL (Peak Hour)	125.5
Max Day + Fire Flow	119.6

2.3 CONFIRMATION OF ADEQUATE DOMESTIC SUPPLY AND PRESSURE

Water demands are based on Table 4.2 of the Ottawa Design Guidelines – Water Distribution. As previously noted, the development is considered as commercial development, consisting of a two-storey office building with underground parking garage. The office building is assumed to have an average demand of at 28,000 L/ha/d as found in Table 4.1 of the Design Guidelines. A water demand calculation sheet is included in Appendix A, and the total water demands are summarized as follows:

	Commercial Office Building
Average Day	1.03 l/s
Maximum Day	1.55 l/s
Peak Hour	2.79 l/s

The 2010 City of Ottawa Water Distribution Guidelines stated that the preferred practice for design of a new distribution system is to have normal operating pressures range between 345 kPa (50 psi) and 552 kPa (80 psi) under maximum daily flow conditions. Other pressure criteria identified in the guidelines are as follows:

Minimum Pressure	Minimum system pressure under peak hour demand conditions shall not be less than 276 kPa (40 psi)
Fire Flow	During the period of maximum day demand, the system pressure shall not be less than 140 kPa (20 psi) during a fire flow event.
Maximum Pressure	Maximum pressure at any point the distribution system shall not exceed 689 kPa (100 psi). In accordance with the Ontario Building/Plumbing Code, the maximum pressure should not exceed 552 kPa (80 psi). Pressure reduction controls may be required for buildings where it is not possible/feasible to maintain the system pressure below 552 kPa.

The minimum water pressure inside the building at the connection is determined by the difference between the water entry elevation of 85.48 m and the minimum HGL condition, resulting in a pressure 334.53 kPa which exceeds the minimum requirement of 276 kPa per the guidelines.

2.4 CONFIRMATION OF ADEQUATE FIRE FLOW PROTECTION

The fire flow rate has been calculated using the Fire Underwriters Survey (FUS) method. The method takes into account the type of building construction, the building occupancy, the use of sprinklers and the exposures to adjacent structures. A calculation was performed for the proposed two-storey office building. Assuming fire resistive construction and a sprinkler system, a fire flow demand of 9,000 l/min has been calculated. A copy of the calculation is included in Appendix A.

The demand of 9,000 l/min can be delivered through two existing municipal fire hydrants. The hydrant directly opposite of the building on the south side of Steacie Drive is within 75 m of the building, and is rated at 5700 l/min. The hydrant located to the east is within 150 m of the building, and is rated at 3800 l/min. The two hydrants have a combined total of 9500 l/min.

The proposed building on site will be serviced by a single 150 mm service off the 200 mm municipal watermain. The service will run into the mechanical/pump room. The proposed building will be fully sprinklered and fire protection will be provided with the fire department Siamese connection within 45 m of the existing fire hydrant on Steacie Drive. The Siamese connection is located on the southwest corner of the building.

The boundary condition for Maximum Day and Fire Flow results in a pressure of 317.8 kPa at the ground floor level. In the guidelines, a minimum residual pressure of 140 kPa must be maintained in the distribution system for a fire flow and maximum day event. As a pressure of 317.8 kPa is achieved, the fire flow requirement is exceeded.

2.5 CHECK OF HIGH PRESSURE

High pressure is not a concern. Maximum water pressure is determined by the difference between the water entry elevation of 87.24 m and the maximum HGL condition resulting in a pressure of 435.7 kPa, which is less than the 552 kPa threshold in the guideline in which pressure control is required. Based on this result, pressure control is not required for this building.

2.6 PHASING CONSTRAINTS

No phasing constraints exist.

2.7 RELIABILITY REQUIREMENTS

A shut off valve will be provided for the building water service at the property line along Steacie Drive. Water can be supplied to the service stub from both the west and east, and can be isolated from either direction.

2.8 NEED FOR PRESSURE ZONE BOUNDAY MODIFICATION

There is no need for a pressure zone boundary modification.

2.9 CAPABILITY OF MAJOR INFRASTRUCTURE TO SUPPLY SUFFICIENT WATER

The current infrastructure is capable of meeting the domestic demand based on City requirements and fire demand as determined by FUS requirements for the proposed building.

2.10 DESCRIPTION OF PROPOSED WATER DISTRUBTION NETWORK

A 150 mm water service is proposed to be provided into the proposed commercial site. An existing municipal hydrant is located within 45 metres of the fire department connection on the south side of the building as per OBC requirements.

2.11 OFF-SITE REQUIREMENTS

No off-site improvements to watermains, feedermains, pumping stations, or other water infrastructure are required to maintain existing conditions and service the adjacent buildings, other than the connection of the new private watermain to the City watermain in the south frontage of the site.

2.12 CALCULATION OF WATER DEMANDS

Water demands were calculated by as described in Sections 2.3 and 2.4 above.

2.13 MODEL SCHEMATIC

As the water works consist of a single building service, a model schematic is not required.

3 WASTEWATER DISPOSAL

3.1 DESIGN CRITERIA

In accordance with the City of Ottawa's Sewer Design Guidelines, the following design criteria have been utilized in order to predict wastewater flows generated by the subject site and complete the sewer design;

- Minimum Velocity 0.6 m/s
- Maximum Velocity 3.0 m/s
- Manning Roughness Coefficient 0.013
- Total est. hectares commercial use 0.54
- Commercial/Institutional Average Flow 28,000 l/gross Ha/d
- Commercial/Institutional Peaking Factor 1.5
- Infiltration Allowance (Total) 0.33 L/s/Ha
- Minimum Sewer Slopes – 200 mm diameter 0.32%

3.2 CONSISTENCY WITH MASTER SERVICING STUDY

The outlet for the sanitary service from the proposed office building is the 250 mm diameter municipal sewer on Steacie Drive.

The Ottawa Sewer Design Guidelines provide estimates of sewage flows based on commercial development. The anticipated average flow based on an ultimate development area of 0.54 Ha (at an average rate of 28,000 L/gross Ha/d) is 0.18 L/s. Applying the peaking factor of 1.5, and adding the extraneous flow, the estimated ultimate peak flow is 0.45 L/s.

The criteria to determine anticipated actual peak flow based on site used as described in Ottawa Sewer Design Guidelines Appendix 4-A are as follows;

- Employees, Various buildings and places of Employment, office workers 75 L/d/person
- Catch basins in garage floors 375 L/day/each

The site will support a maximum of 115 employees and will have 7 interior catch basins for cleaning purposes. Given the above, and the 1.5 commercial peaking factor, the anticipated actual sanitary sewer flow is 0.28 L/s peak flow including the extraneous flow, which is less than the aggregate flow determined above. The on-site sanitary sewer network has been designed in accordance with 0.45 L/s as described above.

3.3 REVIEW OF SOIL CONDITIONS

There are no specific local subsurface conditions that suggest the need for a higher extraneous flow allowance.

3.4 DESCRIPTION OF EXISTING SANITARY SEWER

The outlet sanitary sewer is the existing 254 mm diameter sewer on Steacie Drive. This local sewer will outlet to a sanitary sewer on Station Road then discharge to the sewer on Legget Drive.

3.5 VERIFICATION OF AVAILABLE CAPACITY IN DOWNSTREAM SEWER

The capacity of the downstream 254 mm diameter sewer at 0.40% slope is 39.24 L/s, which is adequate for the flow assumptions from the proposed site as noted above. As noted above, the expected flow based on the proposed office building will be lower than the flow allowance assumed for the site based on the Sewer Design Guidelines.

3.6 CALCULATIONS FOR SANITARY SEWER

The 150 mm diameter sanitary service from the sanitary monitoring manhole at the property line to the street will have a slope of 0.50%, and a capacity of 10.78 L/s, with a velocity of 0.61 m/s. The 150mm sanitary sewer between the building and the private monitoring manhole will have a slope of 1%, and a capacity of 15.24 L/s, with a velocity of 0.86 m/s. the capacity of each pipe exceeds the estimated peak sanitary flow rate of 0.45 L/s for the entire proposed site.

3.7 DESCRIPTION OF PROPOSED SEWER NETWORK

The proposed sanitary sewer network on site will consist of a 150 mm diameter building service, a 1200 mm diameter monitoring manhole near the property boundary, and a 150 mm diameter outlet sewer discharging to the existing 250mm diameter City sanitary sewer on Steacie Drive.

3.8 ENVIRONMENTAL CONSTRAINTS

There are no previously identified environmental constraints that impact the sanitary servicing design in order to preserve the physical condition of watercourses, vegetation, or soil cover, or to manage water quantity or quality.

3.9 PUMPING REQUIREMENTS

The proposed development will have no impact on existing pumping stations and will not require new pumping facilities, other than an internal lift pumping package for the basement level floor drains. The internal pumps are being designed by the mechanical engineer as part of the plumbing system design.

3.10 FORCE-MAINS

No force-mains are required specifically for this development.

3.11 EMERGENCY OVERFLOWS FROM SANITARY PUMPING STATIONS

No pumping stations are required for this site.

3.12 SPECIAL CONSIDERATIONS

Site investigations have not yielded the need for special considerations for sanitary sewer design related to contamination, corrosive environments, or any other issue.

4 SITE STORMWATER MANAGEMENT

4.1 EXISTING CONDITION

Drainage from the site currently flows overland to a receiving ditch on the north side of the property. Further downstream, drainage is conveyed via piped storm sewer network along March Road

As noted in the pre-consultation meeting and associated notes from the City of Ottawa, the stormwater design for the site modifications is required to result in peak flow rates under 5 year and 100 year conditions that do not exceed the 5 year rate generated under existing conditions.

The Mississippi Valley Conservation Authority has asked that 70% TSS removal be provided for stormwater discharges.

4.2 ANALYSIS OF AVAILABLE CAPACITY IN PUBLIC INFRASTRUCTURE

The allowable release rate for the 0.538 Ha site can be calculated as follows:

$Q_{\text{(total allowable)}}$	$= 2.78 \times C \times I_{100yr} \times A$	where:
C	= 0.25 (Weighted average pre-development C)	
I_{5yr}	= Intensity of 5-year storm event (mm/hr)	
	$= 998.071 \times (T_c + 6.053)$^0.814 = 104.19 mm/hr; where T_c = 10 minutes	
A	= Area = 0.538 Ha	

Therefore, the total allowable release rate can be determined as:

= 38.96 L/s

Detailed calculations are provided in Appendix C.

The receiving ditch and downstream sewers already accept uncontrolled flow from the site equal to or greater than the allowable release rate of 38.96 l/s that will be generated from the proposed development under 5 year and higher return period storm events. No capacity issues with existing infrastructure have been noted during consultations with the City or MVCA.

4.3 DRAINAGE DRAWING

Drawing C-02 shows the receiving storm sewer and site storm sewer network. Drawing C-03 provides proposed grading and drainage, and includes existing grading information. Drawing C-04 provides a drainage sub-area plan, including both site and roof information. Site sub-area information is also provided on the storm sewer design sheet attached in Appendix C.

4.4 WATER QUANTITY CONTROL OBJECTIVE

The water quantity objective for the site is to limit the flow release to 38.96 L/s. Excess flows above this limit up to those generated by the 100 year storm event are temporarily stored on site.

No provision is required on the site to accommodate any flow from the adjacent lands. All flows exceeding the defined minor system capacity and on-site storage capability will enter the major system, with overflow to the City right of way on the south and the existing ditch on the north of the site. Detailed stormwater management calculations are provided in Appendix C.

4.5 WATER QUALITY CONTROL OBJECTIVE

As noted previously, the designated water quality control objective is to achieve 70% TSS removal. This objective will be achieved through the use of an oil and grit separator for the runoff generated from the site, achieving the approximate TSS removal required as well as oil capture.

4.6 DESIGN CRITERIA

The stormwater system was designed following the principles of dual drainage, making accommodation for both major and minor flow.
Some of the key criteria include the following:

• Design Storm	1:5 year return (Ottawa)
• Rational Method Sewer Sizing	
• Initial Time of Concentration	10 minutes
• Runoff Coefficients	
Landscaped Areas	C = 0.25
Asphalt/Concrete	C = 0.90
Traditional Roof	C = 0.90
Green Roof (See additional comment in 4.10)	C = 0.30
• Pipe Velocities	0.80 m/s to 6.0 m/s
• Minimum Pipe Size	250 mm diameter (200 mm CB Leads)

4.7 PROPOSED MINOR SYSTEM

The detailed design for this site provides a storm sewer outlet to the north ditch, an overflow pipe to the north ditch, and small areas of uncontrolled surface drainage entering the road side ditch within the Steacie Drive ROW to the south. A limited amount of uncontrolled surface flow will also enter the 52 Steacie Drive to the east and the ditch area to the north, (consistent with existing conditions), with both directed to the existing ditch to the north.

Using the above noted criteria, the proposed on-site storm sewers were sized accordingly. A detailed storm sewer design sheet and the associated storm sewer drainage area plan is included in Appendix C. Please note that an allocation for flows from the adjacent developed parcel of lands to the east and west of the site has been directed to the existing ditch for years within the existing pipe network.

4.8 STORMWATER MANAGEMENT

The subject site will be limited to a release rate established using the criteria described in section 4.6. this will be achieved through a combination of inlet control devices (ICD's) at inlet locations and surface storage.

Flows generated that are in excess of the site's allowable release rate will be stored on site in surface storage areas or by the use of roof top storage and gradually released into the minor system so as not to exceed the site's allocation.

The maximum surface retention depth of the developed areas will be limited to 300mm during a 1:100 year event.

No surface ponding will occur during a 2 year event, and only minimal ponding will occur during a 5 year event.

Overland flow routes will be provided in the grading to permit emergency overland flow from the site. The overflow routes will eliminate any increase in ponding depth for events exceeding 100 years, including under a stress test of 20% above 100 year flow rates.

At certain location within the site, the opportunity to store runoff is limited due to grading constraints and building geometry. These locations are located at the perimeter of the site where it is necessary to tie into public boulevards and adjacent properties, and it is not always feasible to capture or store stormwater runoff. These "uncontrolled areas - 0.058 hectares (Area UC1) (including driveways) along the south frontage on Steacie Drive, and 0.029 hectares (Area UC2) along the north and north area of the east frontage, have a weighted average C values (100 year) of 0.58 and 0.31 respectively. Based on 1:100 year storm uncontrolled flows, the uncontrolled areas generate 21.20 L/s runoff (refer to Section 4.9 for calculation).

The site grading and ponding has been designed to control water generated during the 1:100-year event, with no overflow leaving the site. Please refer to the SWM Calculations in Appendix C.

4.9 INLET CONTROLS

The allowable release rate for the 0.538 Ha site has been calculated in Section 4.2, the total allowable release rate can be determined as:

= 38.96 L/s

As noted in Section 4.8, two small areas of the site (UC1 and UC2), will discharge uncontrolled.

To the south boulevard and Steacie road side ditch (Area UC1):

$Q_{(uncontrolled)}$	$= 2.78 \times C \times I_{100yr} \times A$	where:
C	= 0.58 (Weighted average post-development C)	
I_{100yr}	= Intensity of 100-year storm event (mm/hr)	
	$= 1735.688 \times (T_c + 6.014)$^0.814 = 178.56 mm/hr; where T_c = 10 minutes	
A	= Area = 0.058 Ha	

The uncontrolled release to the south = 16.70 L/s.

To the north ditch (Area UC2):

$Q_{(uncontrolled)}$	$= 2.78 \times C \times I_{100yr} \times A$	where:
C	= 0.31 (Weighted average post-development C)	
I_{100yr}	= Intensity of 100-year storm event (mm/hr)	
	$= 1735.688 \times (T_c + 6.014)$^0.814 = 178.56 mm/hr; where T_c = 10 minutes	
A	= Area = 0.029 Ha	

The uncontrolled release to the north = 4.50 L/s.

The maximum allowable release rate from the remainder of the site can then be determined as:

$Q_{(max\ allowable)} = Q_{(total\ allowable)} - Q_{(uncontrolled}$ = 38.96 L/s – 16.70 – 4.50 L/s = **17.76 L/s**

Based on the flow allowance at the various inlet locations, a combination of various sized of inlet control devices (ICDs) were chosen in the design. The design of the inlet control devices is unique to each drainage area and is determined based on a number of factors, including hydraulic head and allowable release rate. The inlet control devices were sized according to the manufacturer's design charts. The restrictions will cause the on-site catchbasins and manholes to surcharge, generating surface ponding in the parking and landscaped areas. Ponding locations and elevations are summarized on the grading plan C-03, and included in Appendix C.

4.10 ON-SITE DETENTION

Any excess storm water up to the 100-year event is to be stored on-site in order to not surcharge the downstream municipal storm sewer system. Detention will be provided in parking and landscape areas and building rooftops, where feasible. As previously noted, the volume of storage is dependent on the characteristics of each individual drainage area and the ICD's were chosen accordingly. It should be noted that 0.30 m of vertical separation has been provided from all maximum ponding elevations to lowest building openings.

The following Table summarizes the on-site storage requirements during the 1:5-year and 1:100-year events.

Table 4-1: On-Site Storage Requirements

ICD AREA	TRIBUTARY AREA	AVAILABLE STORAGE (m^3)	100-YEAR STORM		5-YEAR STORM	
			RESTRICTED FLOW (L/s)	REQUIRED STORAGE (m^3)	RESTRICTED FLOW (L/s)	REQUIRED STORAGE (m^3)
A101 and A102	0.086	36.41	2.06	21.37	1.97	8.53
A106	0.074	16.47	7.57	15.49	6.66	5.45
A104	0.049	18.45	0.55	8.23	0.53	3.07
A107, ARD6-8	0.081	30.80	4.58	27.58	4.48	10.74
Building Roof	0.160	63.52	1.60	31.22	1.60	11.38
TOTAL	**0.450**	**165.65**	**16.36**	**109.97**	**15.24**	**41.69**

In all instances the required storage is met with surface ponds which retain the stormwater and discharge at the restricted flow rate to the sewer system. Refer to the storm drainage area and ponding plan attached in Appendix C for storage information.

The following Table summarizes the ICD's to be utilized on the site. ICD pre-set flow curves can be found in Appendix C.

Table 4-2: ICD Type

STRUCTURE ID	AREA ID	PROPOSED ICD			
		100 YR HEAD	FLOW (L/s)	TYPE	OUTLET DIA.
CBMH102	A101 and A102	2.48	2.06	HYDROVEX 50VHV-1	250
CB106	A106	0.89	7.57	HYDROVEX 100VHV-1	200
DICB104	A104	3.36	0.55	HYDROVEX 25SVHV-1	200
CBMH107	A107, ARD6-8	4.60	4.58	HYDROVEX 50VHV-1	375

The proposed buildings will have roof inlet controls that help to control the amount of stormwater being released into the system. The restricted into the system. The restricted flow rate for the proposed building is shown below.

Table 4-3: Roof Inlet Controls

ICD AREA	TRIBUTARY AREA (m^2)	100-YEAR STORM		5-YEAR STORM	
		RESTRICTED FLOW (L/s)	REQUIRED STORAGE (m^3)	RESTRICTED FLOW (L/s)	REQUIRED STORAGE (m^3)
ARD1	0.046	0.32	11.10	0.32	4.18
ARD2	0.028	0.32	11.12	0.32	2.10
ARD3	0.046	0.32	11.04	0.32	4.15
ARD4	0.034	0.32	7.58	0.32	2.79
ARD5	0.005	0.32	1.76	0.32	0.69
TOTAL	0.160	1.60	37.31	1.60	13.91

It should be noted that the current architectural design is proposing 5 roof inlets for the building roof. An additional control point will be provided at CBMH107 to control the flows from deck drains RD6, RD7 and RD8 over the basement parking garage, with an allowed release rate of 4.58 L/s.

A vegetated area will be provided on the building roof. The manufacturer has supplied data pertaining to the construction details, and also the hydraulic performance of this roof area. The project garden roof benefit can yield to an average of 34% annual runoff and 66% annual retention compare to the conventional roof. Please refer to the details green roof design calculation in Appendix C.

As demonstrated above, the site uses new inlet control devices to restrict the 100 year storm event to the criteria approved by the City of Ottawa. Restricted stormwater will be contained onsite by utilizing surface ponding and rooftop storage. In the storm event up to 100-year, there will be no over land flow off-site from restricted areas.

The sum of restrictions on the site, including building roof, deck drains, and parking area is 16.36 L/s, which is less than the maximum allowable release of 17.76 L/s noted in Section 4.9.

4.11 WATERCOURSES

There are no watercourses on or adjacent to the site.

4.12 PRE AND POST DEVELOPMENT PEAK FLOW RATES

Pre and post development peak flow rates for the impacted areas of the site have been noted in the sections above.

4.13 DIVERSION OF DRAINAGE CATCHMENT AREAS

There will be no diversion of existing drainage catchment areas arising from the proposed work described in this report.

4.14 DOWNSTREAM CAPACITY WHERE QUANTITY CONTROL IS NOT PROPOSED

This checklist item is not applicable to this development as quantity control is provided.

4.15 IMPACTS TO RECEIVING WATERCOURSES

No significant negative impact is anticipated to downstream receiving watercourses due the separation of the site from the eventual receiving watercourse as a result of discharge through City owned sewers and swales.

4.16 MUNICIPAL DRAINS AND RELATED APPROVALS

There are no municipal drains on the site or associated with the drainage from the site.

4.17 MEANS OF CONVEYANCE AND STORAGE CAPACITY

The means of flow conveyance and storage capacity are described in Sections 4.7, 4.8, 4.9 and 4.10 above.

4.18 HYDRAULIC ANALYSIS

Hydraulic calculations for the site storm sewers are provided in the storm sewer design sheet.

4.19 IDENTIFICATION OF FLOODPLAINS

There are no designated floodplains on the site of this development.

4.20 FILL CONSTRAINTS

There are no known fill constraints applicable to this site related to any floodplain. The site is generally being raised higher relative to existing conditions. No fill constraints related to soil conditions are anticipated, as confirmed in the geotechnical report.

5 SEDIMENT AND EROSION CONTROL

5.1 GENERAL

During construction, existing stream and storm water conveyance system can be exposed to sediment loadings. A number of construction techniques designed to reduce unnecessary construction sediment loadings will be used including;

- The installation of straw bales within existing drainage features surrounding the site;
- Bulkhead barriers will be installed in the outlet pipes;
- Filter cloths will remain on open surface structures such as manholes and catchbasins until these structures are commissioned and put into use;
- Installation of silt fence, where applicable, around the perimeter of the proposed work area.

During construction of the services, any trench dewatering using pumps will be fitted with a "filter sock." Thus, any pumped groundwater will be filtered prior to release to the existing surface runoff. The contractor will inspect and maintain the filter sock as needed including sediment removal and disposal.

All catchbasins, and to a lesser degree, manholes, convey surface water to sewers. Consequently, until the surrounding surface has been completed, these structures will be covered to prevent sediment from entering the minor storm sewer system. These measures will stay in place and be maintained during construction and build-out until it is appropriate to remove them.

During construction of any development both imported and native soils are placed in stockpiles. Mitigative measures and proper management to prevent these materials entering the sewer system are needed.

During construction of the deeper watermains and sewers, imported granular bedding materials are temporarily stockpiled on site. These materials are however quickly used up and generally placed before any catchbasins are installed.

The Sediment and Erosion Control Plan C-05 is included in Appendix D.

6 APPROVAL AND PERMIT REQUIREMENTS

6.1 GENERAL

The proposed development is subject to site plan approval and building permit approval.

No approvals related to municipal drains are required.

No permits or approvals are anticipated to be required from the Ontario Ministry of Transportation, National Capital Commission, Parks Canada, Public Works and Government Services Canada, or any other provincial or federal regulatory agency.

7 CONCLUSION CHECKLIST

7.1 CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development can meet all provided servicing constraints and associated requirements. It is recommended that this report be submitted to the City of Ottawa in support of the application for site plan approval.

7.2 COMMENTS RECEIVED FROM REVIEW AGENCIES

Comments received from the City of Ottawa and Mississippi Valley Conservation Authority are provided in Appendix B. And a request for a pre-consultation with the Ontario Ministry of the Environment, Conservation and Parks has been submitted in November 29, 2018. An acknowledge email was received in November 30, 2018 with an assigned senior environmental officer on the file from MECP. Then a follow up email to the assigned officer was sent in December 13, 2018. But no further feedback or comments have been received since that time. The coordination emails are provided in Appendix B.

APPENDIX

A

- WATERMAIN BOUNDARY CONDITIONS FROM CITY OF OTTAWA
- EMAILS FROM CITY OF OTTAWA
- FIRE UNDERWRITERS SURVEY – FIRE FLOW CALCULATION

BOUNDARY CONDITIONS

Boundary Conditions For: 56 Steacie Dr.

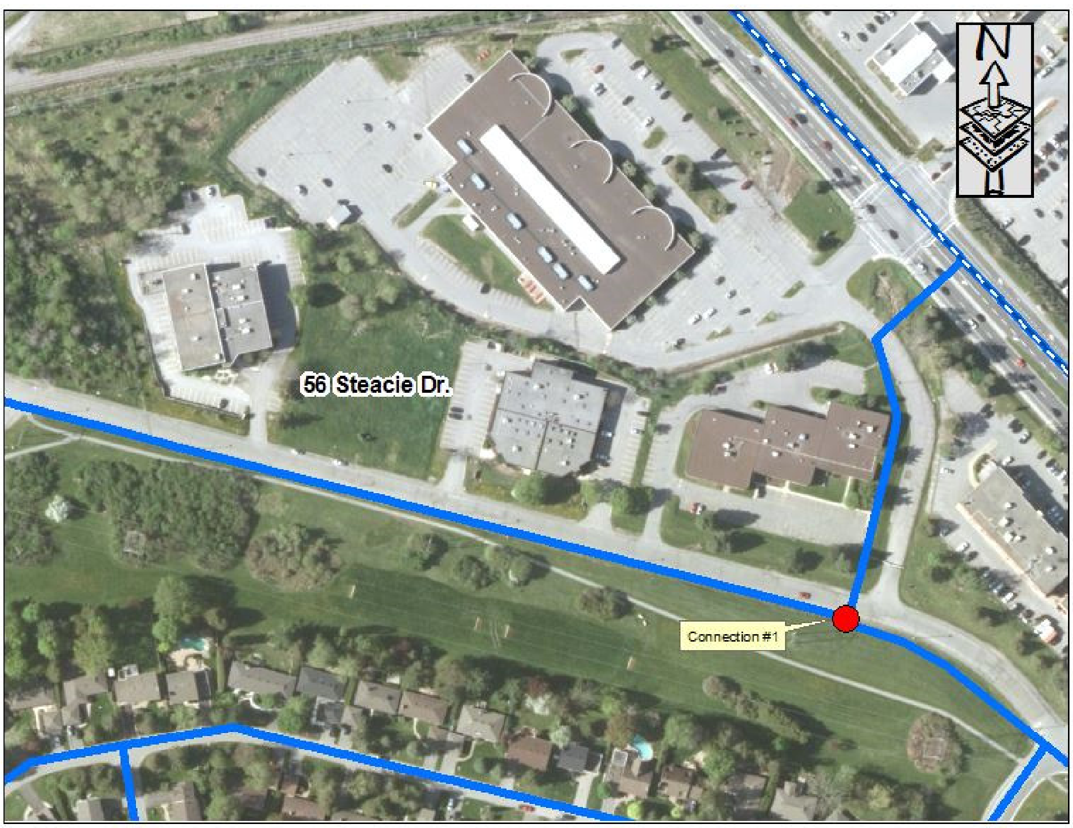
Date of Boundary Conditions:

Provided Information:

Scenario	Demand	
	L/min	L/s
Average Daily Demand	61.8	1.0
Maximum Daily Demand	93.0	1.6
Peak Hour	167.4	2.8
Fire Flow #1 Demand	9,000	150.0

Number Of Connections: 1

Location:



BOUNDARY CONDITIONS

Results:

Connection #: 1

Demand Scenario	Head (m)	Pressure[1] (psi)
Maximum HGL	131.7	63.2
Peak Hour	125.5	54.4
Max Day Plus Fire (9,000) L/min	119.6	46.1

[1]Elevation: **87.240 m**

Notes:

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

a) If possible, systems to be designed to residual pressures of 345 to 552 kPa (50 to 80 psi) in all occupied areas outside of the public right-of-way without special pressure control equipment.
b) Pressure reducing valves to be installed immediately downstream of the isolation valve in the home/ building, located downstream of the meter so it is owner maintained.

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.

From:	Fraser, Mark <Mark.Fraser@ottawa.ca>
Sent:	October-05-18 3:03 PM
To:	Yang, Winston
Cc:	Johnston, Jim
Subject:	RE: Fire Flow Request - 56 Steacie Drive
Attachments:	56 Steacie Dr. Boundary Condition.docx; RE 56 Steacie Drive New Building - CAD Files; 2018-10-01_56 Steacie Drive - FUS calc.pdf; 2018-10-01_Site Location Plan.pdf

Hi Winston,

Please find attached water system boundary conditions as requested.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review West Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Fraser, Mark
Sent: October 01, 2018 4:26 PM
To: 'Yang, Winston' <Winston.Yang@wsp.com>
Cc: Jim Johnson <james.johnston@wspgroup.com>
Subject: RE: Fire Flow Request - 56 Steacie Drive

Thank you Winston.

Please accept this email as confirmation that boundary conditions for hydraulic analysis have been requested from the Infrastructure Planning Unit based on the water demands provided for the subject development. Please note that it takes approximately 5-10 business days to receive and provide you with boundary conditions.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review West Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department

110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Yang, Winston <Winston.Yang@wsp.com>
Sent: October 01, 2018 11:30 AM
To: Fraser, Mark <Mark.Fraser@ottawa.ca>
Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: RE: Fire Flow Request - 56 Steacie Drive

Hi Mark,

I have slightly adjusted the fire flow calculation based on the architect's confirmation. The required fire flow remains the same 150 L/s.
I have attached the email from the architect for reference.
Also please see below for our responses.

General

- The total floor area of 3185m^2 applied to the FUS calculations is not consistent with the total floor area noted in the below email. The total floor area is to exclude the basement. Please provide confirmation from the architect on the total floor area of the building proposal.
  Floor area for each of the two stories of the building area is 1,617.85 m², the total floor area is 3235.70 m². The garage level is larger and has an area of 2,331.06 m².

Construction Unit

Coefficient Related to Type of Construction (C)

- Please provide justification for applying a coefficient related to the type of construction of the building of C=0.8 *(non-combustible construction – unprotected structural components, masonry or metal walls)* and not C=1 *(ordinary construction – masonry walls, combustible floor and interior).* Confirmation from the architect indicating the type of construction of the building is required.
  The construction will be non combustible (cast in place concrete).

Exposure

- Please note the separation distances on a plan to support the applied 20% exposure charge.
  A site location plan with the separation dimension is attached. North Side is about 50.0m, East side is about 43.0m, South side is greater than 100.0m, and West side is 35.0m

Should you have any questions please do not hesitate to contact me.

Yours truly,

Winston Yang, P.Eng.
Project Engineer

Infrastructure

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

From: Fraser, Mark [mailto:Mark.Fraser@ottawa.ca]
Sent: September-28-18 3:26 PM
To: Yang, Winston <Winston.Yang@wsp.com>
Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: RE: Fire Flow Request - 56 Steacie Drive

Thank you Winston.

Additional justification is required to validate the required fire flow based on a preliminary review of the FUS calculations provided. Please provide justification to support the following steps in the FUS calculation as the City would like to avoid requests for updated boundary conditions.

General

- The total floor area of 3185m^2 applied to the FUS calculations is not consistent with the total floor area noted in the below email. The total floor area is to exclude the basement. Please provide confirmation from the architect on the total floor area of the building proposal.

Construction Unit
Coefficient Related to Type of Construction (C)

- Please provide justification for applying a coefficient related to the type of construction of the building of C=0.8 *(non-combustible construction – unprotected structural components, masonry or metal walls)* and not C=1 *(ordinary construction – masonry walls, combustible floor and interior).* Confirmation from the architect indicating the type of construction of the building is required.

Exposure

- Please note the separation distances on a plan to support the applied 20% exposure charge.

Please note that the City will only be providing boundary conditions at the proposed connection point.

If you have any questions please let me know.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review West Branch
City of Ottawa | Ville d'Ottawa

Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Yang, Winston <Winston.Yang@wsp.com>
Sent: September 28, 2018 12:57 PM
To: Fraser, Mark <Mark.Fraser@ottawa.ca>
Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: RE: Fire Flow Request - 56 Steacie Drive

Hi Mark,

Please see attached pdfs for the FUS calculation and Site Location Plan with proposed connection point.

Should you have any questions please do not hesitate to contact me.

Yours truly,

Winston Yang, P.Eng.
Project Engineer
Infrastructure

wsp

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

From: Fraser, Mark [mailto:Mark.Fraser@ottawa.ca]
Sent: September-28-18 9:02 AM
To: Yang, Winston <Winston.Yang@wsp.com>
Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: RE: Fire Flow Request - 56 Steacie Drive

Hi Winston,

We have received your request for boundary conditions. Please provide the following:

- FUS fire flow calculations.
- A Site Plan showing the proposed connection point.

If you have any questions please let me know.

Regards,

Mark Fraser
Project Manager, Planning Services
Development Review West Branch
City of Ottawa | Ville d'Ottawa
Planning, Infrastructure and Economic Development Department
110 Laurier Avenue West. 4th Floor, Ottawa ON, K1P 1J1
Tel:613.580.2424 ext. 27791
Fax: 613-580-2576
Mail: Code 01-14
Email: Mark.Fraser@ottawa.ca

From: Yang, Winston <Winston.Yang@wsp.com>
Sent: September 27, 2018 4:53 PM
To: Fraser, Mark <Mark.Fraser@ottawa.ca>
Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: Fire Flow Request - 56 Steacie Drive

Hi Mark,

We are working on the Site Servicing Study for the proposed commercial development at 56 Steacie Drive. The proposed development is a two-storey office building with underground parking. The building is proposed to be serviced from the 203 mm diameter watermain along Steacie Drive. The total square footage of the proposed building (two stories and basement) are 1593 m² and 2329 m² respectively.

The domestic water demands were calculated using the City of Ottawa's Water Design Guidelines where the commercial consumption rate of 28,000 L/ha/d was used to estimate average day demand. Maximum daily demand was calculated by multiplying average day by a factor of 1.5. Maximum hour demand was calculated by multiplying maximum daily demand by a factor of 1.8.

The fire flow required was determined following the Fire Underwriter Survey (FUS) method.
The resulting FUS fire flow is 9,000 L/min or 150 L/s.

In summary:
Average Daily Demand = 1.03 L/s
Maximum Daily Demand = 1.55 L/s
Maximum Hour Demand = 2.79 L/s

Required Fire Flow = 150 L/s

Please provide fire flow information for the fire hydrant on 56 Steacie Drive in the vicinity of the property.

Should you have any questions please do not hesitate to contact me.

Thank you,

Winston Yang, P.Eng.
Project Engineer
Infrastructure

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

-LAEmHhHzdJzBlTWfa4Hgs7pbKl

Fire Flow Design Sheet (FUS)
56 Steacie Drive
City of Ottawa
WSP Project No. 18M-01672-00

Date: 01-Oct-18

Two-Storey Office Building Design Assumptions - Sprinklered, Non-Combustible

1. An estimate of the Fire Flow required for a given fire area may be estimated by: $F = 220\,C\sqrt{A}$

F = required fire flow in litres per minute
C = coefficient related to the type of construction
- 1.5 for wood construction (structure essentially combustible)
- 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
- 0.8 for noncombustible construction (unprotected metal structural components, masonry or metal walls)
- 0.6 for fire-resistive construction (fully protected frame, floors, roof)

A = total floor area in square metres (including all storeys, but excluding basements at least 50% below grade)

A = 3236 m^2
C = 0.8
F = 10011.4 L/min

rounded off to 11,000 L/min (min value of 2000 L/min)

2. The value obtained in 1. may be reduced by as much as 25% for occupancies having a low contents fire hazard.

Non-combustible	-25%
Limited Combustible	-15%
Combustible	0%
Free Burning	15%
Rapid Burning	25%

Reduction due to low occupancy hazard 0% x 11,000 = 11,000 L/min

3. The value obtained in 2. may be reduced by as much as 75% for buildings equipped with automatic sprinkler protection.

Non-combustible c/w Automatic Sprinkler System	-50%
Combustible c/w Automatic Sprinkler System	-30%
Fully supervised system	-10%
No Automatic Sprinkler System	0%

Reduction due to Sprinkler System -30% x 11,000 = 7,700 L/min

4. The value obtained in 3. may be increased for structures exposed within 45 metres by the fire area under consideration.

Separation	Charge
0 to 3 m	25%
3.1 to 10 m	20%
10.1 to 20 m	15%
20.1 to 30 m	10%
30.1 to 45 m	5%

Side 1	50	0%	north side
Side 2	43	5%	east side
Side 3	100	0%	south side
Side 4	35	5%	west side
		10%	(Total shall not exceed 75%)

Increase due to separation 10% x 7,700 = 8,470 L/min

The fire flow requirement is 9,000 L/min (Rounder to nearest 1000 L/min)
or **150 L/sec**
or 2,378 gpm (us)
or 1,980 gpm (uk)

Based on method described in:
"Water Supply for Public Fire Protection - A Guide to Recommended Practice", 1991
by Fire Underwriters Survey

APPENDIX

B

- PRE-CONSULTATION MEETING NOTES
- EMAIL FROM MISSISSIPPI VALLEY CONSERVATION AUTHORITY
- GEOTECHNICAL REPORT BY PATERSON GROUP
- GEOTECHNICAL COMMENTS
- CORRESPONDENCE WITH MINISTRY OF THE ENVIRONMENT, CONSERVATION AND PARKS

File Number: PC 2018-0271
October 15, 2018

56 Steacie Drive
Pre-application Consultation Meeting Minutes

Location: Room 4103E, City Hall
Date: October 11, 1:00 PM to 2:00 PM

Attendee	Role	Organization
Stream Shen	Planner	City of Ottawa
Julie Candow	Project Manager (Infrastructure)	
Rosanna Baggs	Project Manager (Transportation)	
Colette Gorni	Planning Assistant	
Peter Dooher	Owner	Merkburn Holdings
Scott Hayward	Architect	Pye & Richards Architects
William Dunk	Architect	
James Johnston	Engineer	WSP
Winston Yang	Engineer	
Jim Lennox	Landscape Architect	James B. Lennox and Associates

Comments from the Applicant

1. This is a formal pre-application consultation for 56 Steacie Drive Site Plan Control application.
2. The site is currently vacant.
3. The applicant is proposing to develop a 2-storey office building to accommodate small to mid-size start-up companies, with the goal of becoming a tech hub.
4. The applicant is proposing both surface and underground parking on the site.
5. The building will have two entrances, with the main entrance on the southeast face of the building.
6. The site slopes downward toward the northeast corner. The applicant is proposing to use this natural topographical element to create an access ramp to the underground parking garage.
7. The applicant is proposing to connect water and sanitary to existing infrastructure on Steacie Drive. There are no concerns regarding water pressure based on boundary conditions.
8. Stormwater overflow is likely to be directed to the ditch along the northerly boundary of the site.

File Number: PC 2018-0271
October 15, 2018

Planning Comments

1. This is a formal pre-application consultation meeting for a Site Plan Control Application, Manager Approval, Subject to Public Consultation. Application form, timeline and fees can be found here.

2. Consider including a direct pedestrian connection to March Road as a part of this proposal.

3. Cash-in-lieu of parkland and associated appraisal fee ($565) will be required as a condition of approval, as per the Parkland Dedication By-law.

4. Development charges fee amount can be found here.

5. Please note that a tree permit, issued under the Urban Tree Conservation By-law, is required for the removal of any privately owned trees with a diameter greater than 10 cm.

6. Please contact MVCA prior to application submission.

7. Please consult the Ward Councillor prior to application submission.

8. The pre-consultation notes and list of plans and studies will lapse on October 11, 2019.

Engineering Comments

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

2. 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)
3. 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).

4. The Stormwater Management Criteria, for the subject site, is to be based on the following:
   i. No storm sewer existing on Steacie Drive. As such, storm runoff (minor and major) is to be directed to the existing ditch along the northern property limit.
   ii. The 100-yr post-development release rate is to be controlled to the 5-yr pre-development release rate. The 5-yr pre-development release rate shall be calculated using:
      a. The IDF information derived from the Meteorological Services of Canada rainfall data, taken from the MacDonald Cartier Airport, collected 1966 to 1997.
      b. The pre-development runoff coefficient <u>or</u> a maximum equivalent ‘C’ of 0.5, whichever is less.
      c. The pre-development time of concentration or a minimum ‘Tc’ of 10 minutes, whichever is higher.
   iii. Onsite storm runoff, in excess of the 5-year storm release rate, up to and including the 100-year storm event, must be detained on site.
   iv. Use of rooftop controls are recommended for this site, but are not limited to them.

5. Ensure the storm outlet for the adjacent property, 62 Steacie Drive, is maintained and/or the existing ditch is redirected. Please clearly show the storm outlet location for 62 Steacie Drive on the Servicing and Grading Plans.

6. Contact the Mississippi Valley Conservation Authority (MVCA) for quality control requirements. Please include correspondence in the stormwater management report.

7. It is anticipated that approval from the MVCA may be required for the proposed modifications to the existing ditch along the northern property limit. Please consult with the MVCA to confirm requirements and include correspondence in the Stormwater management report.

8. No sanitary sewer capacity constraints were identified on Steacie Drive during the initial review of the concept plan. A service connection to the existing sanitary maintenance hole fronting the subject property is encouraged.

9. No watermain constraints were identified on Steacie Drive during the initial review of the concept plan. The applicant has noted that boundary conditions have already been requested and received by the City.

10. It was noted that a 1.8m utility easement exists along the southern property limit, however no conflicts were identified during initial review of the concept plan.

11. It is anticipated that a MECP Environmental Compliance Approval will be required due to the proposed minor and major storm outlet to the existing ditch at the rear of the site. Please contact the local Ottawa District Ministry of the

Environment, Conservation and Parks (MECP) office to confirm that an ECA will be required for the proposed development.

Should you have any questions or require additional information, please contact me directly at (613) 580-2424, x13850 or by email at Julie.Candow@ottawa.ca.

Transportation Comments

1. Traffic Impact Assessment Guidelines Screening form submitted, no triggers satisfied, therefore no Traffic Impact Assessment required.
2. Noise Impact Studies required for the following:
    a. Rail
    b. Stationary (due to the proximity to neighbouring exposed mechanical equipment and if there will be any exposed mechanical equipment due to the proximity to neighbouring noise sensitive land uses)
3. On site plan:
    a. Show all details of the roads abutting the site up to and including the opposite curb; include such items as pavement markings, gravel shoulders, accesses and/or sidewalks.
    b. Show all curb radii measurements; ensure that all curb radii are reduced as much as possible
    c. Show lane/aisle widths.
    d. Show grade to garbage area
    e. Hammer head recommended in front parking field at the western edge.
    f. Show depressed curbs for pedestrian pathways.
4. Turning templates will be required for all accesses showing the largest vehicle to access the site; required for internal movements and at all access (entering and exiting and going in both directions). To be provide on a separate drawing.

Please contact me at Stream.Shen@ottawa.ca or at 613-580-2424 extension 24488 if you have any questions.

Sincerely,

Stream Shen MCIP RPP
Planner II
Development Review - West

From:	Nader Nakhaei <NNakhaei@mvc.on.ca>
Sent:	October-11-18 4:21 PM
To:	Yang, Winston
Cc:	Matt Craig
Subject:	RE: Request for MVC Comment on development application - 56 Steacie Drive, Kanata

Hi Winston,

Thanks a lot for your email and providing the information. Generally, we require on-site quantity and quality control for storm water management unless there are city facilities to provide the required controls.
Quantity control: For the mentioned development as the runoff will be conveyed through an existing ditch, post-development flows should be controlled to pre-development flows.
Quality control: If there is no end of pipe facility (e.g., Pond), on-site quality control to "Normal" level (70% TSS removal required for Kizell drain) should be provided.
Please let me know if you have any further question or concern.

Nader Nakhaei, Ph.D. | Water Resources Specialist / Research Fellow | Mississippi Valley Conservation Authority
www.mvc.on.ca | t. 613 253 0006 ext. 259 | f. 613 253 0122 | NNakhaei@mvc.on.ca

Mississippi Valley Conservation Authority
50 YEARS OF CONSERVATION • 1968/2018

From: Yang, Winston [mailto:Winston.Yang@wsp.com]
Sent: October 9, 2018 10:14 AM
To: Matt Craig <MCraig@mvc.on.ca>
Subject: Request for MVC Comment on development application - 56 Steacie Drive, Kanata

Hello Matt,

We are starting the servicing design in support of the site plan application for a new two-storey office building project with PYE & Richards Architects Inc.
The project is located at 56 Steacie Drive in the Breaverbrook area of Kanata.

Please find attached copies of the current proposed site plan. The proposed work will include the new proposed building and associated expansions of the paved area, such as parking and sidewalks.

Anticipated work for services will include the new proposed water and sanitary services to Steacie Drive. The stormwater will be directed to the existing ditch at the north boundary as necessary to service the site plan.

Stormwater quantity control will be implemented for the impacted areas of the site in accordance with City of Ottawa requirements.

We are not aware of any existing stormwater management measures for quantity and quality control along Steacie Drive and the existing ditch across the north boundary.
We would appreciate if your planning group could provide us with preliminary comments and recommendations regarding storm water management for this site.

If you need additional information, please do not hesitate to contact me.

Yours truly,

Winston Yang, P.Eng.
Project Engineer
Infrastructure

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

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Geotechnical Engineering

Environmental Engineering

Hydrogeology

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Building Science

Archaeological Services

patersongroup

Geotechnical Investigation

Proposed Commercial Building
56 Steacie Drive
Ottawa, Ontario

Prepared For

Merkburn Holdings Ltd.

August 14, 2018

Report: PG4484-1

Paterson Group Inc.
Consulting Engineers
154 Colonnade Road South
Ottawa (Nepean), Ontario
Canada K2E 7J5

Tel: (613) 226-7381
Fax: (613) 226-6344
www.patersongroup.ca

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Merkburn Holdings Ltd. to conduct a geotechnical investigation for the proposed multi-storey commercial building to be located at 56 Steacie Drive, in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan presented in Appendix 2).

The objective of the investigation was to:

- ❑ determine the subsoil and groundwater conditions at this site by means of test holes and available soils information.
- ❑ provide geotechnical recommendations for the design of the proposed development based on the results of the test holes and other soil information available.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. It contains our findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as they are understood at the time of writing this report. Environmental considerations for this site have been prepared under separate cover.

2.0 Proposed Project

The proposed project will consist of a building with two floors above ground and one level of underground parking, as well as associated parking areas and access lanes, along with landscaped areas. It is also expected that the subject site will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

Field Program

The field program for the geotechnical investigation was carried out on July 25, 2018. At that time, four (4) boreholes were advanced to a maximum depth of 12.1 m below existing ground surface. The test holes were located in the field by Paterson in a manner to provide general coverage of the subject site. The borehole locations are shown on Drawing PG4484-1 - Test Hole Location Plan in Appendix 2.

The boreholes were drilled with a track-mounted rig operated by a two-person crew. All fieldwork was conducted under the full-time supervision of our personnel under the direction of a senior engineer from our geotechnical department. The drilling procedures consisted of advancing each test hole to the required depths at the selected locations and sampling the overburden.

Sampling and In Situ Testing

Soil samples from the borehole were recovered from the auger flights or using a 50 mm diameter split-spoon sampler. All soil samples were classified on site, placed in sealed plastic bags and transported to our laboratory for further review. The depths at which the auger and split spoon samples were recovered from the test hole are shown as AU and SS, respectively, on the Soil Profile and Test Data sheets presented in Appendix 1.

Standard Penetration Testing (SPT) was conducted in conjunction with the recovery of the split-spoon samples. The SPT results are recorded as “N” values on the Soil Profile and Test Data sheets. The “N” value is the number of blows required to drive the split-spoon sampler 300 mm into the soil after a 150 mm initial penetration using a 63.5 kg hammer falling from a height of 760 mm.

The overburden thickness was also evaluated during the course of the investigation by dynamic cone penetration testing (DCPT) at one borehole location. The DCPT consists of driving a steel drill rod, equipped with a 50 mm diameter cone at its tip, using a 63.5 kg hammer falling from a height of 760 mm. The number of blows required to drive the cone into the soil is recorded for each 300 mm increment.

The subsurface conditions observed in the test holes were recorded in detail in the field. The soil profiles are presented on the Soil Profile and Test Data sheets in Appendix 1 of this report.

Groundwater

Flexible polyethylene standpipes were installed in all boreholes to permit monitoring of the groundwater levels subsequent to the completion of the sampling program.

Sample Storage

All samples from the current investigation will be stored in the laboratory for a period of one month after issuance of this report. They will then be discarded unless we are otherwise directed.

3.2 Field Survey

The test hole locations were selected in the field by Paterson personnel in a manner to provide general coverage of the subject site taking into consideration existing site features. Ground elevations were referenced to a temporary benchmark (TBM), consisting of the top spindle of a fire hydrant in front of the subject site. An elevation of 100.00 m was assigned to the TBM. The location of the test holes and TBM are presented on Drawing PG4484-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples were recovered from the subject site and visually examined in our laboratory to review the results of the field logging.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the corrosion potential for exposed ferrous metals and the potential of sulphate attacks against subsurface concrete structures. The sample was submitted to determine the concentration of sulphate and chloride, the resistivity and the pH of the sample. The results are presented in Appendix 1 and are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is currently undeveloped land with a grass surface. Several mature trees were noted along the borders of the subject site. The site slopes gently down from south to north away from Steacie Drive. The site is at generally slightly above grade (approximately 0.5 m) with respect to the adjacent properties to the east and west. An approximately 2 m high slope was noted north of the site, sloping down towards the north. A shallow ditch was noted parallel to Steacie Drive between the roadway and the subject site. A ditch line was noted along the northern border of the property. The site is bordered to the north by a grass and tree covered area followed by a parking lot, to the east and west by adjacent commercial properties and to the south by Steacie Drive.

4.2 Subsurface Profile

Subsurface conditions noted at the borehole locations were recorded in detail in the field and recovered soil samples were reviewed in our laboratory. Generally, the subsurface profile encountered at the borehole locations consists of a thin topsoil layer, overlying a fill layer, which consisted primarily of silty clay mixed with sand and gravel with some construction debris. A silty clay deposit, with trace to some sand and gravel was noted below the fill layer. A glacial till deposit was noted below the silty clay deposit. The fine matrix of the glacial till consisted primarily of silty clay with some sand and gravel. Practical refusal to DCPT was encountered at a 12.1 m depth at BH 1. Practical refusal to augering was encountered at 4.7 m depth at BH 2.

Reference should be made to the Soil Profile and Test Data sheets in Appendix 1 for details of the soil profiles encountered at each test hole location.

Bedrock

Based on available geological mapping, the local bedrock consists primarily of quartzite, with an anticipated overburden thickness of 5 to 15 m.

4.3 Groundwater

Groundwater levels were measured in the standpipes installed in the boreholes upon completion of the sampling program. The GWL readings are presented in Table 1 and on the Soil Profile and Test Data sheets in Appendix 1.

Table 1 - Summary of Groundwater Levels				
Borehole Number	Ground Surface Elevation (m)	Measured Groundwater Level (m)		Recording Date
		Depth	Elevation	
BH 1	97.78	1.02	96.76	July 31, 2018
BH 2	98.92	1.94	96.98	July 31, 2018
BH 3	99.10	4.60	94.50	July 31, 2018
BH 4	99.50	1.51	97.99	July 31, 2018

It should be noted that groundwater levels can be influenced by surface water infiltrating the backfilled boreholes.

Long-term groundwater levels can also be estimated based on the observed colour and consistency of the recovered soil samples. Based on these observations, it is estimated that the long-term groundwater table can be expected at approximately 3 to 4 m below ground surface.

It should be noted that groundwater levels are subject to seasonal fluctuations. Therefore, the groundwater level could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

The subject site is considered satisfactory for the proposed development from a geotechnical perspective. It is expected that the proposed structure will be founded over conventional shallow footings placed on an undisturbed, stiff silty clay bearing surface. It should be noted that the existing slope along the north property boundary is considered stable from a slope stability perspective with a slope stability factor of safety of greater than 1.5.

Due to the presence of the silty clay layer, the subject site will be subjected to grade raise restrictions. A permissible grade raise restriction of **1.5 m** can be used for design purposes.

The above and other considerations are further discussed in the following sections.

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and fill, containing significant amounts of deleterious materials, should be stripped from under any buildings and other settlement sensitive structures. Care should be taken not to disturb adequate bearing soils below the subgrade level during site preparation activities.

It is anticipated that the existing fill, free of deleterious material and significant amounts of organics, can be left in place below the proposed car parking areas and access lanes. However, it is recommended that the existing fill layer be proof-rolled using heavy vibratory equipment and approved by Paterson at the time of construction. Any poor performing areas noted during the proof-rolling operation should be removed and replaced with an appropriate fill material.

Fill Placement

Fill used for grading beneath the building areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or B Type II. This material should be tested and approved prior to delivery to the site. The fill should be placed in lifts no greater than 300 mm thick and compacted using suitable compaction equipment for the lift thickness. Fill placed beneath the building should be compacted to at least 98% of its standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be used as general landscaping fill where settlement of the ground surface is of minor concern. These materials should be spread in thin lifts and at least compacted by the tracks of the spreading equipment to minimize voids. If these materials are to be used to build up the subgrade level for areas to be paved, they should be compacted in thin lifts to a minimum density of 95% of their respective SPMDD. Non-specified existing fill and site-excavated soils are not suitable for use as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Bearing Resistance Values

Strip footings, up to 3 m wide, and pad footings, up to 6 m wide, placed on an undisturbed, stiff, silty clay bearing surface can be designed using a bearing resistance value at serviceability limit states (SLS) of **100 kPa** and a factored bearing resistance value at ultimate limit states (ULS) of **180 kPa** incorporating a geotechnical resistance factor of 0.5 at ULS.

Footings designed using the above noted bearing resistance value at SLS will be subjected to potential post-construction total and differential settlements of 25 and 20 mm, respectively.

An undisturbed soil bearing surface consists of one from which all topsoil and deleterious materials, such as loose, frozen or disturbed soil, whether in situ or not, have been removed, in the dry, prior to the placement of concrete for footings.

Lateral Support

The bearing medium under footing-supported structures is required to be provided with adequate lateral support with respect to excavations and different foundation levels. Adequate lateral support is provided to stiff silty clay or engineered fill above the groundwater table when a plane extending horizontally and vertically from the underside of the footing at a minimum of 1.5H:1V passing through in situ soil of the same or higher bearing capacity as the bearing medium soil.

Permissible Grade Raise

A permissible grade raise restriction of **1.5 m** can be used for design purposes. If greater permissible grade raises are required, preloading with or without a surcharge, lightweight fill, and/or other measures should be investigated to reduce the risks of unacceptable long-term post construction total and differential settlements.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class D** for the foundations considered at this site. However, a higher seismic site class, such as Class C, may be applicable for the subject site. The higher seismic site class would have to be confirmed by a site specific seismic shear wave velocity test. The soils underlying the proposed shallow foundations are not susceptible to liquefaction. Reference should be made to the latest revision of the 2012 Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Basement Slab

With the removal of all topsoil and deleterious fill, containing organic matter, within the footprint of the proposed building(s), the native soil surface will be considered to be an acceptable subgrade surface on which to commence backfilling for floor slab construction. Any soft areas should be removed and backfilled with appropriate backfill material. OPSS Granular B Type II is recommended for backfilling below the basement slab. It is recommended that the upper 200 mm of sub-slab fill consist of an OPSS Granular A crushed stone.

All backfill materials within the footprint of the proposed building should be placed in maximum 300 mm loose lifts and compact to at least 98% of the material's SPMDD.

5.6 Basement Wall

There are several combinations of backfill materials and retained soils that could be applicable for the basement walls of the subject structure. However, the conditions can be well-represented by assuming the retained soil consists of a material with an angle of internal friction of 30 degrees and a dry unit weight of 20 kN/m^3. The applicable effective unit weight of the retained soil can be estimated as 13 kN/m^3, where applicable. A hydrostatic pressure should be added to the total static earth pressure when calculating the effective unit weight.

Lateral Earth Pressures

The static horizontal earth pressure (P_o) can be calculated by a triangular earth pressure distribution equal to $K_o \cdot \gamma \cdot H$ where:

K_o = at-rest earth pressure coefficient of the applicable retained soil, 0.5
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)

An additional pressure having a magnitude equal to $K_o \cdot q$ and acting on the entire wall height should be incorporated to the diagram for any surcharge loading, q (kPa), that may be placed at ground surface adjacent to the wall. The surcharge pressure will only be applicable for static analyses and should not be calculated with the seismic loading case.

Actual earth pressures could be higher than the “at-rest” case if care is not exercised during the compaction of the backfill materials to stay at least 0.3 m away from the walls with the compaction equipment.

Seismic Earth Pressures

The total seismic force (P_{AE}) includes both the earth force component (P_o) and the seismic component (ΔP_{AE}).

The seismic earth force (ΔP_{AE}) could be calculated using $0.375 \cdot a_c \cdot \gamma \cdot H^2/g$ where:

a_c = $(1.45-a_{max}/g)a_{max}$
γ = unit weight of fill of the applicable retained soil (kN/m^3)
H = height of the wall (m)
g = gravity, 9.81 m/s^2

The peak ground acceleration, (a_{max}), for the Ottawa area is 0.32g according to OBC 2012. The vertical seismic coefficient is assumed to be zero.

The earth force component (P_o) under seismic conditions could be calculated using $P_o = 0.5\ K_o \gamma\ H^2$, where $K_o = 0.5$ for the soil conditions presented above.

The total earth force (P_{AE}) is considered to act at a height, h (m), from the base of the wall, where:

$h = \{P_o \cdot (H/3) + \Delta P_{AE} \cdot (0.6 \cdot H)\}/P_{AE}$

The earth forces calculated are unfactored. For the ULS case, the earth loads should be factored as live loads, as per OBC 2012.

5.7 Pavement Structure

For design purposes, the pavement structure presented in the following tables could be used for the design of car only parking areas and access lanes.

Table 2 - Recommended Pavement Structure - Car Only Parking Areas	
Thickness (mm)	**Material Description**
50	**Wear Course** - HL-3 or Superpave 12.5 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ silty clay or OPSS Granular B Type I or II material placed over in situ soil or fill	

Table 3 - Recommended Pavement Structure - Access Lanes and Heavy Truck Parking Areas	
Thickness (mm)	**Material Description**
40	**Wear Course -** HL-3 or Superpave 12.5 Asphaltic Concrete
50	**Binder Course** - HL-8 or Superpave 19.0 Asphaltic Concrete
150	**BASE** - OPSS Granular A Crushed Stone
450	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill, in situ silty clay or OPSS Granular B Type I or II material placed over in situ soil or fill	

Minimum Performance Graded (PG) 58-34 asphalt cement should be used for this project.

If soft spots develop in the subgrade during compaction or due to construction traffic, the affected areas should be excavated and replaced with OPSS Granular B Type II material.

The pavement granular base and subbase should be placed in maximum 300 mm thick lifts and compacted to a minimum of 98% of the material's SPMDD using suitable vibratory equipment.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on keeping the contact zone between the subgrade material and the base stone in a dry condition. Failure to provide adequate drainage under conditions of heavy wheel loading can result in the fine subgrade soil being pumped into the voids in the stone subbase, thereby reducing its load carrying capacity.

Due to the impervious nature of the subgrade materials consideration should be given to installing subdrains during the pavement construction. These drains should extend in four orthogonal directions or longitudinally when placed along a curb. The clear crushed stone surrounding the drainage lines or the pipe, should be wrapped with suitable filter cloth. The subdrain inverts should be approximately 300 mm below subgrade level. The subgrade surface should be shaped to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

It is recommended that a perimeter foundation drainage system be provided for the proposed structure. The system should consist of a 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 10 mm clear crushed stone, placed at the footing level around the exterior perimeter of the structure. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Backfill against the exterior sides of the foundation walls should consist of free-draining non frost susceptible granular materials. The greater part of the site excavated materials will be frost susceptible and, as such, are not recommended for re-use as backfill against the foundation walls unless used in conjunction with a composite drainage system, such as Delta Drain 6000 or an approved equivalent. Imported granular materials, such as clean sand or OPSS Granular B Type I granular material, should be used for this purpose.

6.2 Protection of Footings Against Frost Action

Perimeter footings of heated structures are required to be insulated against the deleterious effects of frost action. A minimum 1.5 m thick soil cover, or an equivalent combination of foundation insulation and soil cover, should be provided in this regard.

Exterior unheated footings, such as those for isolated exterior piers, are more prone to deleterious movement associated with frost action than the exterior walls of the structure proper and require additional protection. The recommended minimum thickness of soil cover is 2.1 m (or equivalent).

6.3 Excavation Side Slopes

Temporary Side Slopes

The temporary excavation side slopes anticipated should either be excavated to acceptable slopes or retained by shoring systems from the beginning of the excavation until the structure is backfilled.

The excavation side slopes above the groundwater level extending to a maximum depth of 3 m should be cut back at 1.5H:1V or flatter. The flatter slope is required for excavation below groundwater level. The subsurface soil is considered to be mainly a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects.

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should maintain safe working distance from the excavation sides.

Slopes in excess of 3 m in height should be periodically inspected by the geotechnical consultant in order to detect if the slopes are exhibiting signs of distress.

A trench box is recommended to protect personnel working in trenches with steep or vertical sides. Services are expected to be installed by "cut and cover" methods and excavations should not remain open for extended periods of time.

6.4 Pipe Bedding and Backfill

Bedding and backfill materials should be in accordance with the most recent Material Specifications & Standard Detail Drawings from the Department of Public Works and Services, Infrastructure Services Branch of the City of Ottawa.

A minimum of 150 mm of OPSS Granular A should be placed for bedding for sewer or water pipes when placed on soil subgrade. The bedding should extend to the spring line of the pipe. Cover material, from the spring line to a minimum of 300 mm above the obvert of the pipe should consist of OPSS Granular A (concrete or PSM PVC pipes) or sand (concrete pipe). The bedding and cover materials should be placed in maximum 225 mm thick lifts and compacted to 95% of the material's SPMDD.

Where hard surface areas are considered above the trench backfill, the trench backfill material within the frost zone (about 1.8 m below finished grade) should match the soils exposed at the trench walls to reduce the potential differential frost heaving. The trench backfill should be placed in maximum 300 mm thick loose lifts and compacted to a minimum of 95% of the SPMDD.

To reduce long term lowering of the groundwater level at this site, clay seals should be provided in the service trenches. The seals should be at least 1.5 m long and should extend from trench wall to trench wall. Generally, the seals should extend from the frost line and fully penetrate the bedding, subbedding and cover material. The barriers should consist of relatively dry and compatible brown silty clay placed in maximum 225 mm thick loose layers and compacted to a minimum of 95% of the material's SPMDD. The clay seals should be placed at the site boundaries and at strategic locations at no more than 60 m intervals in the service trenches.

6.5 Groundwater Control

Groundwater Control for Building Construction

It is anticipated that groundwater infiltration into the excavations should be low and controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of the shallow excavation. The contractor should be prepared to direct water away from all bearing surfaces and subgrades, regardless of the source, to prevent disturbance to the founding medium.

A temporary Ministry of the Environment and Climate Change (MOECC) permit to take water (PTTW) may be required for this project if more than 400,000 L/day of ground and/or surface water is to be pumped during the construction phase. A minimum 4 to 5 months should be allowed for completion of the PTTW application package and issuance of the permit by the MOECC.

For typical ground or surface water volumes being pumped during the construction phase, typically between 50,000 to 400,000 L/day, it is required to register on the Environmental Activity and Sector Registry (EASR). A minimum of two to four weeks should be allotted for completion of the EASR registration and the Water Taking and Discharge Plan to be prepared by a Qualified Person as stipulated under O.Reg. 63/16. If a project qualifies for a PTTW based upon anticipated conditions, an EASR will not be allowed as a temporary dewatering measure while awaiting the MOECC review of the PTTW application.

Long-term Groundwater Control

Any groundwater encountered along the building's perimeter or underfloor drainage system will be directed to the proposed building's sump pit. It is expected that groundwater flow will be low (i.e. less than 25,000 L/day) with peak periods noted after rain events. A more accurate estimate can be provided at the time of construction, once groundwater infiltration levels are observed. It is anticipated that the groundwater flow will be controllable using conventional open sumps.

Impacts on Neighbouring Structures

Based on our observations, a local groundwater lowering is anticipated under short-term conditions due to construction of the proposed building. It should be noted that the extent of any significant groundwater lowering will take place within a limited range of the subject site due to the minimal temporary groundwater lowering.

The neighbouring structures are expected to be founded within native silty clay. No issues are expected with respect to groundwater lowering that would cause long term damage to adjacent structures surrounding the proposed building.

6.6 Winter Construction

Precautions must be taken if winter construction is considered for this project.

The subsoil conditions at this site mostly consist of frost susceptible materials. In presence of water and freezing conditions, ice could form within the soil mass. Heaving and settlement upon thawing could occur.

In the event of construction during below zero temperatures, the founding stratum should be protected from freezing temperatures by the use of straw, propane heaters and tarpaulins or other suitable means. In this regard, the base of the excavations should be insulated from sub-zero temperatures immediately upon exposure and until such time as heat is adequately supplied to the building and the footings are protected with sufficient soil cover to prevent freezing at founding level.

The trench excavations should be carried out in a manner to avoid the introduction of frozen materials, snow or ice into the trenches. As well, pavement construction is difficult during winter. The subgrade consists of frost susceptible soils which will experience total and differential frost heaving as the work takes place. Also, the introduction of frost, snow or ice into the pavement materials, which is difficult to avoid, could adversely affect the performance of the pavement structure.

6.7 Corrosion Potential and Sulphate

The results of analytical testing show that the sulphate content is less than 0.1%. These results are indicative that Type 10 Portland cement (normal cement) would be appropriate for this site. The results of the chloride and sulphate content, pH and resistivity indicate the presence of a non-aggressive to slightly aggressive environment for exposed ferrous metals at this site.

7.0 Recommendations

For the foundation design data provided herein to be applicable, a materials testing and observation services program is required to be completed. The following aspects should be performed by the geotechnical consultant:

- ❑ Review of the site grading plan, once available.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials.
- ❑ Observation of the placement of the foundation insulation, if applicable.
- ❑ Periodic observation of the condition of unsupported excavation side slopes in excess of 3 m in height, if applicable.
- ❑ Observation of all subgrades prior to backfilling.
- ❑ Field density tests to determine the level of compaction achieved.
- ❑ Sampling and testing of the bituminous concrete including mix design reviews.

A report confirming the construction has been conducted in general accordance with the recommendations could be issued, upon request, following the completion of a satisfactory materials testing and observation program by the geotechnical consultant.

8.0 Statement of Limitations

The recommendations made in this report are in accordance with our present understanding of the project. We request that we be permitted to review the grading plan once available and our recommendations when the drawings and specifications are complete.

A geotechnical investigation of this nature is a limited sampling of a site. The recommendations are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around the test locations. The extent of the limited area depends on the soil, bedrock and groundwater conditions, as well the history of the site reflecting natural, construction, and other activities. Should any conditions at the site be encountered which differ from those at the test locations, we request notification immediately in order to permit reassessment of our recommendations.

The recommendations provided in this report are intended for the use of design professionals associated with this project. Contractors bidding on or undertaking the work should examine the factual information contained in this report and the site conditions, satisfy themselves as to the adequacy of the information provided for construction purposes, supplement the factual information if required, and develop their own interpretation of the factual information based on both their and their subcontractors construction methods, equipment capabilities and schedules.

The present report applies only to the project described in this document. Use of this report for purposes other than those described herein or by person(s) other than Merkburn Holdings Ltd. or their agent(s) is not authorized without review by Paterson Group for the applicability of our recommendations to the altered use of the report.

Paterson Group Inc.

LICENSED PROFESSIONAL ENGINEER
Aug. 14-2018
D. J. GILBERT
100116130
PROVINCE OF ONTARIO

Nathan F. S. Christie, P.Eng.

David J. Gilbert, P.Eng.

Report Distribution:

- ❑ Merkburn Holdings Ltd. (3 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 56 Steacie Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 25, 2018

FILE NO. PG4484

HOLE NO. BH 1

SOIL DESCRIPTION	Sample TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE					0	97.78
FILL: Brown silty clay some organics, trace sand (to 0.18)	AU	1				
Brown **SILTY CLAY,** trace sand	SS	2	29	10	1	96.78
	SS	3	67	6	2	95.78
	SS	4	92	4	3	94.78
	SS	5	96	3		
	SS	6	96	1	4	93.78
- grey by 4.6m depth	SS	7	96	W	5	92.78
	SS	8	96	W	6	91.78
(to 6.70)	SS	9	96	1		
Dynamic Cone Penetration Test commenced at 6.70m depth. Cone pushed to 9.1m depth.					7	90.78
					8	89.78
					9	88.78
					10	87.78
					11	86.78
(to 12.14)					12	85.78

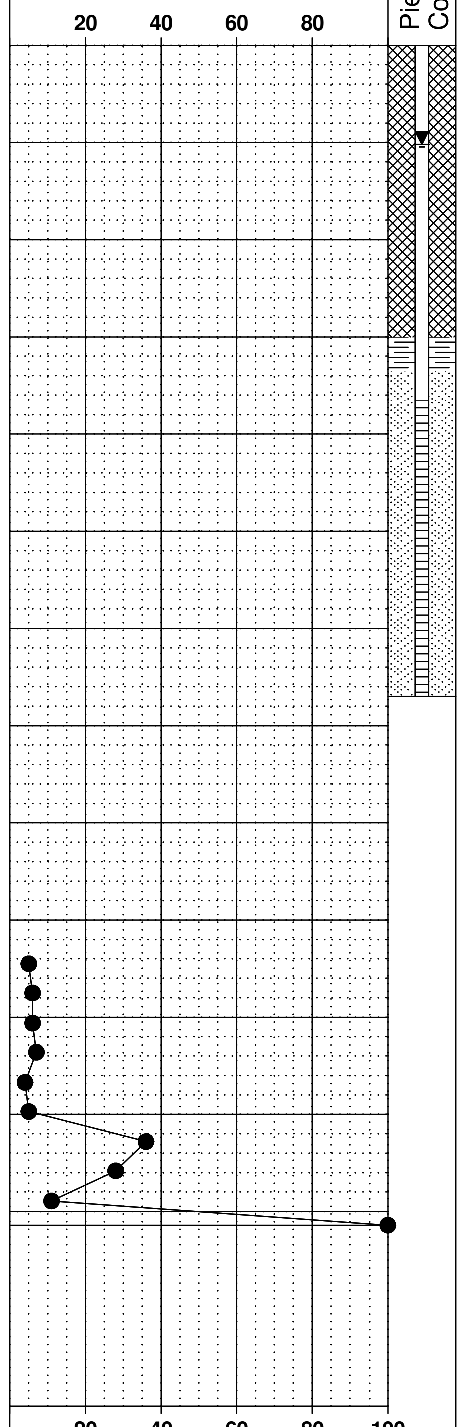
End of Borehole

Practical DCPT refusal at 12.14m depth

(GWL @ 1.02m - July 31, 2018)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %



Shear Strength (kPa)

▲ Undisturbed △ Remoulded

Piezometer Construction

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 56 Steacie Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 25, 2018

FILE NO. PG4484

HOLE NO. BH 2

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	98.92
FILL: Brown silty clay, some gravel, organics (0.15)		AU	1				
FILL: Brown silty clay, trace gravel (1.45)		SS	2	33	10	1	97.92
FILL: Brown silty clay, trace organics and brick fragments (2.21)		SS	3	54	10	2	96.92
Brown **SILTY CLAY,** some sand and gravel		SS	4	92	9	3	95.92
		SS	5	96	4	4	94.92
		SS	6	50	10		
(4.67)		SS	7	100	50+		

End of Borehole

Practical refusal to augering at 4.67m depth

(GWL @ 1.94m - July 31, 2018)

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers
154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 56 Steacie Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 25, 2018

FILE NO. PG4484

HOLE NO. BH 3

SOIL DESCRIPTION	Depth to base (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.10
FILL: Brown silty clay with organics	0.23	AU	1				
Brown **SILTY CLAY,** some sand		SS	2	12	10	1	98.10
- grey by 1.3m depth		SS	3	46	10	2	97.10
		SS	4	100	7	3	96.10
		SS	5	92	3	4	95.10
		SS	6	96	2	5	94.10
	5.30	SS	7	96	3		
GLACIAL TILL: Grey silty sand with clay and gravel		SS	8	8	8	6	93.10
	6.70	SS	9	96	12		
End of Borehole							
(GWL @ 4.60m - July 31, 2018)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100
Shear Strength (kPa)
▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Prop. Commercial Development - 56 Steacie Drive
Ottawa, Ontario

DATUM TBM - Top spindle of fire hydrant. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

BORINGS BY CME 55 Power Auger

DATE July 25, 2018

FILE NO. PG4484

HOLE NO. BH 4

SOIL DESCRIPTION	Strata depth (m)	SAMPLE TYPE	NUMBER	% RECOVERY	N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.50
FILL: Brown silty clay, some organics, trace sand	0.15	AU	1				
Brown **SILTY CLAY,** trace sand		SS	2	33	7	1	98.50
		SS	3	42	6	2	97.50
- grey by 2.3m depth		SS	4	88	8		
		SS	5	96	10	3	96.50
		SS	6	96	4	4	95.50
	5.26	SS	7	96	3	5	94.50
GLACIAL TILL: Grey silty clay, some sand		SS	8	42	4		
	6.40	SS	9	58	5	6	93.50
End of Borehole							
(GWL @ 1.51m - July 31, 2018)							

Pen. Resist. Blows/0.3m
● 50 mm Dia. Cone

○ Water Content %

20 40 60 80

Piezometer Construction

20 40 60 80 100

Shear Strength (kPa)

▲ Undisturbed △ Remoulded

SYMBOLS AND TERMS

SOIL DESCRIPTION

Behavioural properties, such as structure and strength, take precedence over particle gradation in describing soils. Terminology describing soil structure are as follows:

Desiccated	-	having visible signs of weathering by oxidation of clay minerals, shrinkage cracks, etc.
Fissured	-	having cracks, and hence a blocky structure.
Varved	-	composed of regular alternating layers of silt and clay.
Stratified	-	composed of alternating layers of different soil types, e.g. silt and sand or silt and clay.
Well-Graded	-	Having wide range in grain sizes and substantial amounts of all intermediate particle sizes (see Grain Size Distribution).
Uniformly-Graded	-	Predominantly of one grain size (see Grain Size Distribution).

The standard terminology to describe the relative strength of cohesionless soils is the compactness condition, usually inferred from the results of the Standard Penetration Test (SPT) 'N' value. The SPT N value is the number of blows of a 63.5 kg hammer, falling 760 mm, required to drive a 51 mm O.D. split spoon sampler 300 mm into the soil after an initial penetration of 150 mm. An SPT N value of "P" denotes that the split-spoon sampler was pushed 300 mm into the soil without the use of a falling hammer.

Compactness Condition	'N' Value	Relative Density %
Very Loose	<4	<15
Loose	4-10	15-35
Compact	10-30	35-65
Dense	30-50	65-85
Very Dense	>50	>85

The standard terminology to describe the strength of cohesive soils is the consistency, which is based on the undisturbed undrained shear strength as measured by the in situ or laboratory shear vane tests, unconfined compression tests, or occasionally by the Standard Penetration Test (SPT). Note that the typical correlations of undrained shear strength to SPT N value (tabulated below) tend to underestimate the consistency for sensitive silty clays, so Paterson reviews the applicable split spoon samples in the laboratory to provide a more representative consistency value based on tactile examination.

Consistency	Undrained Shear Strength (kPa)	'N' Value
Very Soft	<12	<2
Soft	12-25	2-4
Firm	25-50	4-8
Stiff	50-100	8-15
Very Stiff	100-200	15-30
Hard	>200	>30

SYMBOLS AND TERMS (continued)

SOIL DESCRIPTION (continued)

Cohesive soils can also be classified according to their “sensitivity”. The sensitivity, S_t, is the ratio between the undisturbed undrained shear strength and the remoulded undrained shear strength of the soil. The classes of sensitivity may be defined as follows:

Low Sensitivity:	$S_t < 2$
Medium Sensitivity:	$2 < S_t < 4$
Sensitive:	$4 < S_t < 8$
Extra Sensitive:	$8 < S_t < 16$
Quick Clay:	$S_t > 16$

ROCK DESCRIPTION

The structural description of the bedrock mass is based on the Rock Quality Designation (RQD).

The RQD classification is based on a modified core recovery percentage in which all pieces of sound core over 100 mm long are counted as recovery. The smaller pieces are considered to be a result of closely-spaced discontinuities (resulting from shearing, jointing, faulting, or weathering) in the rock mass and are not counted. RQD is ideally determined from NQ or larger size core. However, it can be used on smaller core sizes, such as BQ, if the bulk of the fractures caused by drilling stresses (called “mechanical breaks”) are easily distinguishable from the normal in situ fractures.

RQD %	**ROCK QUALITY**
90-100	Excellent, intact, very sound
75-90	Good, massive, moderately jointed or sound
50-75	Fair, blocky and seamy, fractured
25-50	Poor, shattered and very seamy or blocky, severely fractured
0-25	Very poor, crushed, very severely fractured

SAMPLE TYPES

SS	-	Split spoon sample (obtained in conjunction with the performing of the Standard Penetration Test (SPT))
TW	-	Thin wall tube or Shelby tube, generally recovered using a piston sampler
G	-	"Grab" sample from test pit or surface materials
AU	-	Auger sample or bulk sample
WS	-	Wash sample
RC	-	Rock core sample (Core bit size BQ, NQ, HQ, etc.). Rock core samples are obtained with the use of standard diamond drilling bits.

SYMBOLS AND TERMS (continued)

PLASTICITY LIMITS AND GRAIN SIZE DISTRIBUTION

WC%	-	Natural water content or water content of sample, %
LL	-	Liquid Limit, % (water content above which soil behaves as a liquid)
PL	-	Plastic Limit, % (water content above which soil behaves plastically)
PI	-	Plasticity Index, % (difference between LL and PL)
Dxx	-	Grain size at which xx% of the soil, by weight, is of finer grain sizes These grain size descriptions are not used below 0.075 mm grain size
D10	-	Grain size at which 10% of the soil is finer (effective grain size)
D60	-	Grain size at which 60% of the soil is finer
Cc	-	Concavity coefficient = $(D30)^2$ / (D10 x D60)
Cu	-	Uniformity coefficient = D60 / D10

Cc and Cu are used to assess the grading of sands and gravels:
Well-graded gravels have: $1 < Cc < 3$ and $Cu > 4$
Well-graded sands have: $1 < Cc < 3$ and $Cu > 6$
Sands and gravels not meeting the above requirements are poorly-graded or uniformly-graded.
Cc and Cu are not applicable for the description of soils with more than 10% silt and clay (more than 10% finer than 0.075 mm or the #200 sieve)

CONSOLIDATION TEST

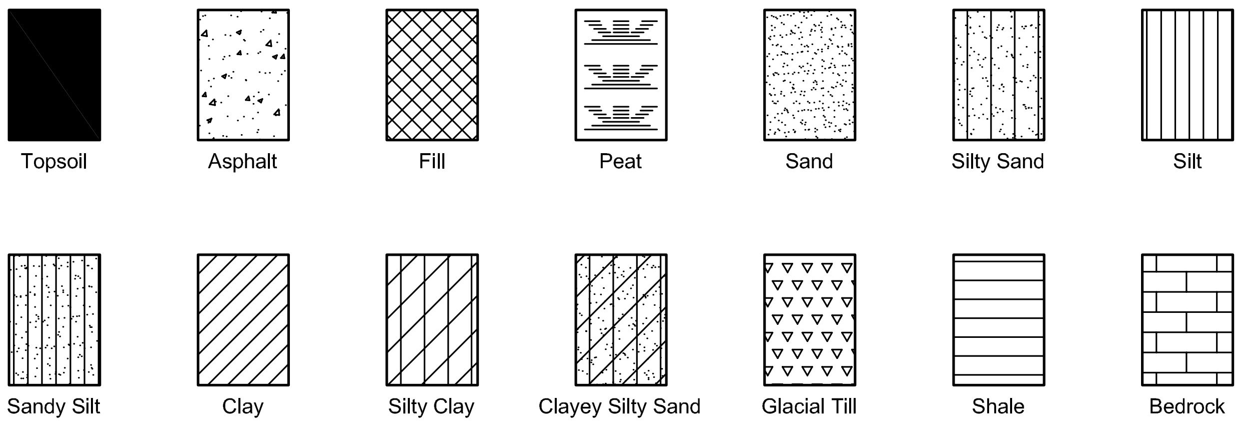
p'_o	-	Present effective overburden pressure at sample depth
p'_c	-	Preconsolidation pressure of (maximum past pressure on) sample
Ccr	-	Recompression index (in effect at pressures below p'_c)
Cc	-	Compression index (in effect at pressures above p'_c)
OC Ratio		Overconsolidaton ratio = p'_c / p'_o
Void Ratio		Initial sample void ratio = volume of voids / volume of solids
Wo	-	Initial water content (at start of consolidation test)

PERMEABILITY TEST

k	-	Coefficient of permeability or hydraulic conductivity is a measure of the ability of water to flow through the sample. The value of k is measured at a specified unit weight for (remoulded) cohesionless soil samples, because its value will vary with the unit weight or density of the sample during the test.

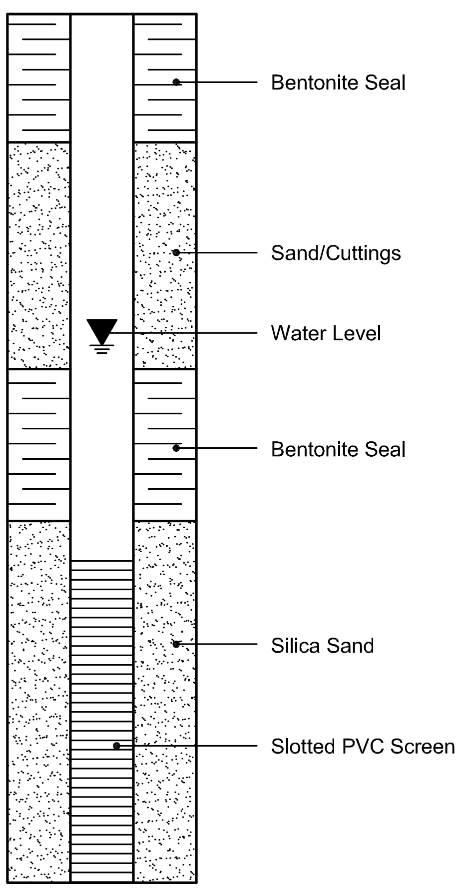
SYMBOLS AND TERMS (continued)

STRATA PLOT

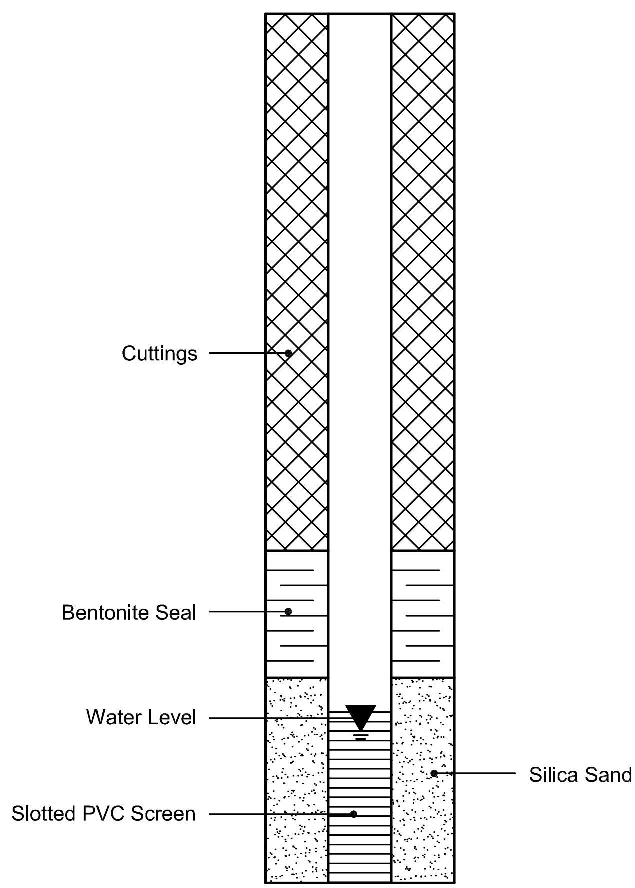


MONITORING WELL AND PIEZOMETER CONSTRUCTION

MONITORING WELL CONSTRUCTION



PIEZOMETER CONSTRUCTION



Certificate of Analysis

Client: Paterson Group Consulting Engineers

Client PO: 24810

Report Date: 01-Aug-2018

Order Date: 30-Jul-2018

Project Description: PG4484

	Client ID:	BH2-SS3	-	-	-
	Sample Date:	07/25/2018 09:00	-	-	-
	Sample ID:	1831096-01	-	-	-
	MDL/Units	Soil	-	-	-
Physical Characteristics					
% Solids	0.1 % by Wt.	80.6	-	-	-
General Inorganics					
pH	0.05 pH Units	7.47	-	-	-
Resistivity	0.10 Ohm.m	51.0	-	-	-
Anions					
Chloride	5 ug/g dry	32	-	-	-
Sulphate	5 ug/g dry	43	-	-	-

APPENDIX 2

FIGURE 1 - KEY PLAN

DRAWING PG4484-1 - TEST HOLE LOCATION PLAN

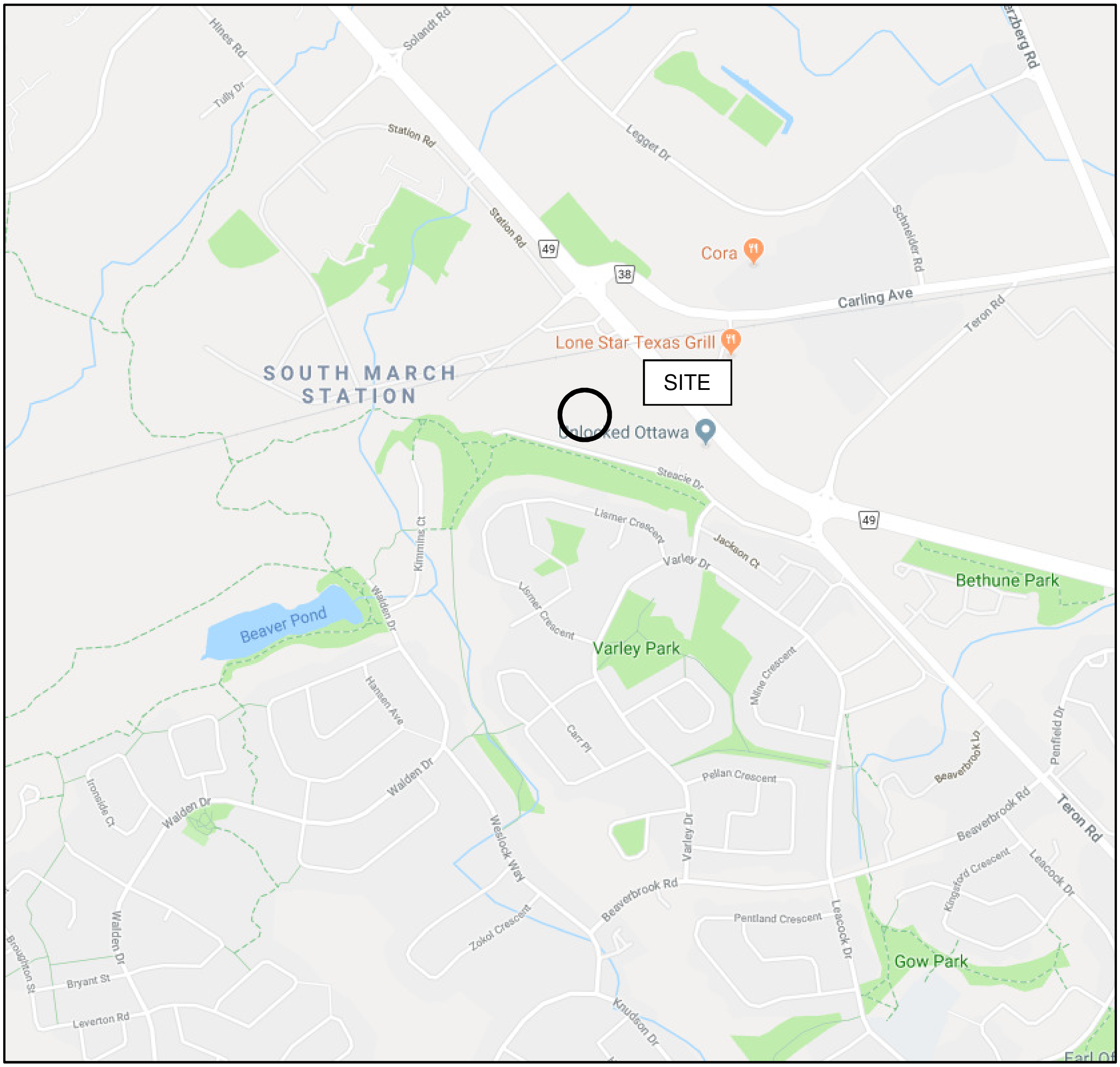
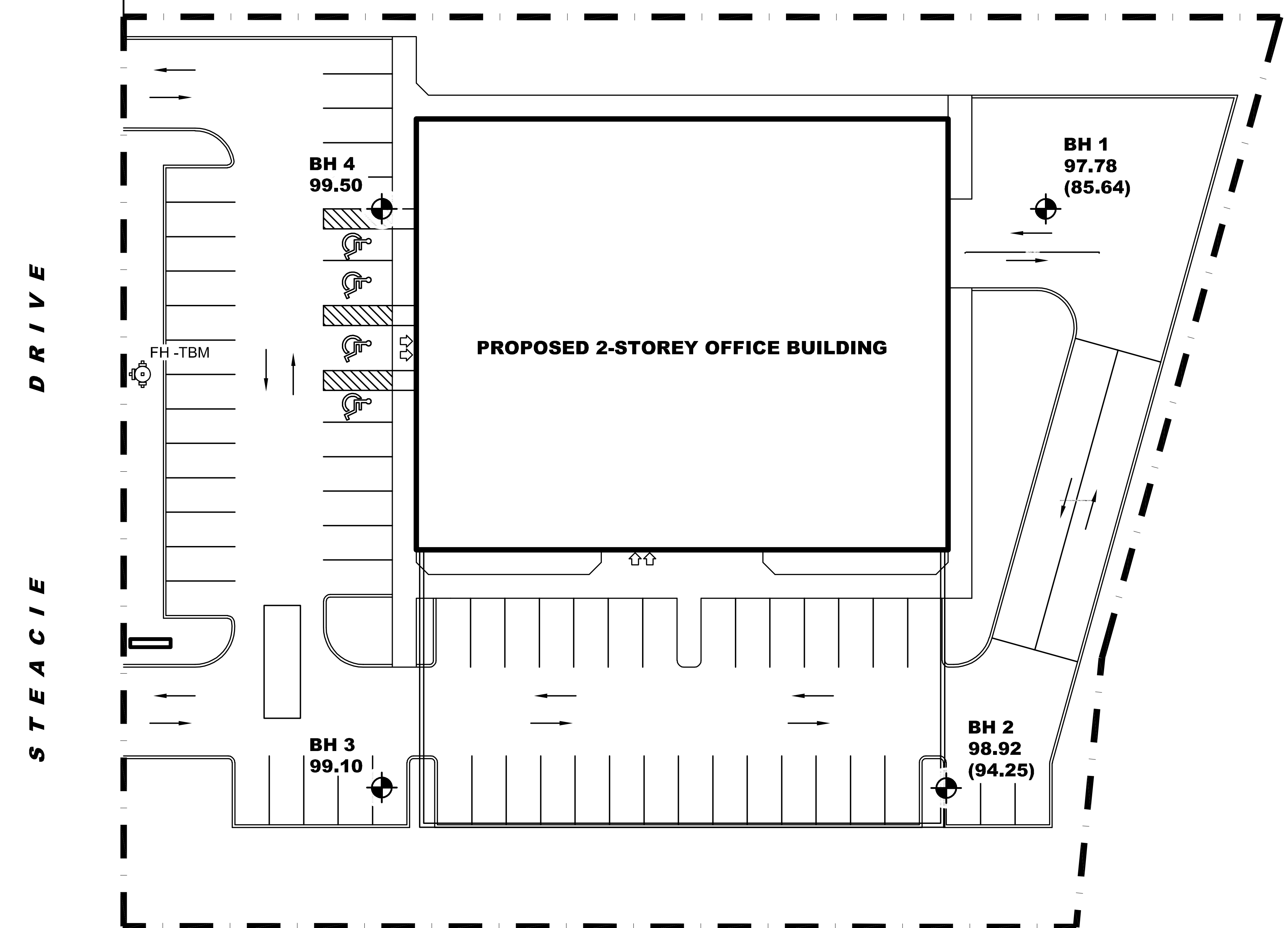
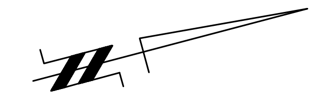


FIGURE 1

KEY PLAN





LEGEND:

⊕	BOREHOLE LOCATION
97.78	GROUND SURFACE ELEVATION (m)
(85.64)	PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m)

TBM - TOP SPINDLE OF FIRE HYDRANT. AN ARBITRARY ELEVATION OF 100.00m WAS ASSIGNED TO THE TBM.

SCALE: 1:400

0 5 10 15 20 25m

patersongroup
consulting engineers

154 Colonnade Road South
Ottawa, Ontario K2E 7J5
Tel: (613) 226-7381 Fax: (613) 226-6344

NO.	REVISIONS	DATE	INITIAL
0			

MERKBURN HOLDINGS LTD.

GEOTECHNICAL INVESTIGATION
PROP. COMMERCIAL DEVELOPMENT - 56 STEACIE DRIVE

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:400	Date: 08/2018
Drawn by: MPG	Report No.: PG4484-1
Checked by: NC	Dwg. No.: PG4484-1
Approved by: DJG	Revision No.: 0

p:\autocad drawings\geotechnical\pg44xx\pg4484-1 thp.dwg

From: Nathan Christie <nchristie@Patersongroup.ca>
Sent: January-10-19 9:48 AM
To: Peter Dooher; Johnston, Jim; Scott Hayward
Cc: Will Dunk; Yang, Winston; rlefebvre@gwal.com; David Gilbert
Subject: RE: 56 Steacie - Fire Route and Heavy Duty Pavement

Hi Peter,

Based on the drawings provided by WSP and the previous discussion below, it appears as though the concrete ramp will carry only light-duty traffic. It is anticipated that granular fill, such as OPSS Granular A or Granular B Type II, will be used to locally raise the grade to accommodate the access ramp. I note the grade raise slightly exceeds our recommended permissible grade raise of 1.5 m (the maximum appears to be approximately 2.1 m), however due to the localized nature this is considered acceptable from a geotechnical perspective. The granular materials should be placed in maximum 300 mm thick lifts and compacted to 98% of the material's SPMDD.

The aforementioned granular material is considered free-draining. Therefore if it is used to build up the ramp area, and double as the retaining wall backfill, the material would be considered non-frost susceptible and no additional frost protection would be required for the retaining wall.

Best regards,

Nathan Christie, P.Eng.
Geotechnical Engineer

patersongroup
Solution Oriented Engineering

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

From: Nathan Christie
Sent: Monday, January 7, 2019 10:40 AM
To: 'Peter Dooher' <pdooher@merkburn.com>; Johnston, Jim <James.Johnston@wsp.com>; Scott Hayward <scott.hayward@pnrarch.com>
Cc: Will Dunk <will.dunk@pnrarch.com>; Yang, Winston <Winston.Yang@wsp.com>; rlefebvre@gwal.com; David Gilbert <DGilbert@Patersongroup.ca>
Subject: RE: 56 Steacie - Fire Route and Heavy Duty Pavement

Hi Peter,

I spoke on the phone with Jim Johnston just now. I will review the available drawings and get back to you as soon as possible. Based on my conversation with Jim I don't foresee any major issues regarding the bearing soils for the concrete ramp, however some vertical insulation may be required for frost protection of soils behind the retaining wall away from the building.

Regards,

Nathan Christie, P.Eng.
Geotechnical Engineer

patersongroup
Solution Oriented Engineering

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

From: Peter Dooher <pdooher@merkburn.com>
Sent: Wednesday, January 2, 2019 5:44 PM
To: Johnston, Jim <James.Johnston@wsp.com>; Nathan Christie <nchristie@Patersongroup.ca>; Scott Hayward <scott.hayward@pnrarch.com>
Cc: Will Dunk <will.dunk@pnrarch.com>; Yang, Winston <Winston.Yang@wsp.com>; rlefebvre@gwal.com
Subject: RE: 56 Steacie - Fire Route and Heavy Duty Pavement

Nathan,

Can you please comment on this?

Thanks

From: Johnston, Jim <James.Johnston@wsp.com>
Sent: Wednesday, January 2, 2019 11:44 AM
To: Scott Hayward <scott.hayward@pnrarch.com>
Cc: Will Dunk <will.dunk@pnrarch.com>; Yang, Winston <Winston.Yang@wsp.com>; Peter Dooher <pdooher@merkburn.com>; rlefebvre@gwal.com
Subject: RE: 56 Steacie - Fire Route and Heavy Duty Pavement

I spoke with one of our bridge engineers regarding the concrete pavement, and the following recommendations were suggested for consideration:

- Slab should be 200mm thick, with two-way 15M reinforcing with depth of cover of 80mm +20mm – 10mm.
- Reinforcing should be either epoxy coated, galvanized, or stainless steel.
- Reinforcing should stop on either side of construction joints. Provide water stop at joints.
- Heated concrete slab should extend to lower level area near garage door. Otherwise, melt water from the ramp will run down to the lower level and then freeze. Heating the lower area will also avoid the need for snow and ice removal in that area.
- Upper end of concrete ramp should extend to the edge of the building.
- Consider removal of proposed landscaped areas on either side of the upper end of the ramp that are over top of the basement roof slab.
- Ensure that roof slab over top of parking garage is property waterproofed.
- As with of ramp exceeds 4.5m, a longitudinal expansion joint is recommended in addition to the cross joints.
- Expansion joint material should be placed around the perimeter of the concrete slab to allow for differential expansion/contraction of the heated slab versus the adjacent unheated areas.

James (Jim) Johnston, P.Eng., MBA, M.Sc., LEED AP BD+C
Infrastructure

T+ 1 613-690-3786 M+ 1 613-298-5960
2611 Queensview Drive, Suite 300, Ottawa, Ontario. K2B 8K2 Canada
wsp.com

From: Scott Hayward [mailto:scott.hayward@pnrarch.com]
Sent: Wednesday, January 02, 2019 10:46 AM
To: Johnston, Jim <James.Johnston@wsp.com>; 'pdooher@merkburn.com' <pdooher@merkburn.com>; rlefebvre@gwal.com
Cc: Will Dunk <will.dunk@pnrarch.com>; Yang, Winston <Winston.Yang@wsp.com>
Subject: RE: 56 Steacie - Fire Route and Heavy Duty Pavement

Hi Jim,
see my comments in red below.

Peter &Rob
what are your thoughts regarding ramp heating. I think we should show one but we could always wait for comments to come back and address at that time. Rob, I assume we would go with a hydronic or glycol solution at the ramp ? Can you provide this design ?

Peter,
can you also have Paterson comment on bearing design of a concrete ramp ?

Happy New Year to all and thanks,
Scott Hayward, B.Arch., OAA, MRAIC, LEED AP
Principal
PYE & RICHARDS ARCHITECTS INC.
200-824 Meath Street,
Ottawa, Ontario. K1Z 6E8
p. 613-724-7700 x.55
e. scott.hayward@pnrarch.com
w. www.pyeandrichardsarchitects.com

From: Johnston, Jim <James.Johnston@wsp.com>
Sent: January 2, 2019 10:31 AM
To: Scott Hayward <scott.hayward@pnrarch.com>
Cc: Will Dunk <will.dunk@pnrarch.com>; Yang, Winston <Winston.Yang@wsp.com>
Subject: RE: 56 Steacie - Fire Route and Heavy Duty Pavement

Please ignore my question regarding the garbage enclosure in my previous email below.

James (Jim) Johnston, P.Eng., MBA, M.Sc., LEED AP BD+C
Infrastructure

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2611 Queensview Drive, Suite 300, Ottawa, Ontario. K2B 8K2 Canada
wsp.com

From: Johnston, Jim
Sent: Wednesday, January 02, 2019 10:10 AM
To: 'Scott Hayward' <scott.hayward@pnrarch.com>
Cc: Will Dunk <will.dunk@pnrarch.com>; Yang, Winston <Winston.Yang@wsp.com>
Subject: 56 Steacie - Fire Route and Heavy Duty Pavement

Hello Scott,
We have a few loose ends to tidy up prior to delivery of the civil drawings and specifications.

- I believe we will have to show heavy duty pavement locations for a fire route, and also for any truck routes for delivery or garbage pickup. Is the intent to have an interior garbage enclosure? **yes**
- Is the roof slab of the extended basement area being designed to accommodate vehicle weights in the access aisle above? **yes**
- I presume the fire route should be shown for the access aisle across the front of the site, incorporating both driveway entrances. **we are showing this in our drawings. We also show a dead end route extending strait to front of main entrance along east side of building.**
- The geotechnical report has only two types of asphalt pavement – one for car only parking, and one for access lanes and heavy truck parking. The City reviewer will therefore be looking for heavy duty pavement for all access routes. If some parts of the access routes will only have light duty use, a supplemental letter from the geotechnical engineer should be obtained permitting this. **Let's stick with these two types – parking and heavy duty. Peter, can you get Paterson to provide geotechnical information on the bearing design of a concrete ramp ?**
- Is the access ramp to the parking garage being heated? If yes, who is providing this design? We should reference this area of special design on the civil drawings Peter, do you have a preference

James (Jim) Johnston, P.Eng., MBA, M.Sc., LEED AP BD+C
Infrastructure

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wsp.com

-LAEmHhHzdJzBITWfa4Hgs7pbKl

From: Yang, Winston
Sent: December-13-18 11:17 AM
To: Diamond, Emily (MECP); Primeau, Charlie (MECP)
Cc: 'MECPOttawaSewage (MECP)'
Subject: RE: 56 Steacie Drive / Two Storey Office Building with underground parking / Application File No. To Be Determined

Hi Emily,

We have submitted a request for a pre-consultation for a project to a Two Storey Office building with underground parking development at 56 Steacie Drive, Ottawa few weeks ago. And I was informed that you are the officer to handle this request. I just want to follow up with you to see what the next step will be.

Should you have any questions please do not hesitate to contact me.

Thanks,

Ding Bang (Winston) Yang, P.Eng.
Project Engineer
Infrastructure

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

From: MECPOttawaSewage (MECP) [mailto:MOECCOttawaSewage@ontario.ca]
Sent: November-30-18 3:06 PM
To: Yang, Winston <Winston.Yang@wsp.com>
Cc: Diamond, Emily (MECP) <Emily.Diamond@ontario.ca>; Primeau, Charlie (MECP) <Charlie.Primeau@ontario.ca>
Subject: RE: 52 Steacie Drive / Two Storey Office Building with underground parking / Application File No. To Be Determined

Good Afternoon:

The MECP Ottawa District Office has received your pre-submission consultation request. Emily Diamond, Senior Environmental Officer, assigned to your file will contact you.

Thank you,

Jéhanne Hurlbut

District Administrative Assistant (Bilingual)
Ministry of the Environment, Conservation and Parks | Ottawa District Office
2430 Don Reid Drive, Unit 103
Ottawa, ON K1H 1E1
Tel: (613) 521-3450 X 221 | Fax: 613-521-5437 | jehanne.hurlbut@ontario.ca

---

From: Yang, Winston [mailto:Winston.Yang@wsp.com]
Sent: Thursday, November 29, 2018 11:36 AM
To: MECPOttawaSewage (MECP) <MOECCOttawaSewage@ontario.ca>
Subject: 52 Steacie Drive / Two Storey Office Building with underground parking / Application File No. To Be Determined

To whom it may concern,

Please find attached a request for a pre-consultation for a project to a Two Storey Office building with underground parking development at 52 Steacie Drive, Ottawa.
Should you have any questions please do not hesitate to contact me.

Yours truly,

Ding Bang (Winston) Yang, P.Eng.
Project Engineer
Infrastructure

wsp

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

-LAEmHhHzdJzBlTWfa4Hgs7pbKl

APPENDIX

C

- STORM SEWER DESIGN SHEET
- STORM DRAINAGE AREA AND PONDING PLAN DRAWING NO. C-04
- STORMWATER MANAGEMENT CALCULATIONS
- TEMPEST ICD FLOW CURVES
- STORMCEPTOR
- GREEN ROOF DETAILS
- EMAILS FROM MECHNICAL ENGINEER

STORM SEWER DESIGN SHEET

56 Steacie Drive
Project: 18M-01672-00
Date: April, 2019

LOCATION				AREA (Ha)						RATIONAL DESIGN FLOW													PROPSOED SEWER DATA								
STREET	AREA ID	FROM	TO	C= 0.25	C= 0.35	C= 0.50	C= 0.60	C= 0.75	C= 0.90	IND 2.78AC	CUM 2.78 AC	INLET (min)	TOTAL (min)	i (5) (mm/hr)	i (10) (mm/hr)	i (100) (mm/hr)	BLDG FLOW (L/s)	5yr PEAK FLOW (L/s)	10yr PEAK FLOW (L/s)	100yr PEAK FLOW (L/s)	FIXED FLOW (L/s)	DESIGN FLOW (L/s)	MATERIAL PIPE	SIZE (mm)	SLOPE (%)	LENGTH (m)	CAPACITY (l/s)	VELOCITY (m/s)	TIME IN PIPE	AVAIL CAP (5yr) (L/s)	(%)
56 Steacie Drive	A101	CB101	CBMH102						0.036	0.090	0.090	10.00	10.51	104.19	122.14	178.56		9.38				9.38	PVC DR-35	200.0	0.60	24.80	25.43	0.81	0.51	16.05	63.10%
56 Steacie Drive	A102	CBMH102	STMH103	0.003					0.047	0.120	0.210	10.51	11.04	101.57	119.05	174.02		21.30				21.30	PVC DR-35	250.0	0.45	25.85	39.93	0.81	0.53	18.63	46.65%
56 Steacie Drive		STMH103	STMH110							0.000	0.210	11.04	11.96	99.00	116.02	169.57		20.76				20.76	PVC DR-35	250.0	0.45	44.80	39.93	0.81	0.92	19.17	48.00%
												20.00																			
56 Steacie Drive	A104	DICB104	STMH105	0.045					0.004	0.041	0.041	20.00	20.21	70.25	82.21	119.95		2.90				2.90	PVC DR-35	200.0	0.60	10.40	25.43	0.81	0.21	22.53	88.60%
56 Steacie Drive	A106	CB106	STMH105-STMH108	0.018					0.056	0.153	0.153	10.00	10.04	104.19	122.14	178.56		15.90				15.90	PVC DR-28	200.0	0.60	2.10	25.43	0.81	0.04	9.53	37.47%
Flow from the Building Roof Drains																															
56 Steacie Drive	BLDG	BLDG	STMH105-CBMH108		0.154				0.005	0.162	0.162	10.00	10.06	104.19	122.14	178.56		16.92				16.92	PVC DR-35	250.0	0.80	4.20	53.24	1.08	0.06	36.33	68.23%
56 Steacie Drive		STMH105	STMH108							0.000	0.356	20.21	21.39	69.78	81.66	119.15		24.86				24.86	PVC DR-28	375.0	0.26	57.05	89.49	0.81	1.17	64.63	72.22%
Flow from the Deck Drains																															
56 Steacie Drive	ARD6-8	RD6-8	CBMH107						0.076	0.190	0.190	10.00	10.03	104.19	122.14	178.56		19.81				19.81	PVC DR-35	200.0	0.60	1.30	25.43	0.81	0.03	5.62	22.09%
56 Steacie Drive	A107	CBMH107	STMH108-STMH110	0.005						0.003	0.194	10.03	10.11	104.05	121.98	178.31		20.15				20.15	PVC DR-35	375.0	0.26	4.20	89.49	0.81	0.09	69.34	77.49%
56 Steacie Drive		STMH108	STMH110							0.000	0.740	21.39	21.52	67.34	78.79	114.94		49.84				49.84	PVC DR-35	375.0	0.26	6.40	89.49	0.81	0.13	39.66	44.31%
Ex. Ditch		STMH110	*Ex. Ditch*							0.000	0.950	21.52	21.61	67.08	78.49	114.49		63.71				63.71	PVC DR-35	375.0	0.26	4.15	89.49	0.81	0.09	25.78	28.81%
Overflow Pipe Exceeding 100 year																															
56 Steacie Drive	A109	CB109	*Ex. Ditch*	0.018					0.056	0.153	0.153	10.00	10.23	104.19	122.14	178.56		15.90		27.25		11.35	PVC DR-35	300.0	0.35	11.30	57.27	0.81	0.23	45.92	80.18%

Definition:
Q=2.78CiA, where:
Q = Peak Flow in Litres per Second (L/s)
A = Area in Hectares (Ha)
i = Rainfall Intensity in millimeters per hour (mm/hr)
i = 998.071/(TC+6.053)^0.814 — 5 Year
i = 1174.184/(TC+6.014)^0.816 — 10 Year
i = 1735.688/(TC+6.014)^0.820 — 100 Year

Notes:
1. Mannings coefficient (n) = 0.013

2 .Building flow for the office building is calculated at 42 l/s/ha

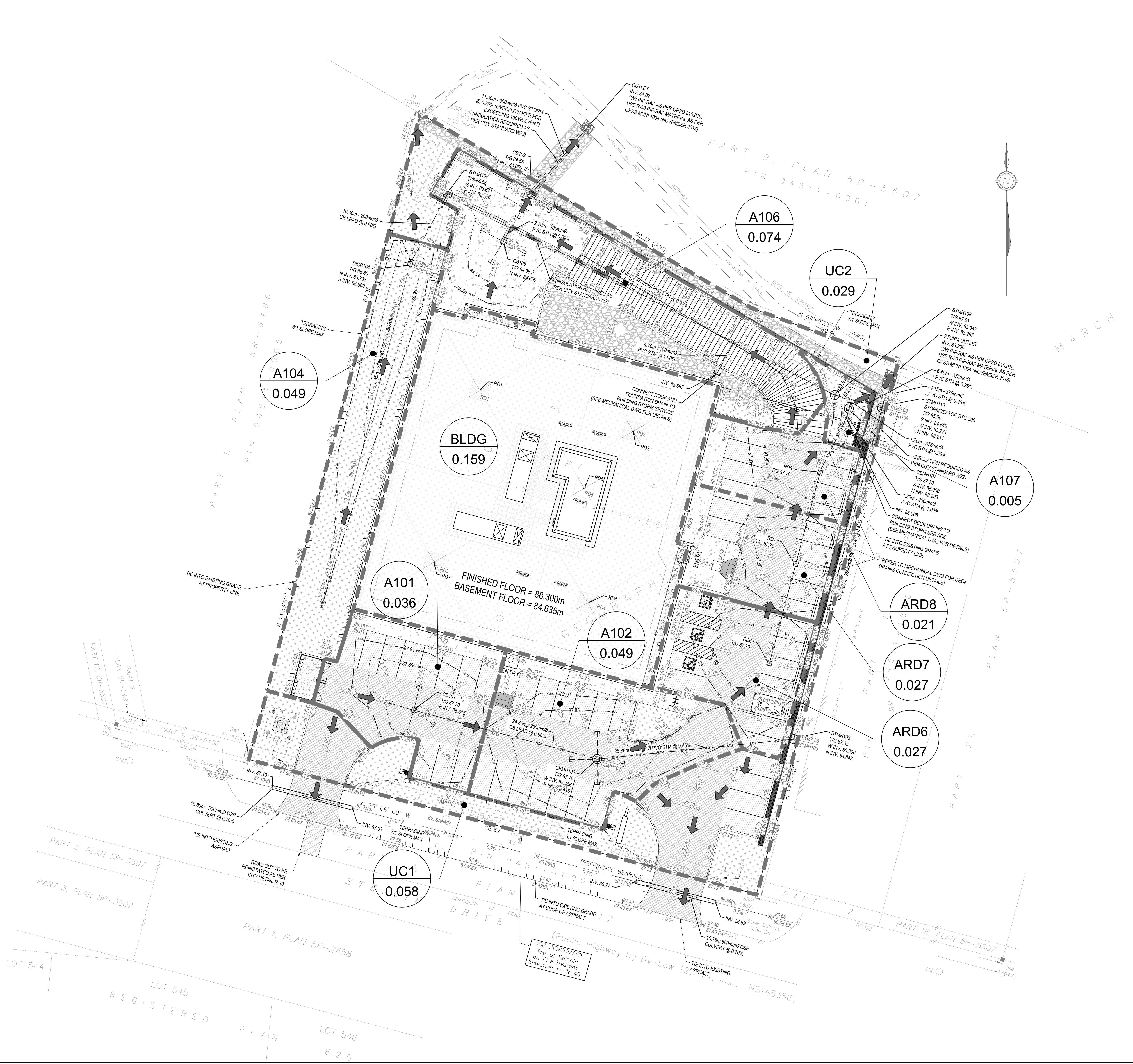
Time-of-Concentration in the Bio-Swale
FAA Equation: t (min) = 3.258 [(1.1 - C) L^0.5 / S^.33]
Where: Longest Watercourse Length, L (m). S (%)
Runoff Coef.C = 0.25 Impervious

No.	L (m)	S %
1	45.45	0.70

Designed: W.Y.
Checked: W.Y./J.J.
Dwg. Reference: C-04

No.	Revision	Date
1.	City Submission No. 1	23/01/2019
2.	City Submission No. 2	03/04/2019

File Reference:	Date:	Sheet No:
18M-01672-00	15/11/2018	1 of 1



1 C-04 POST DEV. DRAINAGE AREA PLAN
SCALE= 1:250

SCALE: 1:250

LEGEND

AREA ID / Ha — DRAINAGE AREA ID / AREA IN HECTARES

EMERGENCY FLOW ROUTE FOR STORM ABOVE THE 1:100 EVEN

PONDING AREA
100 YEAR PONDING LIMIT

STORM DRAINAGE AREA BOUNDARY

PONDING TABLE

POND #	AREA ID	PONDING ELEVATION (m)	TOP OF CB ELEVATION (m)	PONDING DEPTH (m)	PONDING AREA (m^2)	PONDING VOLUME (m^3)
1	A101	87.91	87.70	0.21	210.63	14.74
2	A102	87.91	87.70	0.21	309.58	21.67
3	A104	87.10	86.80	0.30	184.46	18.45
4	A106	84.58	84.38	0.20	247.10	16.47
5	ARD6	87.91	87.70	0.21	160.40	11.23
6	ARD7	87.91	87.70	0.21	128.99	9.03
7	ARD8	87.91	87.70	0.21	113.41	7.94
8	A107	87.91	87.70	0.21	37.20	2.60

*Ponding Volume is calculated using ponding area mulitplied by the maximum ponding depth, and divided by 3 for a conical pond.

wsp
300-2611 QUEENSVIEW DRIVE
OTTAWA ONTARIO CANADA K2B 8K2
TEL: 1-613-829-2800 | FAX: 1-613-829-8299 | WWW.WSPGROUP.COM

LOCATION MAP

SEAL

J. C. JOHNSTON 2019-04-03 — REGISTERED PROFESSIONAL ENGINEER, PROVINCE OF ONTARIO

D. B. YANG 100230568 2019-04-03 — REGISTERED PROFESSIONAL ENGINEER, PROVINCE OF ONTARIO

Not for construction unless SEALED and SIGNED.

NO.	ISSUE & REVISIONS	DATE
2	SUBMISSION NO. 2	APR 03, 2019
1	ISSUED FOR SITE PLAN APPLICATION	JAN 23, 2019

PROJECT NORTH

P & R
PYE & RICHARDS ARCHITECTS INC
200–824 MEATH STREET OTTAWA ONTARIO K1Z 6E8
TEL: 613–724–7700 FAX: 613–724–1289
EMAIL: staff@pnrarch.com
WEBSITE: www.pyeandrichardsarchitects.com

PROJECT

NEW 2-STOREY OFFICE BUILDING
WITH BASEMENT PARKING GARAGE

56 STEACIE DRIVE **OTTAWA, ONTARIO**

DRAWING

STORM DRAINAGE AREA AND PONDING PLAN

Do not scale. Refer any dimensional errors and/or possible trade interference/conflict to the architects for clarification prior to commencement of the work.
The conditions of the contract apply.

PROJECT NO. 18M-01672-00
SCALE: AS NOTED
DRAWN: WY
CHECKED: JJ
PLOT DATE –2019–04–03
DRAWING NO. C-04
REVISION NO. 1

D07-12-19-0010

#17875

56 Steacie Drive
Project: 18M-01672-00
Date: April, 2019

Stormwater Management Summary

Sub Area I.D.	Sub Area (ha)	Avg. Composite C' 5 yr	Avg. Composite C' 100 yr	Outlet Location	5 Year Controlled Release (L/s)	5 year Storage Required (m^3)	100 Year Controlled Release (L/s)	100 year Storage Required (m^3)	100 Year Storage Provided (m^3)
				Total Allowable Release Rate			**38.96**		
Uncontrolled UC1	0.058		0.58	Steacie Drive	8.60	N/A	16.70	N/A	N/A
Uncontrolled UC2	0.029		0.31	Ex. Ditch	2.10	N/A	4.50	N/A	N/A
				Maximum Allowable Release Rate			**17.76**		
A101 and A102	0.086	0.52	0.60	Ex. Ditch	1.97	8.53	2.06	21.37	36.41
A106	0.074	0.74	0.83	Ex. Ditch	6.66	5.45	7.57	15.49	16.47
A104	0.049	0.30	0.37	Ex. Ditch	0.53	3.07	0.55	8.23	18.45
A107, ARD6-8	0.081	0.86	0.95	Ex. Ditch	4.48	10.74	4.58	27.58	30.80
BLDG ROOF									
ARD1	0.046	0.35	0.44	Ex. Ditch	0.32	4.18	0.32	11.10	18.40
ARD2	0.028	0.35	0.44	Ex. Ditch	0.32	2.10	0.32	5.82	11.12
ARD3	0.046	0.35	0.44	Ex. Ditch	0.32	4.15	0.32	11.04	18.32
ARD4	0.034	0.35	0.44	Ex. Ditch	0.32	2.79	0.32	7.58	13.64
ARD5	0.005	0.90	0.99	Ex. Ditch	0.32	0.69	0.32	1.76	2.04
Total	0.449				15.24	41.69	16.36	109.97	165.65

56 Steacie Drive

Project: 18M-01672-00

Date: April, 2019

Pre-Deleveopment

Table 1 - Allowable Release Rate (PA1)

Runoff Coefficient Equation

$C = (A_{hard} \times 0.9 + A_{soft} \times 0.25)/A_{tot}$

5 Year Event

	C	Intensity	Area
5 Year	0.25	104.19	0.538
2.78CIA=	38.96		
	38.96	L/s	

*Use a 10 minute time of concentration for 5 year

Equations:

Flow Equation

$Q = 2.78 \times C \times I \times A$

Where:

C is the runoff coefficient

I is the intensity of rainfall, City of Ottawa IDF

Rainfall Intensity = $998.071/(T+6.053)^{-0.814}$ T= time in minutes

A is the total drainage area

56 Steacie Drive
Project: 18M-01672-00
Date: April, 2019

TABLE 2a - Storage Required for Area A101 and A102

Maximum Allowable Release Rate:
39.0 l/s

Post Dev run-off Coefficient "C"

Area	Surface	Ha	5 Year Event "C"	5 Year Event C_{avg}	100 Year Event "C" x 1.25	100 Year Event $C_{100\ avg}$
Total	Asphalt	0.036	0.90	0.52	0.99	0.60
0.086	Roof		0.90		0.99	
	Grass	0.050	0.25		0.31	

*Areas are approximate based on Architectural site plan and Storm Draiange Area Plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$^*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.086 = Area(ha)
0.52 = C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
5 YEAR	10	104.19	12.95	1.97	10.99	6.59	36.41
	20	70.25	8.73	1.97	6.77	8.12	36.41
	30	**53.93**	**6.70**	**1.97**	**4.74**	**8.53**	**36.41**
	40	44.18	5.49	1.97	3.53	8.46	36.41
	50	37.65	4.68	1.97	2.71	8.14	36.41
	60	32.94	4.10	1.97	2.13	7.67	36.41

Orifice #1 Sizing
CBMH102

Event	Flow (L/s)	Head (m)	ORIFICE AREA(m^2)	SQUARE (1-side mm)	CIRC (mmØ)
5 Year	1.97	2.27	0.000	22	25
100 Year	2.06	2.48	0.000	22	25

ICD TYPE WILL BE HYDROVEX 50VHV-1
Orifice Control Sizing
Q = 0.6 x A x (2gh)1/2
Where:
Q is the release rate in m^3/s
A is the orifice area in m^2
g is the acceleration due to gravity, 9.81m/s^2
h is the head of water above the orifice centre in m
d is the diameter of the orifice in m

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.086 = Area(ha)
0.60 = *C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
100 YEAR	10	178.56	25.61	2.06	23.56	14.14	36.41
	30	91.87	13.18	2.06	11.12	20.02	36.41
	50	63.95	9.17	2.06	7.12	21.36	36.41
	70	**49.79**	**7.14**	**2.06**	**5.09**	**21.37**	**36.41**
	90	41.11	5.90	2.06	3.84	20.75	36.41
	110	35.20	5.05	2.06	2.99	19.76	36.41
	130	30.90	4.43	2.06	2.38	18.54	36.41

Orifice Invert = 85.416 m
Ponding Elevation = 87.910 m
Top of CB Elevation = 87.700 m

Note: Orifice #1 is located on the downstream invert of CBMH102

Equations:
Flow Equation
Q = 2.78 x C x I x A
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

56 Steacie Drive
Project: 18M-01672-00
Date: April, 2019

TABLE 2b - Storage Required for Area A106

Maximum Allowable Release Rate:
39.0 l/s

Post Dev run-off Coefficient "C"

Area	Surface	Ha	5 Year Event "C"	5 Year Event C_{avg}	100 Year Event "C" x 1.25	100 Year Event $C_{100\ avg}$
Total	Asphalt	0.056	0.90	**0.74**	0.99	**0.83**
0.074	Roof		0.90		0.99	
	Grass	0.018	0.25		0.31	

*Areas are approximate based on Architectural site plan and Storm Draiange Area Plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$^*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.074 = Area(ha)
0.74 = C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
	10	**104.19**	**15.86**	**6.66**	**9.20**	**5.52**	**16.47**
	15	83.56	12.72	6.66	6.06	5.45	16.47
	20	70.25	10.69	6.66	4.03	4.84	16.47
5 YEAR	25	60.90	9.27	6.66	2.61	3.91	16.47
	30	53.93	8.21	6.66	1.54	2.78	16.47
	35	48.52	7.39	6.66	0.72	1.51	16.47

Orifice #4 Sizing
CB106

Event	Flow (L/s)	Head (m)	ORIFICE AREA(m^2)	SQUARE (1-side mm)	CIRC (mmØ)
5 Year	6.66	0.69	0.003	55	62
100 Year	7.57	0.89	0.003	55	62

ICD TYPE WILL BE HYDROVEX 100VHV-1
Orifice Control Sizing
Q = 0.6 x A x (2gh)1/2
Where:
Q is the release rate in m^3/s
A is the orifice area in m^2
g is the acceleration due to gravity, 9.81m/s^2
h is the head of water above the orifice centre in m
d is the diameter of the orifice in m

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.074 = Area(ha)
0.83 = *C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
	10	178.56	30.49	7.57	22.92	13.75	16.47
	20	**119.95**	**20.48**	**7.57**	**12.91**	**15.49**	**16.47**
100 YEAR	30	91.87	15.69	7.57	8.12	14.61	16.47
	40	75.15	12.83	7.57	5.26	12.63	16.47
	50	63.95	10.92	7.57	3.35	10.05	16.47
	60	55.89	9.54	7.57	1.97	7.11	16.47

Orifice Invert = 83.659 m
Ponding Elevation = 84.580 m
Top of CB Elevation = 84.380 m

Note: Orifice #2 is located on the downstream invert of CB106

Equations:
Flow Equation
Q = 2.78 x C x I x A
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

56 Steacie Drive
Project: 18M-01672-00
Date: April 2019

TABLE 2c - Storage Required for Area A104

Maximum Allowable Release Rate:
39.0 l/s

Post Dev run-off Coefficient "C"

Area	Surface	Ha	5 Year Event "C"	5 Year Event C_{avg}	100 Year Event "C" x 1.25	100 Year Event $C_{100\ avg}$
Total	Asphalt	0.004	0.90	**0.30**	0.99	**0.37**
0.049	Roof		0.90		0.99	
	Grass	0.045	0.25		0.31	

*Areas are approximate based on Architectural site plan and Storm Draiange Area Plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.049 = Area(ha)
0.30 = C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
	10	104.19	4.26	0.53	3.73	2.24	18.45
	20	70.25	2.87	0.53	2.35	2.81	18.45
	30	53.93	2.20	0.53	1.68	3.02	18.45
5 YEAR	**40**	**44.18**	**1.81**	**0.53**	**1.28**	**3.07**	**18.45**
	50	37.65	1.54	0.53	1.01	3.04	18.45
	60	32.94	1.35	0.53	0.82	2.95	18.45

Orifice #5 Sizing
DICB104

Event	Flow (L/s)	Head (m)	ORIFICE AREA(m^2)	SQUARE (1-side mm)	CIRC (mmØ)
5 Year	0.53	3.06	0.000	11	12
100 Year	0.55	3.36	0.000	11	12

ICD TYPE WILL BE HYDROVEX 25SVHV-1
Orifice Control Sizing
$Q = 0.6 \times A \times (2gh)1/2$
Where:
Q is the release rate in m^3/s
A is the orifice area in m^2
g is the acceleration due to gravity, $9.81 m/s^2$
h is the head of water above the orifice centre in m
d is the diameter of the orifice in m

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.049 = Area(ha)
0.37 = *C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
	10	178.56	9.00	0.55	8.45	5.07	18.45
	30	91.87	4.63	0.55	4.08	7.34	18.45
100 YEAR	50	63.95	3.22	0.55	2.67	8.02	18.45
	70	**49.79**	**2.51**	**0.55**	**1.96**	**8.23**	**18.45**
	90	41.11	2.07	0.55	1.52	8.21	18.45
	110	35.20	1.77	0.55	1.22	8.07	18.45
	130	30.90	1.56	0.55	1.01	7.85	18.45

Orifice Invert =	83.733	m
Ponding Elevation =	87.100	m
Top of CB Elevation =	86.800	m

Note: Orifice #3 is located on the downstream invert of DICB104

Equations:
Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

56 Steacie Drive
Project: 18M-01672-00
Date: April 2019

TABLE 2d - Storage Required for Area A107, ARD6, ARD7 and ARD8

Maximum Allowable Release Rate:
39.0 l/s

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" x 1.25	$C_{100\ avg}$
Total	Asphalt	0.076	0.90	0.86	0.99	0.95
0.081	Roof		0.90		0.99	
	Grass	0.005	0.25		0.31	

*Areas are approximate based on Architectural site plan and Storm Draiange Area Plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$^*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.081 = Area(ha)
0.86 = C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
	10	104.19	20.18	4.48	15.70	9.42	30.80
	20	70.25	13.60	4.48	9.13	10.95	30.80
	30	**53.93**	**10.44**	**4.48**	**5.96**	**10.74**	**30.80**
5 YEAR	40	44.18	8.56	4.48	4.08	9.79	30.80
	50	37.65	7.29	4.48	2.81	8.44	30.80
	60	32.94	6.38	4.48	1.90	6.84	30.80

Orifice #5 Sizing
CBMH107

Event	Flow (L/s)	Head (m)	ORIFICE AREA(m^2)	SQUARE (1-side mm)	CIRC (mmØ)
5 Year	4.48	4.39	0.001	28	32
100 Year	4.58	4.60	0.001	28	32

ICD TYPE WILL BE HYDROVEX 50VHV-1

Orifice Control Sizing
Q = 0.6 x A x (2gh)1/2
Where:
Q is the release rate in m^3/s
A is the orifice area in m^2
g is the acceleration due to gravity, $9.81 m/s^2$
h is the head of water above the orifice centre in m
d is the diameter of the orifice in m

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.081 = Area(ha)
0.95 = *C
39.0 l/s = max allowable release rate

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Controlled Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd m^3	Storage Avail m^3
	10	178.56	38.20	4.58	33.61	20.17	30.80
	20	119.95	25.66	4.58	21.08	25.29	30.80
100 YEAR	30	91.87	19.65	4.58	15.07	27.12	30.80
	40	**75.15**	**16.08**	**4.58**	**11.49**	**27.58**	**30.80**
	50	63.95	13.68	4.58	9.10	27.29	30.80
	60	55.89	11.96	4.58	7.37	26.54	30.80
	70	49.79	10.65	4.58	6.07	25.48	30.80

Orifice Invert = 83.293 m
Ponding Elevation = 87.910 m
Top of CB Elevation = 87.700 m

Note: Orifice #4 is located on the downstream invert of CBMH107

Equations:
Flow Equation
Q = 2.78 x C x I x A
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

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TABLE 3a - Proposed Roof Drain #1

Allowable Release Rate

Roof Area #1 = 0.046 Ha
Ponding Depth = 0.150 m
The flow rate through the WATTS Accutrol Weir will be = 5.00 gpm
0.32 L/s

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt		0.90	**0.35**	0.99	**0.44**
0.046	Green Roof	0.046	0.35		0.44	
	Grass		0.25		0.31	

*Areas are approximate based on Architectural site plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$^*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.046 = Area(ha)
0.35 = C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available* (m^3)
5 YEAR	10	104.19	4.66	0.32	4.34	2.61	18.40
	30	53.93	2.41	0.32	2.09	3.77	18.40
	50	37.65	1.69	0.32	1.37	4.10	18.40
	70	**29.37**	**1.31**	**0.32**	**0.99**	**4.18**	**18.40**
	90	24.29	1.09	0.32	0.77	4.14	18.40

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.046 = Area(ha)
0.44 = *C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available (m^3)
100 YEAR	10	178.56	10.05	0.32	9.73	5.84	18.40
	40	75.15	4.23	0.32	3.91	9.38	18.40
	70	49.79	2.80	0.32	2.48	10.42	18.40
	100	37.90	2.13	0.32	1.81	10.88	18.40
	130	30.90	1.74	0.32	1.42	11.06	18.40
	160	**26.24**	**1.48**	**0.32**	**1.16**	**11.10**	**18.40**
	190	22.90	1.29	0.32	0.97	11.04	18.40
	210	21.14	1.19	0.32	0.87	10.96	18.40

*Storage available is calculated using 80% of the roof area mulitplied by the maximum ponding depth of 0.15m, and divided by 3 for a conical pond.

Equations:

Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

56 Steacie Drive
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TABLE 3b - Proposed Roof Drain #2

Allowable Release Rate

Roof Area #2 = 0.028 Ha
Ponding Depth = 0.150 m
The flow rate through the WATTS Accutrol Weir will be = 5.00 gpm
0.32 L/s

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	Surface	Ha	"C"	C_{avg}	"C" x 1.25	$C_{100\ avg}$
Total	Asphalt		0.90	0.35	0.99	0.44
0.028	Green Roof	0.028	0.35		0.44	
	Grass		0.25		0.31	

*Areas are approximate based on Architectural site plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$^*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.028 = Area(ha)
0.35 = C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available* (m^3)
5 YEAR	10	104.19	2.82	0.32	2.50	1.50	11.12
	30	53.93	1.46	0.32	1.14	2.05	11.12
	50	**37.65**	**1.02**	**0.32**	**0.70**	**2.10**	**11.12**
	70	29.37	0.79	0.32	0.47	1.99	11.12
	90	24.29	0.66	0.32	0.34	1.82	11.12

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.028 = Area(ha)
0.44 = *C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available (m^3)
100 YEAR	10	178.56	6.07	0.32	5.75	3.45	11.12
	30	91.87	3.12	0.32	2.80	5.05	11.12
	50	63.95	2.17	0.32	1.85	5.56	11.12
	70	49.79	1.69	0.32	1.37	5.77	11.12
	80	44.99	1.53	0.32	1.21	5.81	11.12
	90	**41.11**	**1.40**	**0.32**	**1.08**	**5.82**	**11.12**
	100	37.90	1.29	0.32	0.97	5.81	11.12

*Storage available is calculated using 80% of the roof area mulitplied by the maximum ponding depth of 0.15m, and divided by 3 for a conical pond.

Equations:

Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

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TABLE 3c - Proposed Roof Drain #3

Allowable Release Rate

Roof Area #3 = 0.046 Ha
Ponding Depth = 0.150 m
The flow rate through the WATTS Accutrol Weir will be = 5.00 gpm
0.32 L/s

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt		0.90	**0.35**	0.99	**0.44**
0.046	Green Roof	0.046	0.35		0.44	
	Grass		0.25		0.31	

*Areas are approximate based on Architectural site plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.046 = Area(ha)
0.35 = C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available* (m^3)
5 YEAR	10	104.19	4.64	0.32	4.32	2.59	18.32
	30	53.93	2.40	0.32	2.08	3.75	18.32
	50	37.65	1.68	0.32	1.36	4.07	18.32
	70	**29.37**	**1.31**	**0.32**	**0.99**	**4.15**	**18.32**
	90	24.29	1.08	0.32	0.76	4.12	18.32

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.046 = Area(ha)
0.44 = *C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available (m^3)
100 YEAR	10	178.56	10.00	0.32	9.68	5.81	18.32
	40	75.15	4.21	0.32	3.89	9.34	18.32
	70	49.79	2.79	0.32	2.47	10.37	18.32
	100	37.90	2.12	0.32	1.80	10.82	18.32
	130	30.90	1.73	0.32	1.41	11.01	18.32
	160	**26.24**	**1.47**	**0.32**	**1.15**	**11.04**	**18.32**
	190	22.90	1.28	0.32	0.96	10.98	18.32
	210	21.14	1.18	0.32	0.86	10.89	18.32

*Storage available is calculated using 80% of the roof area mulitplied by the maximum ponding depth of 0.15m, and divided by 3 for a conical pond.

Equations:

Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

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TABLE 3d - Proposed Roof Drain #4

Allowable Release Rate

Roof Area #4 = 0.034 Ha
Ponding Depth = 0.150 m
The flow rate through the WATTS Accutrol Weir will be = 5.00 gpm
0.32 L/s

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt		0.90	**0.35**	0.99	**0.44**
0.034	Green Roof	0.034	0.35		0.44	
	Grass		0.25		0.31	

*Areas are approximate based on Architectural site plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.034 = Area(ha)
0.35 = C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available* (m^3)
5 YEAR	10	104.19	3.46	0.32	3.14	1.88	13.64
	30	53.93	1.79	0.32	1.47	2.64	13.64
	50	**37.65**	**1.25**	**0.32**	**0.93**	**2.79**	**13.64**
	70	29.37	0.97	0.32	0.65	2.75	13.64
	90	24.29	0.81	0.32	0.49	2.62	13.64

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.034 = Area(ha)
0.44 = *C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available (m^3)
100 YEAR	10	178.56	7.45	0.32	7.13	4.28	13.64
	30	91.87	3.83	0.32	3.51	6.32	13.64
	50	63.95	2.67	0.32	2.35	7.04	13.64
	70	49.79	2.08	0.32	1.76	7.38	13.64
	90	41.11	1.71	0.32	1.39	7.53	13.64
	110	**35.20**	**1.47**	**0.32**	**1.15**	**7.58**	**13.64**
	130	30.90	1.29	0.32	0.97	7.56	13.64

*Storage available is calculated using 80% of the roof area mulitplied by the maximum ponding depth of 0.15m, and divided by 3 for a conical pond.

Equations:

Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

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TABLE 3e - Proposed Roof Drain #5

Allowable Release Rate

Roof Area #5 = 0.005 Ha
Ponding Depth = 0.150 m
The flow rate through the WATTS Accutrol Weir will be = 5.00 gpm
0.32 L/s

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C" x 1.25**	**$C_{100\ avg}$**
Total	Asphalt		0.90	**0.90**	0.99	**0.99**
0.005	Roof	0.005	0.90		0.99	
	Grass		0.25		0.31	

*Areas are approximate based on Architectural site plan

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

QUANTITY STORAGE REQUIREMENTS - 5 Year

0.005 = Area(ha)
0.90 = C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available* (m^3)
5 YEAR	10	104.19	1.33	0.32	1.01	0.61	2.04
	20	**70.25**	**0.90**	**0.32**	**0.58**	**0.69**	**2.04**
	30	53.93	0.69	0.32	0.37	0.66	2.04
	40	44.18	0.56	0.32	0.24	0.59	2.04
	50	37.65	0.48	0.32	0.16	0.48	2.04

QUANTITY STORAGE REQUIREMENTS - 100 Year

0.005 = Area(ha)
0.99 = *C

Return Period	Time (min)	Intensity (mm/hr)	Flow Q (L/s)	Allowable Runoff (L/s)	Net Runoff To Be Stored (L/s)	Storage Req'd (m^3)	Storage Available (m^3)
100 YEAR	10	178.56	2.51	0.32	2.19	1.31	2.04
	20	119.95	1.68	0.32	1.36	1.64	2.04
	30	91.87	1.29	0.32	0.97	1.75	2.04
	40	**75.15**	**1.05**	**0.32**	**0.73**	**1.76**	**2.04**
	50	63.95	0.90	0.32	0.58	1.73	2.04
	60	55.89	0.78	0.32	0.46	1.67	2.04
	70	49.79	0.70	0.32	0.38	1.59	2.04

*Storage available is calculated using 80% of the roof area mulitplied by the maximum ponding depth of 0.15m, and divided by 3 for a conical pond.

Equations:

Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

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TABLE 4a - Uncontrolled Flow UC1

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2)/A_{tot}$
$*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C"+25%**	**$*C_{avg}$**
Total	Asphalt	0.023	0.90	**0.51**	0.99	**0.58**
0.058	Roof		0.90		0.99	
	Grass	0.035	0.25		0.31	

Post Dev Free Flow
5 Year Event

Pre Dev.	C	Intensity	Area
5 Year	0.51	104.19	0.06
2.78CIA=	8.57		
8.60	L/S		

**Use a 10 minute time of concentration for 5 year

100 Year Event

Pre Dev.	C	Intensity	Area
100 Year	0.58	178.56	0.06
2.78CIA=	16.70		
16.70	L/S		

**Use a 10 minute time of concentration for 100 year

Equations:
Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

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TABLE 4b - Uncontrolled Flow UC2

Runoff Coefficient Equation
$C = (A_{hard} \times 0.9 + A_{soft} \times 0.2\ )/A_{tot}$
$*C = (A_{hard} \times 1.0 + A_{soft} \times 0.25)/A_{tot}$

*Runoff coefficients increased by 25% up to a maximum value of 0.99 for the 100-Year event

Post Dev run-off Coefficient "C"

			5 Year Event		100 Year Event	
Area	**Surface**	**Ha**	**"C"**	**C_{avg}**	**"C"+25%**	**$*C_{avg}$**
Total	Asphalt		0.90	**0.25**	0.99	**0.31**
0.029	Roof		0.90		0.99	
	Grass	0.029	0.25		0.31	

Post Dev Free Flow
5 Year Event

Pre Dev.	**C**	**Intensity**	**Area**
5 Year	0.25	104.19	0.03
2.78CIA=	2.10		
2.10	L/S		

**Use a 10 minute time of concentration for 5 year

100 Year Event

Pre Dev.	**C**	**Intensity**	**Area**
100 Year	0.31	178.56	0.03
2.78CIA=	4.46		
4.50	L/S		

**Use a 10 minute time of concentration for 100 year

Equations:
Flow Equation
$Q = 2.78 \times C \times I \times A$
Where:
C is the runoff coefficient
I is the intensity of rainfall, City of Ottawa IDF
A is the total drainage area

HYDROVEX®

VHV Vertical Vortex Flow Regulator

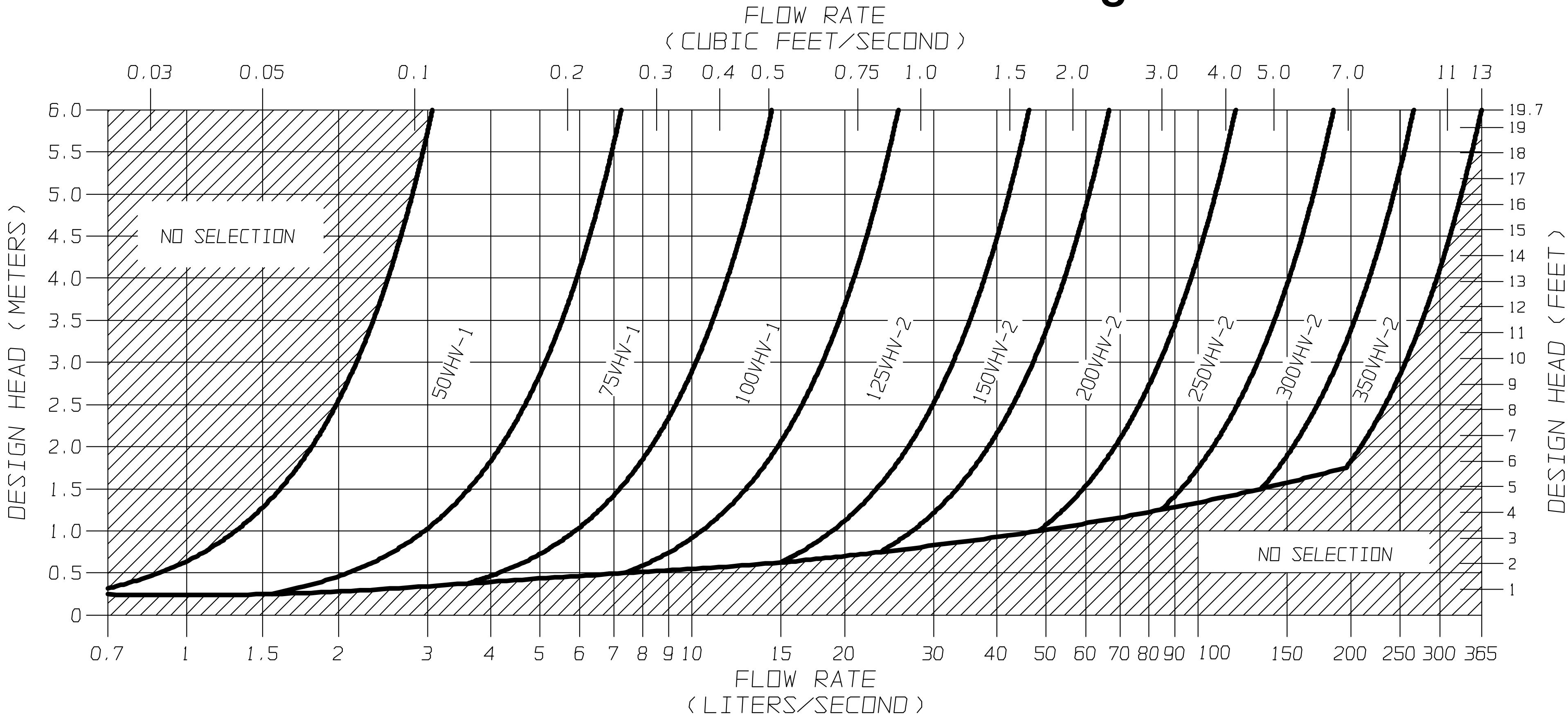


FIGURE 2 - VHV

JOHN MEUNIER

SVHV Vertical Vortex Flow Regulator

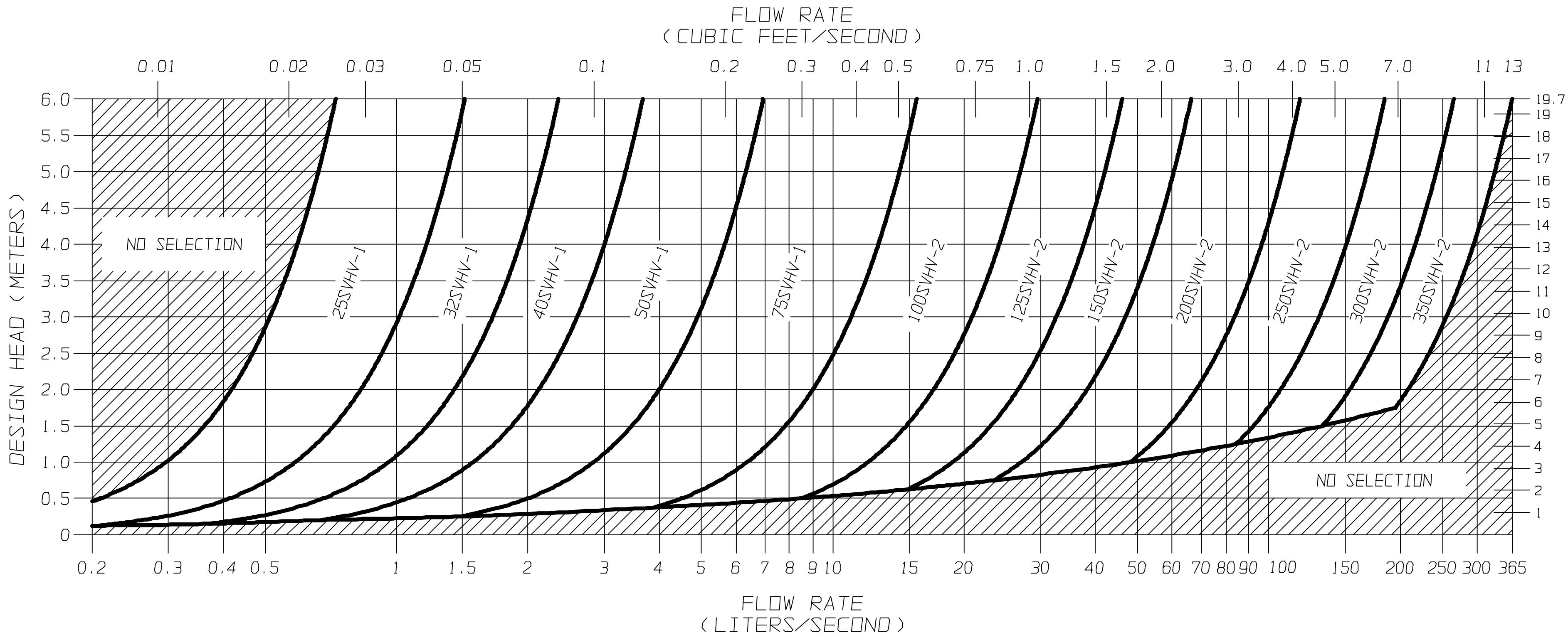


FIGURE 2 - SVHV

Stormceptor®

FORTERRA™

Detailed Stormceptor Sizing Report – 56 Steacie Drive

Project Information & Location			
Project Name	56 Steacie Drive	**Project Number**	18M-01672-00
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	12/13/2018
Designer Information		**EOR Information (optional)**	
Name	Ding Bang Yang	**Name**	
Company	WSP Canada Inc	**Company**	
Phone #	613-690-0538	**Phone #**	
Email	winston.yang@wsp.com	**Email**	

Stormwater Treatment Recommendation

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

Site Name	56 Steacie Drive
Recommended Stormceptor Model	STC 300
Target TSS Removal (%)	70.0
TSS Removal (%) Provided	73
PSD	Fine Distribution
Rainfall Station	OTTAWA MACDONALD-CARTIER INT'L A

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

Stormceptor Sizing Summary		
Stormceptor Model	**% TSS Removal Provided**	**% Runoff Volume Captured Provided**
STC 300	73	91
STC 750	82	97
STC 1000	83	97
STC 1500	84	97
STC 2000	86	99
STC 3000	88	99
STC 4000	90	100
STC 5000	91	100
STC 6000	92	100
STC 9000	95	100
STC 10000	94	100
STC 14000	96	100
StormceptorMAX	Custom	Custom

Stormceptor

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 each rainfall event, 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.

Design Methodology

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

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

Hydrology Analysis

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

Rainfall Station

State/Province	Ontario	**Total Number of Rainfall Events**	4093
Rainfall Station Name	OTTAWA MACDONALD-CARTIER INT'L A	**Total Rainfall (mm)**	20978.1
Station ID #	6000	**Average Annual Rainfall (mm)**	567.0
Coordinates	45°19'N, 75°40'W	**Total Evaporation (mm)**	1579.6
Elevation (ft)	370	**Total Infiltration (mm)**	3553.7
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	15844.8

Notes

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

Drainage Area	
Total Area (ha)	0.447
Imperviousness %	83.0

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

Water Quality Objective	
TSS Removal (%)	70.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	16.89

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

Design Details	
Stormceptor Inlet Invert Elev (m)	84.64
Stormceptor Outlet Invert Elev (m)	83.21
Stormceptor Rim Elev (m)	85.70
Normal Water Level Elevation (m)	83.20
Pipe Diameter (mm)	375
Pipe Material	PVC - plastic
Multiple Inlets (Y/N)	Yes
Grate Inlet (Y/N)	No

Particle Size Distribution (PSD)

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

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

Stormceptor® FORTERRA

Site Name	56 Steacie Drive

Site Details

Drainage Area	
Total Area (ha)	0.447
Imperviousness %	83.0

Surface Characteristics	
Width (m)	134.00
Slope %	2
Impervious Depression Storage (mm)	0.508
Pervious Depression Storage (mm)	5.08
Impervious Manning's n	0.015
Pervious Manning's n	0.25

Maintenance Frequency	
Maintenance Frequency (months) >	12

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

Evaporation	
Daily Evaporation Rate (mm/day)	2.54

Dry Weather Flow	
Dry Weather Flow (lps)	0

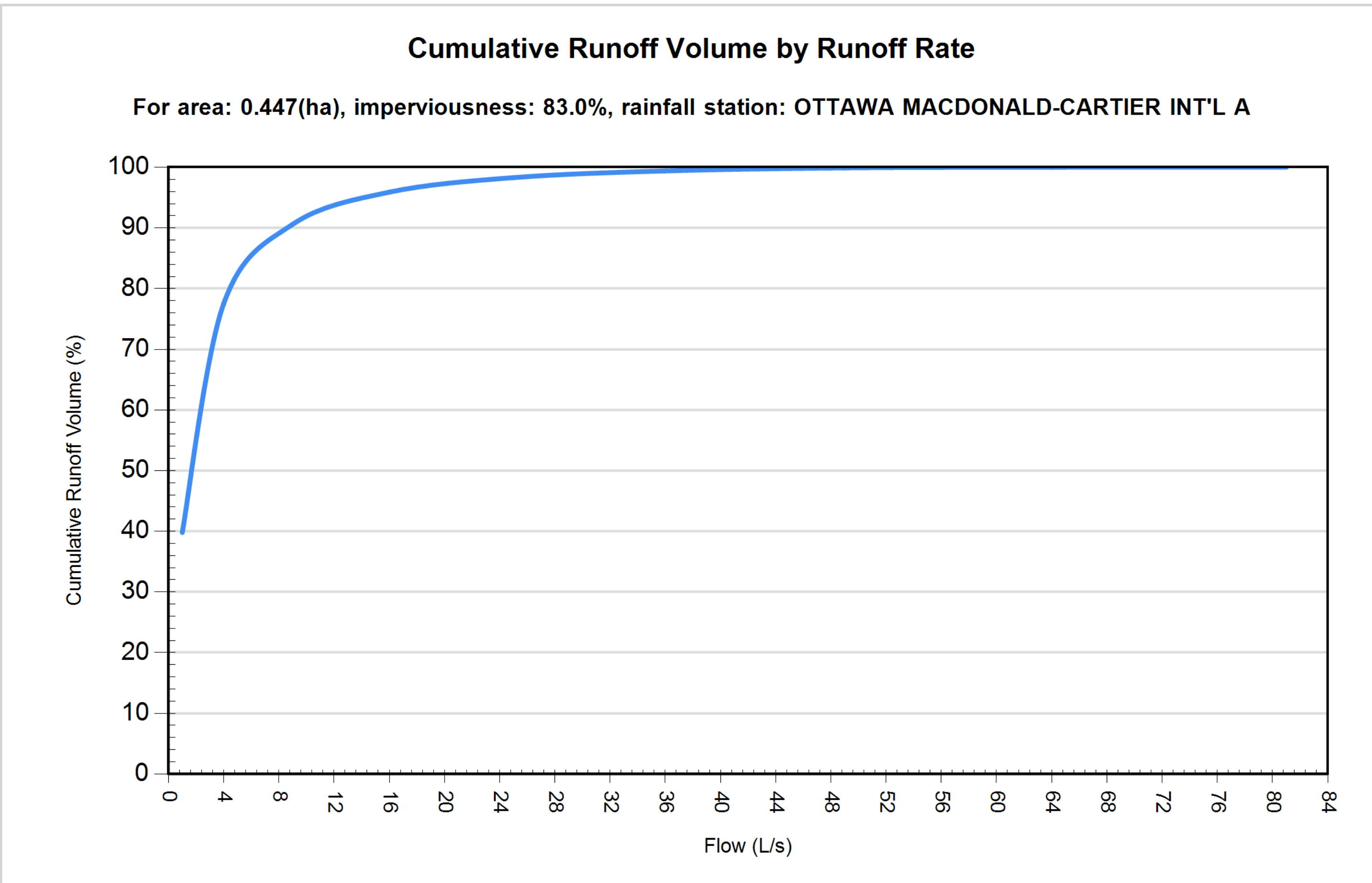
Winter Months	
Winter Infiltration	0

TSS Loading Parameters	
TSS Loading Function	

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

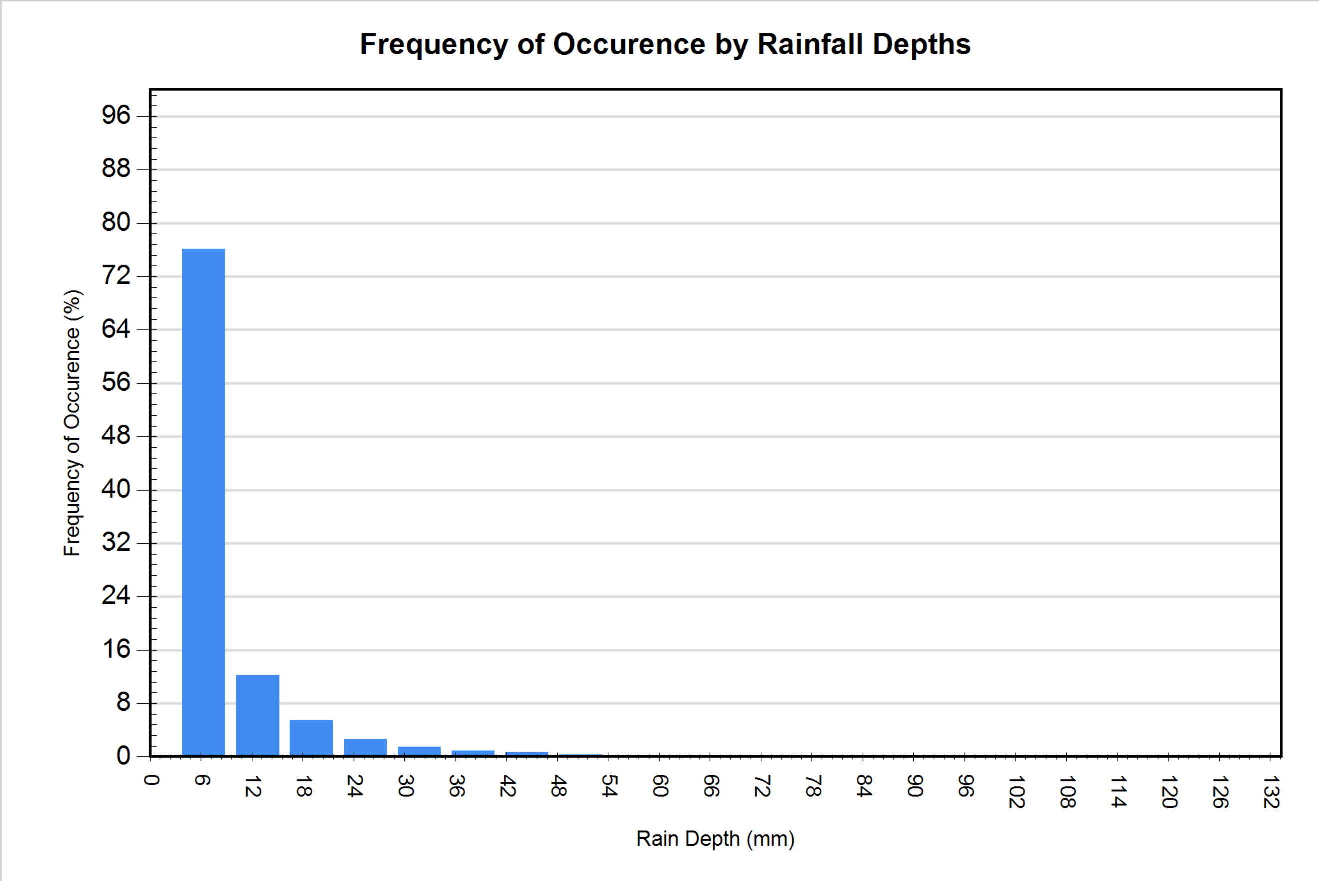
TSS Availability Parameters	
Availability Constant A	
Availability Factor B	
Availability Exponent C	
Min. Particle Size Affected by Availability (micron)	

Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m^3)	Volume Over (m^3)	Cumulative Runoff Volume (%)
1	28364	42909	39.8
4	55212	16059	77.5
9	64547	6725	90.6
16	68375	2897	95.9
25	70081	1190	98.3
36	70860	411	99.4
49	71165	106	99.9
64	71252	18	100.0
81	71270	0	100.0



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

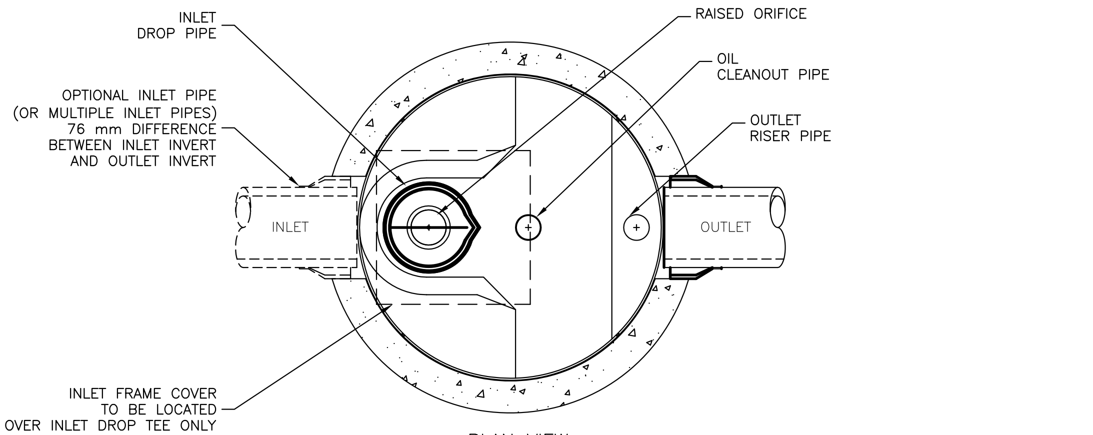
Stormceptor® FORTERRA™



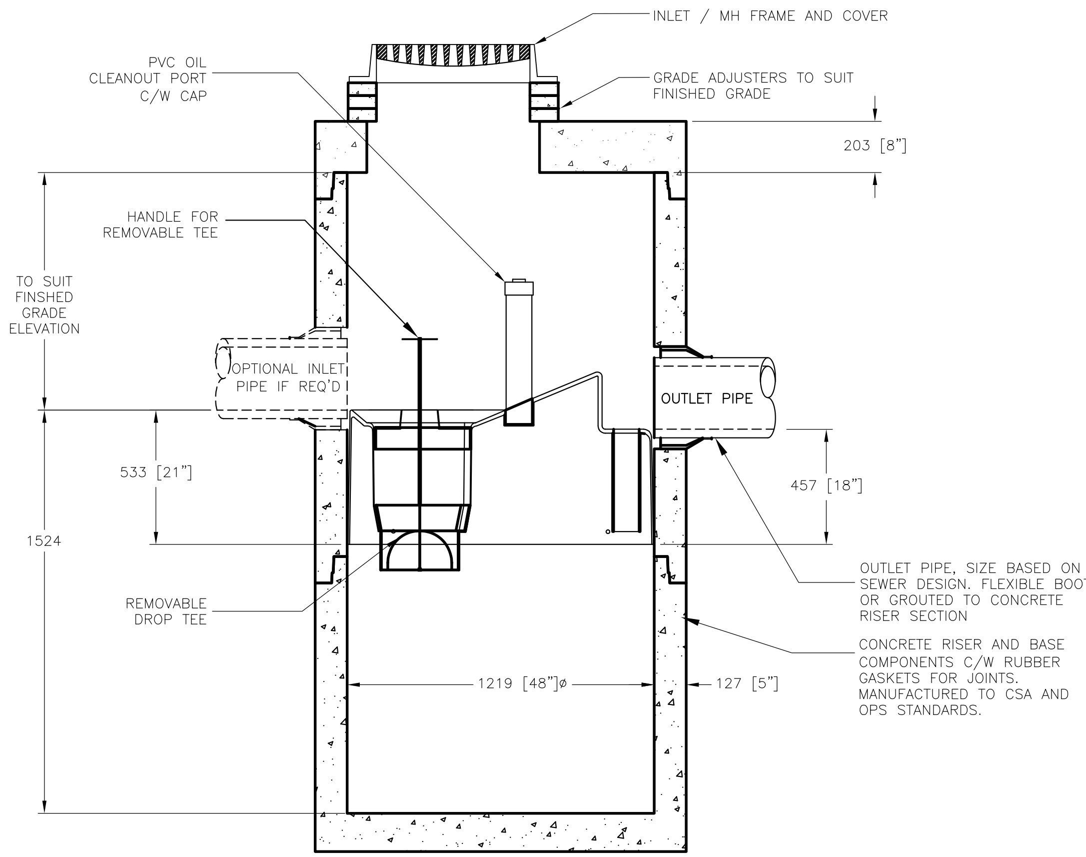
For Stormceptor Specifications and Drawings Please Visit:
http://www.imbriumsystems.com/technical-specifications

DRAWING NOT TO BE USED FOR CONSTRUCTION

THE STORMCEPTOR SYSTEM IS PROTECTED BY ONE OR MORE OF THE FOLLOWING PATENTS:
United States Patent No. 5,753,115 • 5,849,181 • 6,068,765 • 6,371,690 • 7,582,216 • 7,666,303 | Australia Patent No. 729,096 • 779,401 • 2008,279,378 • 2008,288,900 |
Canadian Patent No. 2,206,338 • 2,327,768 • 2,694,159 • 2,697,287 | Indonesian Patent No. 007058 | Japan Patent No. 9-11476 • 3,581,233 • 5,555,160 |
Korea Patent No. 10-1451593 • 0519212 | Malaysia Patent No. 118987 | New Zealand Patent No. 314,646 • 583,583 • 583,008 | South African Patent No. 2010,00683 • 2010,01796 |



PLAN VIEW



SECTION VIEW

Stormceptor®

imbrium®
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STC 300i
STANDARD MODEL

####

REV #	DATE	REVISION DESCRIPTION	BY

SHEET NUMBER 1 OF 1

DATE:######## SCALE: 30 PROJECT No.: ##### DRAWN: ### CHECKED: ###

\\AD.CONTECH-CPI.COM\ROOT\CORPORATE\MARKETING\IMBRIUM\CAD & PDF\STORMCEPTOR\CANADIAN\STC 300I.DWG 8/8/2016 9:17 AM

GARDEN ROOF® HYDROLOGY

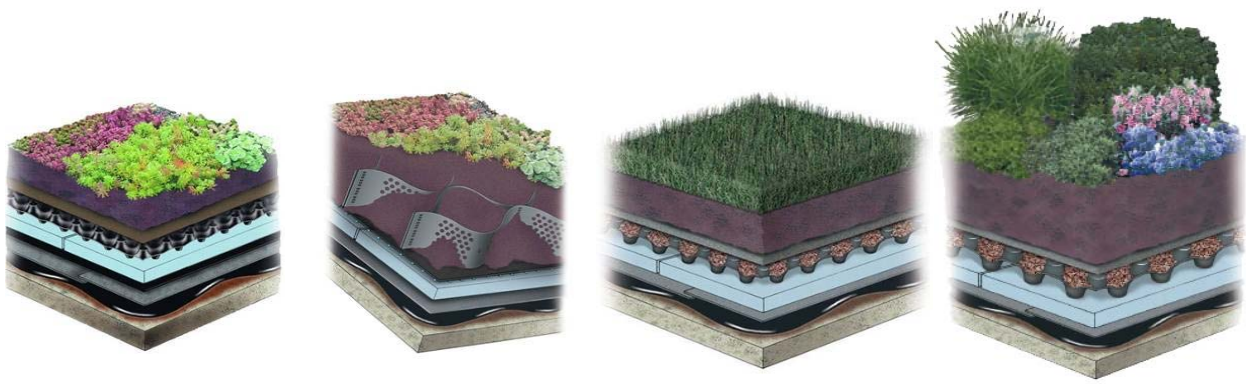
Project: **56 STEACHIE DRIVE, 5Y 24H**
OTTAWA, ONTARIO CANADA

Prepared for: **Scott Hayward, PnR Arch.**

Date: **April 4, 2019**

Garden Roof Assembly - Summary:

Total Roof Area:	**18,008**	SF
Garden Roof Area:	**14,574**	SF
Media Depth:	**12.0**	Inches
Gardendrain	**GR30 FILLED**	
Moisture Mat:	**NOT USED**	
Media:	MONTREAL EXT (SAV)	



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HYDROTECH HYDROLOGY TOOLS

STEP 1 of 2: **ENTER THE PROJECT INFORMATION:**

required

PROJECT NAME: 56 Steachie Drive, 5y 24H

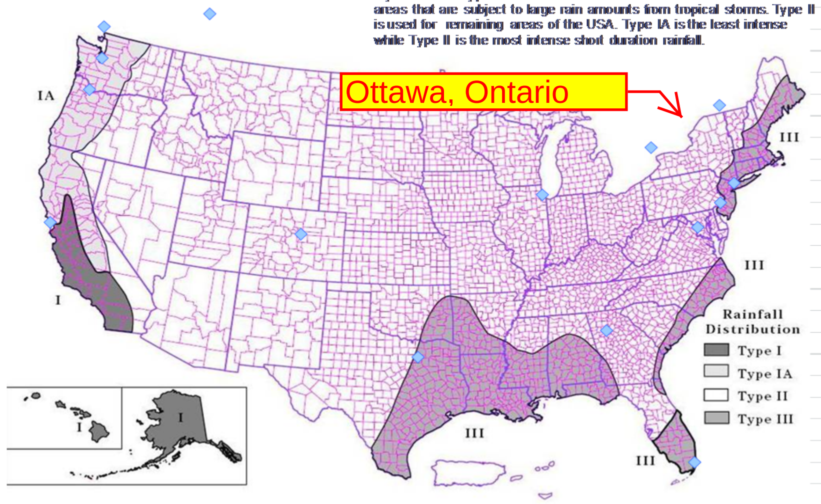
PREPARED FOR: Scott Hayward, PnR Arch.

LOCATION: Other
OTHER CITY NAME: Ottawa, Ontario Canada
RAINFALL TYPE FROM MAP: NRCS Type II
GO TO STEP 1A (BELOW MAP)

GARDEN ROOF® AREA:	14,574	SF	81%
'BARE' ROOF AREA:	3,434	SF	19%
TOTAL ROOF AREA:	18,008	SF (0.413 ACRES)	

NRCS TR55 RAINFALL DISTRIBUTION MAP

Rainfall Types I & IA are for Pacific maritime climate with wet winters & dry summers. Type III is used for the Gulf of Mexico & Atlantic coastal areas that are subject to large rain amounts from tropical storms. Type II is used for remaining areas of the USA. Type IA is the least intense while Type II is the most intense short duration rainfall.



STEP 2 of 2: **ENTER GARDEN ROOF ASSEMBLY INFORMATION:**

required

LITETOP® MEDIA	MONTREAL EXT (SAV)	
MEDIA DEPTH	12.0	INCHES
GARDENDRAIN™	GR30 FILLED	
MOISTURE MAT	NOT USED	
MOISTURE CAPACITY OF VEG	0.4	INCHES FOR SEDUMS, 10mm (0.4 inch) PER PENN. STATE UNIV.

The moisture storage capacity of this assembly is 3.05 inches; the total storage is 3,709 cubic feet (27,749 gallons).

Analysis A: **24-HR STORMS**

Used to compute GR Curve Number, runoff volumes, flow rates, & to size stormwater BMPs req'd by code.

DESIGN STORM: 5-YR

ROOF SLOPE (as percent):	2.1%	
FLOW PATH LENGTH:	25	FT
ANTECEDENT MOISTURE:	0.0	INCH
Historic antecedent moisture:	0.5	

REFER TO WORKSHEET SERIES 'A'

24-HR STORM ANALYSIS RESULTS PREVIEW

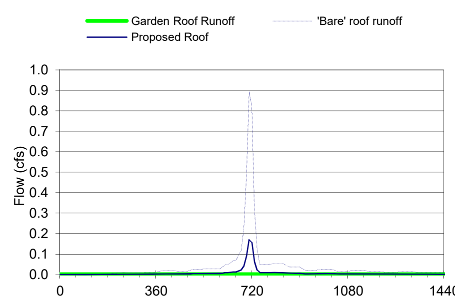
Ottawa, Ontario Canada rainfall type: NRCS Type II

	24-hr storms, inch		ENTER PRECIP:
	2-YR	1.91	1.91
	5-YR	2.52	2.52
	10-YR	2.93	2.93
	25-YR	3.50	3.50
other	100-YR	4.20	

56 Steachie Drive, 5Y 24H Roof

Curve Number = 69.2

5-YR NRCS Type II - 2.52 INCH STORM HYDROGRAPH



Analysis B: **SHORT DURATION STORMS (5 minutes - 120 minutes)**

Used to compute the 'C-factor' (runoff coefficient), peak flow rate, and to size pipes & drains.

RECURRENCE: 10 YEAR

DURATION: 5 MINUTES

For info only, not used in calc.

REFER TO WORKSHEET SERIES 'B'

C-FACTOR METHOD: Chicago Stormwater Manual

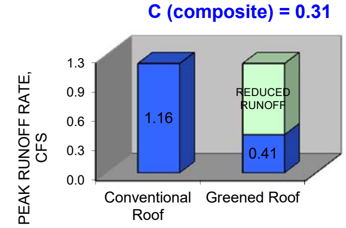
Recommended: Chicago Stormwater Manual

STORM DATA AVAILABLE FOR MONTREAL: Enter user value

User-provided rainfall intensity, inches/hr: 3.13 USED IN CALC

PEAK FLOW RESULTS PREVIEW

C (composite) = 0.31



Analysis C: **ANNUAL & LONG-TERM CONTINUOUS SIMULATION**

Used to compute the average annual/monthly runoff & retention[1]/ET for the Garden Roof Assembly.

EVAPOTRANSPIRATION CROP FACTOR: P.S.U. - sedum/succulents

REFER TO WORKSHEET SERIES 'C'

v1.22a

[1]Retention = evapotranspiration (ET)

LONG-TERM PERFORMANCE PREVIEW

56 STEACHIE DRIVE, 5Y 24H: Ottawa, Ontario Canada

AVG ANNUAL PRECIP	38.2	inches
ANNUAL RUNOFF	34%	
ANNUAL RETENTION[1]	66%	

60% less runoff than a 'bare' roof.

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Version 3.9.4 - rev.20160304
56 Steachie - 12-GR30-Filled - 20190404.xlsm

GARDEN ROOF® ASSEMBLY - MOISTURE STORAGE CAPACITY

HYDROTECH

56 STEACHIE DRIVE, 5Y 24H GARDEN ROOF® MEDIA PROPERTIES

A	LITETOP® MEDIA DEPTH	12	INCHES	MONTREAL EXT (SAV)
B	MAX WATER CAPACITY MEDIA	39%		FROM TEST DATA FOR MONTREAL EXT (SAV) MEDIA BLEND
C	MAX WATER CAPACITY	4.73	INCHES	B * A; DIFF. BETWEEN SATURATED & OVEN DRY CONDITIONS
D	WILT POINT	20%		FROM TEST DATA FOR MONTREAL EXT (SAV) MEDIA BLEND
E	AVAIL MEDIA MOISTURE STORAGE	20%		B - D; THIS IS THE AVAILABLE MOISTURE HOLDING CAPCITY

MOISTURE RETENTION CAPACITY OF TOTAL ASSEMBLY

					Assembly %	cubic feet	gallons
F	MEDIA STORAGE CAPACITY	*2.37*	INCHES	E * A	77.4%	2,873	21,491
G	MOISTURE CAPACITY OF VEG	*0.40*	INCHES	FOR SEDUMS, 10mm PER PENN. STATE UNIV. RESEARCH	13.1%	486	3,634
H	GARDENDRAIN™ STORAGE	*0.29*	INCHES	GR30 FILLED; FROM TEST DATA, 0.18 gal/sf	9.5%	351	2,623
I	MOISTURE MAT STORAGE	*0.00*	INCHES	NOT USED	0.0%	0	0
J	**SYSTEM TOTAL STORAGE**	**3.05**	**INCHES**	F + G + H + I	100.0%	3,709	27,749

This is the equivalent depth of water that can be stored over the Garden Roof® area.

The total moisture storage is 3,709 cubic feet (27,749 gallons).

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GARDEN ROOF® ASSEMBLY RUNOFF CURVE NUMBER

HYDROTECH®

THE 56 STEACHIE DRIVE, 5Y 24H ROOF CONSISTS OF:

GARDEN ROOF® -	**14,574**	SF
'BARE' ROOF -	**3,434**	SF
TOTAL	18,008	SF

A THE GARDEN ROOF CAN HOLD .... **3.05** INCHES OF MOISTURE (SYSTEM TOTAL STORAGE - ANTECEDENT RAINFALL)

THE TOTAL MOISTURE STORAGE IS 3,709 CUBIC FEET (27,749 GALLONS).

B THE DESIGN 24-HR STORM IS .... **2.52** INCHES OF RAINFALL 5-YR

WHICH IS 3,782 CF (28,291 gallons)

THE GARDEN ROOF RUNOFF IS .... **0.00** INCHES (B - A)

C WHICH IS - CF (gallons)

'BARE' ROOF RUNOFF IS .... **2.29** INCHES BASED ON TR-55 EQUATION 2-2

D WHICH IS 656 CF (4,904 gallons)

THE TOTAL RUNOFF IS .... 656 CF (4,904 gallons) (C + D)

WHICH IS 0.44 INCHES

WHAT RUNOFF CURVE NUMBER YIELDS 0.44 INCHES OF RUNOFF FROM A 2.52 INCH STORM?

RUNOFF CURVE NUMBER = 69.2 **(COMPOSITE GARDEN ROOF® AND 'BARE' AREAS)**

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LEED[1] CREDIT STORM ANALYSES

HYDROTECH

[1] LEED for New Construction Version 2.2

LEED SS CREDIT 6.1: Stormwater Design: Quantity Control

STEP 1: **Predevelopment Runoff**

LEED SS Credit 6.1 requires projects to match or reduce the site runoff.

LEED STORM INFO	One-yr, 24-hr storm	2.68	inch
	2-yr, 24-hr storm	3.23	inch

Predev. site impervious area	17,108	sf (95%)	Impervious CN	98	
Predev. site pervious area	900	sf (5%)	Pervious CN	74	FROM PROJECT ENGINEER
Predev. site time-of-concentration	6	min	Composite CN	**96.8**	

Predeveloped Site Runoff [2]:		Runoff Volume	Peak Rate
	One-yr storm	3,482 cf (26,045 gal)	1.51 cfs
	2-yr storm	4,292 cf (32,108 gal)	1.87 cfs

[2] Computed using TR55 graphical method

STEP 2: **Determine the LEED SS 6.1 requirement**

Is the existing imperviousness less than or equal to 50%? **NO**

LEED requires a 25% decrease in storm runoff rate and volume for the 1- and 2-yr storms:

LEED TARGETS:		Runoff Volume	Peak Rate
	One-yr storm	2,611 cf (19,534 gal)	1.14 cfs
	2-yr storm	3,219 cf (24,081 gal)	1.40 cfs

STEP 3: **Determine the 56 Steachie Drive, 5Y 24H Garden Roof® Runoff**

Total roof area: 18,008 sf   Garden Roof® portion: 81%   Composite CN: 67.9 for one-yr storm

67.2 for 2-yr storm

Developed Site Runoff [2]:		Runoff Volume	Peak Rate	Reduction	Does roof achieve LEED 6.1?
	One-yr storm	705 cf (5,276 gal)	0.27 cfs	82%	LEED COMPLIANT
	2-yr storm	1,065 cf (7,971 gal)	0.43 cfs	77%	LEED COMPLIANT

[2] Computed using TR55 graphical method

LEED SS 6.1 CONCLUSION

56 STEACHIE DRIVE, 5Y 24H ROOF MEETS LEED 2.2 CREDIT SS 6.1 QUANTITY CONTROL CRITERIA

LEED SS CREDIT 6.2: Stormwater Design: Quality Control

LEED SS Credit 6.2 requires projects to treat 90% of the annual rainfall using acceptable BMPs.

LEED states the size of the storm that must be treated depends on the average annual rainfall.

AVERAGE ANNUAL RAINFALL = 42.6 inches (Humid Watershed)

For this credit, treating 90% of the average annual rainfall is met by treating a storm siz 1.00 inch of rainfall

The 56 Steachie Drive, 5Y 24H roof can hold: 3.05 inch of rainfall (from GR moisture storage calc)

LEED SS 6.2 CONCLUSION

56 STEACHIE DRIVE, 5Y 24H ROOF MEETS LEED SS CREDIT 6.2 STORMWATER QUALITY CONTROL CRITERIA

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TR-55 Worksheet 4: Graphical Peak Discharge Method

HYDROTECH

Project 56 Steachie Drive, 5y 24H

Location Ottawa, Ontario Canada

Condition: **PREDEVELOPED 1-yr** (for Garden Roof® LEED calculation)

1. Data

Drainage area	18,008	sf	A_m =	0.000646	mi^2
Runoff Curve Number	96.8				
Time of Concentration	6	min	T_c =	0.10 hr	
Rainfall distribution	II	(I, IA, II, III)			

	STORM INFO	
2. Frequency, yr	1	
3. Rainfall, P (24 hr)	2.68	
Potential maximum ret., S, in	0.33	From equation 2-4
4. Initial abstraction, I_a, in	0.066	From equation 2-2
5. Compute I_a/P	0.025	
6. Unit peak discharge, q_u, csm/in	1010	Use T_c and I_a/P with Exhibit 4-II
7. Runoff, Q, in	2.32	From equation 2-3
8. Pond & Swamp adjustment factor	1	Per table 4-2; F_p = 1 for 0% percent pond & swamp area
9. **Peak discharge, Q_p, cfs**	**1.51**	Where $Q_p = q_u A_m Q F_p$

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TR-55 Worksheet 4: Graphical Peak Discharge Method

HYDROTECH

Project 56 Steachie Drive, 5y 24H

Location Ottawa, Ontario Canada

Condition: **PREDEVELOPED 2-yr** (for Garden Roof® LEED calculation)

1. Data

Drainage area	18,008	sf	A_m =	0.000646 mi^2
Runoff Curve Number	96.8			
Time of Concentration	6	min	T_c =	0.10 hr
Rainfall distribution	II	(I, IA, II, III)		

	STORM INFO	
2. Frequency, yr	2	
3. Rainfall, P (24 hr)	3.23	
Potential maximum ret., S, in	0.33	From equation 2-4
4. Initial abstraction, I_a, in	0.066	From equation 2-2
5. Compute I_a/P	0.020	
6. Unit peak discharge, q_u, csm/in	1010	Use T_c and I_a/P with Exhibit 4-II
7. Runoff, Q, in	2.86	From equation 2-3
8. Pond & Swamp adjustment factor	1	Per table 4-2; F_p = 1 for 0% percent pond & swamp area
9. **Peak discharge, Q_p, cfs**	**1.87**	Where $Q_p = q_u A_m Q F_p$

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GARDEN ROOF® ASSEMBLY: CURVE NUMBERS FOR LEED

HYDROTECH

THE PROPOSED 56 STEACHIE DRIVE, 5Y 24H ROOF CONSISTS OF:

GARDEN ROOF® -	**14,574**	SF
'BARE' ROOF -	**3,434**	SF
TOTAL	18,008	SF

A THE GARDEN ROOF® CAN HOLD .. **3.05** INCHES OF MOISTURE (SEE 'GR STORAGE' CALC.)

ONE-YEAR STORM CURVE NUMBER CALCULATION

B THE DESIGN 24-HR STORM IS .... **2.68** INCHES OF RAINFALL

THE GARDEN ROOF® RUNOFF IS . **0.00** INCHES (B - A)
C WHICH IS - CF (gallons)

'BARE' ROOF RUNOFF IS .... **2.45** INCHES PER TR-55 EQUATION 2-2
D WHICH IS 701 CF (5,244 gallons)

THE TOTAL RUNOFF IS .... 701 CF (5,244 gallons) (C + D)
WHICH IS 0.47 INCHES

WHAT RUNOFF CURVE NUMBER YIELDS 0.47 INCHES OF RUNOFF FROM A 2.68 INCH STORM?

1-YR STORM CURVE NUMBER = 67.9 **(COMPOSITE GARDEN ROOF® AND 'BARE' AREAS)**

TWO-YEAR STORM CURVE NUMBER CALCULATION

E THE DESIGN 24-HR STORM IS .... **3.23** INCHES OF RAINFALL

THE GARDEN ROOF® RUNOFF IS . **0.18** INCHES (E - A)
F WHICH IS 214 CF (1,598 gallons)

'BARE' ROOF RUNOFF IS .... **3.00** INCHES PER TR-55 EQUATION 2-2
G WHICH IS 858 CF (6,417 gallons)

THE TOTAL RUNOFF IS .... 1,071 CF (8,015 gallons) (F + G)
WHICH IS 0.71 INCHES

WHAT RUNOFF CURVE NUMBER YIELDS 0.71 INCHES OF RUNOFF FROM A 3.23 INCH STORM?

2-YR STORM CURVE NUMBER = 67.2 **(COMPOSITE GARDEN ROOF® AND 'BARE' AREAS)**

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TR-55 Worksheet 4: Graphical Peak Discharge Method

HYDROTECH

Project 56 Steachie Drive, 5y 24H

Location Ottawa, Ontario Canada

Condition: **DEVELOPED 1-yr** (for Garden Roof® LEED calculation)

1. Data

Drainage area	18,008	sf	A_m =	0.000646	mi^2
Runoff Curve Number	67.9				
Time of Concentration	6	min	T_c =	0.10 hr	
Rainfall distribution	II	(I, IA, II, III)			

	STORM INFO	
2. Frequency, yr	1	
3. Rainfall, P (24 hr)	2.68	
Potential maximum ret., S, in	4.72	From equation 2-4
4. Initial abstraction, I_a, in	0.944	From equation 2-2
5. Compute I_a/P	0.352	
6. Unit peak discharge, q_u, csm/in	881	Use T_c and I_a/P with Exhibit 4-II
7. Runoff, Q, in	0.47	From equation 2-3
8. Pond & Swamp adjustment factor	1	Per table 4-2; F_p = 1 for 0% percent pond & swamp area
9. **Peak discharge, Q_p, cfs**	**0.27**	Where $Q_p = q_u A_m Q F_p$

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TR-55 Worksheet 4: Graphical Peak Discharge Method

HYDROTECH

Project 56 Steachie Drive, 5y 24H

Location Ottawa, Ontario Canada

Condition: **DEVELOPED 2-yr** (for Garden Roof® LEED calculation)

1. Data

Drainage area	18,008	sf	A_m =	0.000646	mi^2
Runoff Curve Number	67.2				
Time of Concentration	6	min	T_c =	0.10 hr	
Rainfall distribution	II	(I, IA, II, III)			

	STORM INFO	
2. Frequency, yr	2	
3. Rainfall, P (24 hr)	3.23	
Potential maximum ret., S, in	4.87	From equation 2-4
4. Initial abstraction, I_a, in	0.974	From equation 2-2
5. Compute I_a/P	0.302	
6. Unit peak discharge, q_u, csm/in	934	Use T_c and I_a/P with Exhibit 4-II
7. Runoff, Q, in	0.71	From equation 2-3
8. Pond & Swamp adjustment factor	1	Per table 4-2; F_p = 1 for 0% percent pond & swamp area
9. **Peak discharge, Q_p, cfs**	**0.43**	Where $Q_p = q_u A_m Q F_p$

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GARDEN ROOF® 24-HR STORM ANALYSES

56 STEACHIE DRIVE, 5Y 24H BEFORE GREENING VS. AFTER GREENING

5-YR NRCS TYPE II - 2.52 INCH STORM HYDROGRAPH

	American Hydrotech Garden Roof® Model[1]						NRCS TR-55 model[4]		
Roof Greening Scenario:	Roof Runoff Rate (cfs)	Stormwater Model Used[2]	Time of Peak (min)	Runoff Volume (cf)	Runoff Volume (gal)	Runoff Volume (inches)	Effective Curve Number[3]	Peak Runoff Rate[4] (cfs)	Rainfall Retained (in)
'Bare' roof" (before greening) (18,008 sf)	0.89	SBUH	710	3,437	25,716	2.29	98.0	1.5	0.23
56 Steachie Drive, 5Y 24H Roof (18,008 sf)	0.17	WBM/PULS & SBUH	710	656	4,904	0.44	69.2	0.2	2.08
56 Steachie Drive, 5Y 24H Roof vs 'bare' roof:	**REDUCES RATE 81%**			**REDUCES RUNOFF VOLUME 81%**			See note 4	**REDUCES TR55 RATE 83%**	**ROOF RETAINS 9.1 TIMES MORE RAIN**

56 Steachie Drive, 5Y 24H Roof Subareas	Roof Runoff Rate (cfs)	Stormwater Model Used[2]	Time of Peak (min)	Runoff Volume (cf)	Runoff Volume (gal)	Runoff Volume (inches)	Effective Curve Number[3]	Rainfall Retained (in)
Garden Roof® portion (81%) (14,574 sf)	0.00	WBM/PULS	0	0	0	0.00	44.6	2.52
Unvegetated portion (19%) (3,434 sf)	0.17	SBUH	710	656	4,904	2.29	98.0	0.23

Notes:

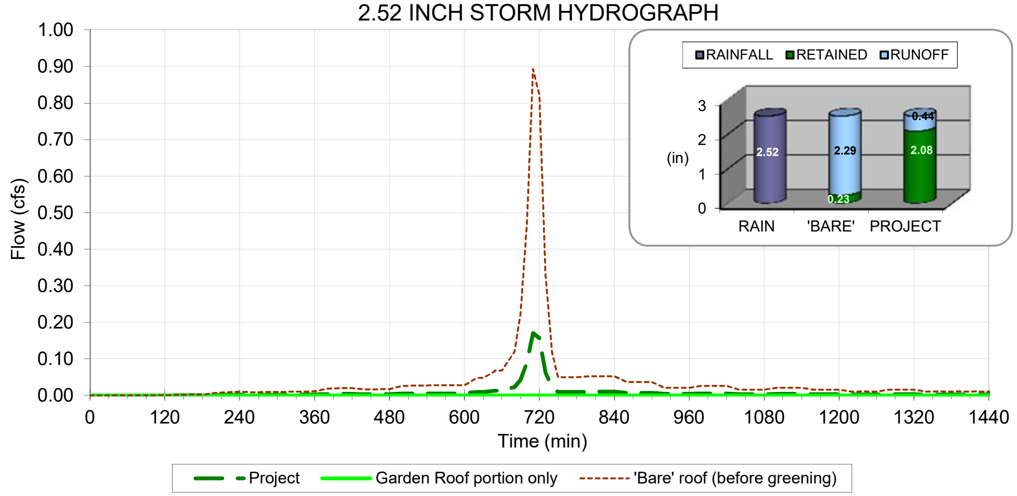
1. American Hydrotech's Garden Roof Model was developed to simulate 24-hr storm runoff for projects incorporating American Hydrotech's Garden Roof Assembly. Calculations are based on tested Garden Roof components. The roof hydrograph, rate, & volume are synthesized from separate Garden Roof and 'bare' roof analyses. Non-roof project areas are not included.

2. American Hydrotech's Garden Roof Model uses the Santa Barbara Urban Hydrograph (SBUH) method for 'bare' roof runoff simulation. The Garden Roof surfaces are modeled using a water balance model (WBM) that accounts for the tested site-specific LiteTop media blend & depth, the GardenDrain & moisture mat, site rainfall & antecedent rainfall, and roof dimensions. Excess moisture (that becomes storm runoff) is routed using the PULS method.

3. Effective curve numbers will yield the GR assembly runoff volume (based on tested moisture retention properties) from the selected design storm, per TR-55 equation 2-3.

4. TR-55 is a widely used set of procedures to calculate storm runoff developed by the U.S. Natural Resources Conservation Service (NRCS). Peak Runoff was computed using the TR-55 Graphical Peak Discharge Method. These computations may be used as an alternative to the Garden Roof Model.

2.52 INCH STORM HYDROGRAPH



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TR-55 Worksheet 4: Graphical Peak Discharge Method

Project 56 Steachie Drive, 5y 24H

Location Ottawa, Ontario Canada

Condition: **'Bare' roof (pre- greening)**

1. Data

Drainage area	18,008	sf	A_m =	0.000646	mi^2
Runoff Curve Number	98				
Time of Concentration	6	min	T_c =	0.10 hr	
Rainfall distribution	II	(I, IA, II, III)			

	STORM INFO	
2. Frequency, yr	5-YR	
3. Rainfall, P (24 hr)	2.52	
Potential maximum ret., S, in	0.20	From equation 2-4
4. Initial abstraction, I_a, in	0.041	From equation 2-2
5. Compute I_a/P	0.016	
6. Unit peak discharge, q_u, csm/in	1010	Use T_c and I_a/P with Exhibit 4-II
7. Runoff, Q, in	2.29	From equation 2-3
8. Pond & Swamp adjustment factor	1	Per table 4-2; F_p = 1 for 0% percent pond & swamp area
9. Peak discharge, Q_p, cfs	**1.49**	Where $Q_p = q_u A_m Q F_p$

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TR-55 Worksheet 4: Graphical Peak Discharge Method

HYDROTECH

Project 56 Steachie Drive, 5y 24H

Location Ottawa, Ontario Canada

Condition: **56 STEACHIE DRIVE, 5Y 24H ROOF**

1. Data

Drainage area	18,008	sf	A_m =	0.000646	mi^2
Runoff Curve Number	69.2				
Time of Concentration	6	min	T_c =	0.10 hr	
Rainfall distribution	II	(I, IA, II, III)			

STORM INFO

2. Frequency, yr	5-YR	
3. Rainfall, P (24 hr)	2.52	
Potential maximum ret., S, in	4.45	From equation 2-4
4. Initial abstraction, I_a, in	0.890	From equation 2-2
5. Compute I_a/P	0.353	
6. Unit peak discharge, q_u, csm/in	879	Use T_c and I_a/P with Exhibit 4-II
7. Runoff, Q, in	0.44	From equation 2-3
8. Pond & Swamp adjustment factor	1	Per table 4-2; F_p = 1 for 0% percent pond & swamp area
9. **Peak discharge, Q_p, cfs**	**0.25**	Where $Q_p = q_u A_m Q F_p$

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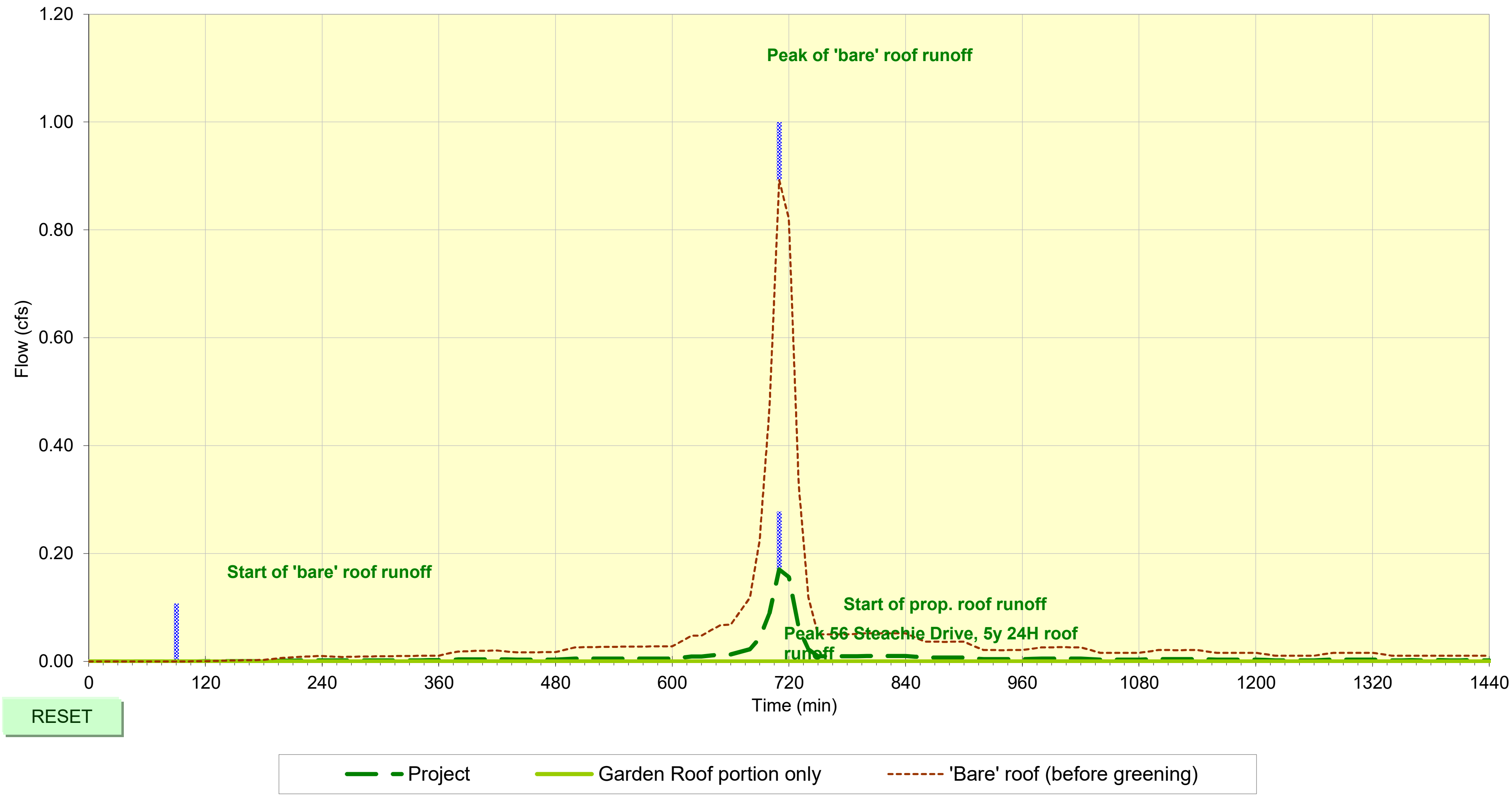
56 STEACHIE DRIVE, 5Y 24H BEFORE GREENING VS. AFTER GREENING

HYDROTECH

5-YR NRCS TYPE II - 2.52 INCH STORM HYDROGRAPH



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GARDEN ROOF® PEAK FLOW CALCULATOR

56 STEACHIE DRIVE, 5Y 24H INFORMATION

GARDEN ROOF® AREA:	**14,574**	**SF**
TOTAL ROOF AREA:	**18,008**	**SF**

DESIGN PEAK-RATE STORM EVENT

RECURRENCE:	**10**	**YEAR**
DURATION:	**5**	**MINUTES**

PEAK FLOW CALCULATION (RATIONAL METHOD):

56 STEACHIE DRIVE, 5Y 24H ROOF

Q = peak runoff rate (cfs) = C * I * A

Garden Roof® Assembly

C = runoff coefficient = 0.20 C-factor per Chicago stormwater manual

Un-greened portion of roof

C = runoff coefficient = **0.80**

TOTAL ROOF $C_{composite}$ = **0.31**

I = rain intensity =	3.13	in/hr
A = area =	0.41	acre

Q = 0.41 cfs (183 gpm)

COMPARISON CONVENTIONAL 'BARE' ROOF

Q = C * I * A

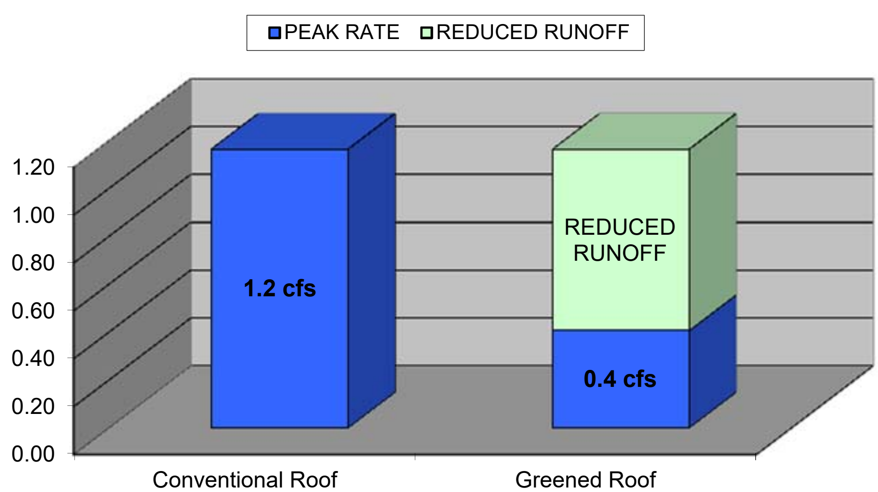
C = runoff coefficient = **0.90**

I =	3.13	in/hr
A =	0.41	acre

Q = 1.16 cfs (523 gpm)

Notes:
cfs = cubic feet per second
gpm = gallons per minute
1 acre = 43,560 sf
1 cfs = 448.8 gpm
Runoff coef. C is also called the 'C-factor'

ROOF RUNOFF RATE FOR 10-YR 5-MINUTE STORM



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THIS WORKSHEET DOES NOT APPLY - CHANGE 'HOME' ANALYSIS B SETTINGS TO ACTIVATE THIS WORKSHEET

HYDROTECH

Surface infiltration rate of Garden Roof® LiteTop® media: 19.3 inches/hr *FROM LITETOP® MEDIA TEST DATA*

The moisture storage capacity of this system is 3.05 inches; the total storage is 3,709 cubic feet (27,749 gallons).

INTENSITY-DURATION-FREQUENCY DATA*					SURFACE RUNOFF[2]		INFILTRATION & SEEPAGE[3]						TOTAL DISCHARGE	
Return	**Duration** min	**Avg Intensity** inch/hr	**Storm volume** inch	**Antecedent Precip[1]** inch	**Surface Runoff rate** inch/hr	**surface runoff volume** inch	**Garden Roof absorb. Rate** inch/hr	**Time to Saturation** min	**retained rainfall** inch	**excess rainfall (seepage)** inch	**underdrain collection time** minutes	**Duration that runoff occurs** minutes	**Total runoff rate[4]** inch/hr	**equiv C runoff coefficient[5]**
2-yr				1.12			Available storage = 1.93 inches							
	5	3.94	0.33		0.00	0.00	3.94	29	0.33	0.00	6	6		
	10	2.81	0.47		0.00	0.00	2.81	41	0.47	0.00	6	6		
	15	2.27	0.57		0.00	0.00	2.27	51	0.57	0.00	6	6		
	30	1.46	0.73		0.00	0.00	1.46	80	0.73	0.00	6	6		
	60	0.88	0.88		0.00	0.00	0.88	132	0.88	0.00	6	6		
	120	0.52	1.05		0.00	0.00	0.52	222	1.05	0.00	6	6		
5-yr				0.45			Available storage = 2.60 inches					0		
	5	5.11	0.43		0.00	0.00	5.11	31	0.43	0.00	6	6		
	10	3.65	0.61		0.00	0.00	3.65	43	0.61	0.00	6	6		
	15	3.01	0.75		0.00	0.00	3.01	52	0.75	0.00	6	6		
	30	1.99	1.00		0.00	0.00	1.99	78	1.00	0.00	6	6		
	60	1.20	1.20		0.00	0.00	1.20	130	1.20	0.00	6	6		
	120	0.68	1.36		0.00	0.00	0.68	229	1.36	0.00	6	6		
10-yr				0.70			Available storage = 2.35 inches					0		
0	5	5.89	0.49		0.00	0.00	5.89	24	0.49	0.00	6	6		
	10	4.21	0.70		0.00	0.00	4.21	34	0.70	0.00	6	6		
	15	3.50	0.87		0.00	0.00	3.50	40	0.87	0.00	6	6		
	30	2.35	1.17		0.00	0.00	2.35	60	1.17	0.00	6	6		
	60	1.41	1.41		0.00	0.00	1.41	100	1.41	0.00	6	6		
	120	0.79	1.57		0.00	0.00	0.79	179	1.57	0.00	6	6		
25-yr				0.66			Available storage = 2.40 inches					0		
	5	6.87	0.57		0.00	0.00	6.87	21	0.57	0.00	6	6		
	10	4.91	0.82		0.00	0.00	4.91	29	0.82	0.00	6	6		
	15	4.11	1.03		0.00	0.00	4.11	35	1.03	0.00	6	6		
	30	2.79	1.40		0.00	0.00	2.79	52	1.40	0.00	6	6		
	60	1.68	1.68		0.00	0.00	1.68	86	1.68	0.00	6	6		
	120	0.92	1.84		0.00	0.00	0.92	156	1.84	0.00	6	6		

* Intensity-duration-frequency data for MONTREAL

Notes:
1. See table (right) for antecedent moisture estimated for the proposed Garden Roof using continuous hydrologic modeling.
2. Surface runoff occurs when the rainfall rate exceeds the surface infiltration rate.
3. The Garden Roof absorbs rainfall at the lesser of the rainfall rate or the surface infiltration rate. The saturation time is based on the absorbtion rate and media storage available. Retained rainfall is the difference in the system moisture storage capacity and the antecedent precipitation that is held in the media. Excess rainfall is the difference in the total rainfall and the retained rainfall. Drainage collection time is assumed to be 5 minutes for typical size roof catchments. The duration that runoff occurs begins when seepage occurs and is the sum of the remaining storm duration and the underdrain flow time.
4. The total runoff rate, expressed as an equivalent intensity for the Garden Roof area, is computed as the total surface runoff volume and excess rainfall (seepage) amounts divided by the total duration that water is flowing.
5. The equivalent Rational Method runoff coefficient 'C', calcuated as the ratio of total runoff intensity to rainfall intensity.

ANTECEDENT RAINFALL Precipitation totals for MONTREAL

REF: Rainfall data from Calgary International Airport

	Precipitation, inches	
recurrence, yr	24-hr	Soil AMC from model
2	1.49	1.12
5	2.10	0.45
10	2.50	0.70
25	3.00	0.66

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GARDEN ROOF ANNUAL AVG. & LONG-TERM HYDROLOGY

HYDROTECH

56 STEACHIE DRIVE, 5Y 24H

SIMULATION PERIOD:	1970 - 1995	**PROJECT GARDEN ROOF® BENEFIT**			
LOCATION*:	Ottawa, Ontario Canada	AVG ANNUAL PRECIP	38.2	inches	gallons/year
ET[1] CROP FACTOR:	P.S.U. - sedum/succulents	ANNUAL RUNOFF	**34%**	**19,455 cf**	145,522
GARDEN ROOF® AREA:	14,574 sf	ANNUAL RETENTION (ET[1])	**66%**	**37,803 cf**	282,769
TOTAL ROOF AREA:	18,008 sf	**60%**	**less runoff than a 'bare' roof.**		

* Historic climate data from MONTREAL, QC used for these calculations

1 ET = evapotranspiration

RESULTS BY YEAR

		GARDEN ROOF® (100% coverage)			'BARE' ROOF (at 100%)		PROJECT ROOF (81% GR)		
YEAR	PRECIP (IN)	RUNOFF (IN)	ET[1] (IN)	RUNOFF/ RAINFALL	RUNOFF[2], IN	ET, IN	RUNOFF (IN)	ET (IN)	RUNOFF/ RAINFALL
1970	37.2	10.5	26.7	28%	31.8	5.4	14.6	22.6	39%
1971	34.7	11.9	22.8	34%	29.7	5.0	15.3	19.4	44%
1972	40.5	7.1	33.4	17%	34.6	5.9	12.3	28.2	30%
1973	43.0	12.6	30.4	29%	36.7	6.2	17.2	25.8	40%
1974	37.8	9.5	28.4	25%	32.3	5.5	13.8	24.0	37%
1975	42.8	8.9	33.8	21%	36.6	6.2	14.2	28.6	33%
1976	46.7	15.0	31.8	32%	40.0	6.8	19.7	27.0	42%
1977	35.3	5.6	29.7	16%	30.2	5.1	10.3	25.1	29%
1978	34.4	10.8	23.6	31%	29.4	5.0	14.3	20.1	42%
1979	36.7	5.8	30.9	16%	31.4	5.3	10.7	26.0	29%
1980	36.2	3.7	32.5	10%	31.0	5.3	8.9	27.3	25%
1981	37.8	4.8	32.9	13%	32.3	5.5	10.1	27.7	27%
1982	35.4	6.8	28.6	19%	30.3	5.1	11.3	24.1	32%
1983	35.0	7.8	27.2	22%	29.9	5.1	12.0	23.0	34%
1984	41.5	10.5	31.1	25%	35.5	6.0	15.2	26.3	37%
1985	35.1	8.2	26.9	23%	30.0	5.1	12.3	22.8	35%
1986	39.9	6.6	33.3	16%	34.1	5.8	11.8	28.1	30%
1987	35.9	5.8	30.1	16%	30.7	5.2	10.6	25.4	29%
1988	31.0	4.2	26.7	14%	26.5	4.5	8.5	22.5	27%
1989	33.1	4.6	28.5	14%	28.3	4.8	9.1	24.0	28%
1990	43.4	11.4	32.0	26%	37.1	6.3	16.3	27.1	38%
1991	42.9	12.3	30.6	29%	36.7	6.2	16.9	25.9	39%
1992	36.4	5.9	30.5	16%	31.1	5.3	10.7	25.7	29%
1993	41.2	10.7	30.5	26%	35.2	6.0	15.4	25.8	37%
1994	41.4	9.4	31.9	23%	35.4	6.0	14.4	27.0	35%
1995	36.7	6.4	30.3	18%	31.4	5.3	11.2	25.5	30%
AVERAGE	**38.2**	**8.3**	**29.8**	**22%**	**32.6**	**5.5**	**13.0**	**25.2**	**34%**
MAXIMUM	46.7	15.0	33.8	34%	40.0	6.8	19.7	28.6	44%
MINIMUM	31.0	3.7	22.8	10%	26.5	4.5	8.5	19.4	25%

AVERAGE MONTHLY RESULTS (ARRANGED AS 'WATER YEAR')

(average monthly values in inches)

		GARDEN ROOF® (100% coverage)			'BARE' ROOF (at 100%)		PROJECT ROOF (81% GR)		
YEAR	RAINFALL	RUNOFF	ET[1] (IN)	RUNOFF/ RAINFALL	RUNOFF[2], IN	ET	RUNOFF	ET	RUNOFF/ RAINFALL
October	3.2	0.2	3.0	7%	2.8	0.5	0.7	2.5	22%
November	3.7	1.0	2.7	27%	3.2	0.5	1.4	2.3	38%
December	3.2	1.8	1.4	56%	2.8	0.5	2.0	1.2	61%
January	2.7	1.6	1.1	60%	2.3	0.4	1.8	0.9	65%
February	2.3	1.4	1.0	59%	2.0	0.3	1.5	0.8	64%
March	2.8	1.3	1.5	45%	2.4	0.4	1.5	1.3	53%
April	3.1	0.8	2.3	26%	2.6	0.4	1.1	1.9	37%
May	2.9	0.1	2.8	4%	2.5	0.4	0.6	2.4	19%
June	3.2	0.0	3.2	0%	2.8	0.5	0.5	2.7	16%
July	3.5	0.0	3.5	0%	3.0	0.5	0.6	3.0	16%
August	3.8	0.0	3.8	0%	3.2	0.5	0.6	3.2	16%
September	3.6	0.1	3.5	4%	3.1	0.5	0.7	2.9	19%

Note:
1. ET = evapotranspiration, computed for Garden Roof® using the Penman method
2. 'Bare' roof runoff estimated using the "Simple Method"

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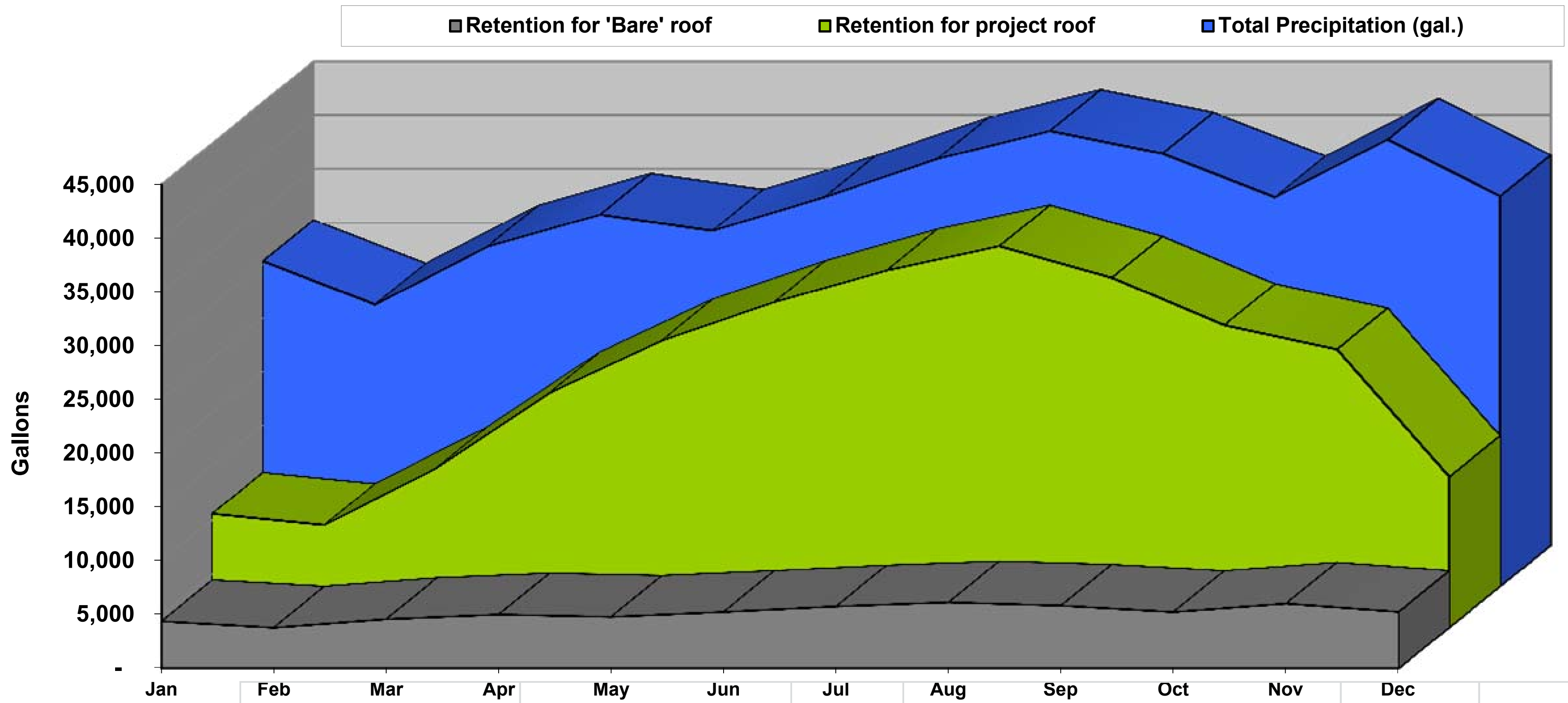
56 STEACHIE DRIVE, 5Y 24H
(18,008 sf tot.; GR coverage = 81%)



SIMULATION PERIOD:	1970 - 1995		**PROJECT GARDEN ROOF® BENEFIT**			
LOCATION[*]:	Ottawa, Ontario Canada		AVG ANNUAL PRECIP	38.2	inches	gallons/year
ET[1] CROP FACTOR:	P.S.U. - sedum/succulents		ANNUAL RUNOFF	**34%**	**19,455 cf**	145,522
GARDEN ROOF® AREA:	14,574	sf	ANNUAL RETENTION (ET[1])	**66%**	**37,803 cf**	282,769
TOTAL ROOF AREA:	18,008	sf	**60%**	**less runoff than a 'bare' roof.**		

* Historic climate data from MONTREAL, QC used for these calculations

[1] ET = evapotranspiration

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4/4/2019

From: Robert Lefebvre <rlefebvre@gwal.com>
Sent: March-25-19 4:44 PM
To: Scott Hayward; Yang, Winston
Cc: Johnston, Jim
Subject: RE: 56 Steacie Drive - First Round Comments
Attachments: Flow Control Roof Drainage.pdf

Hi Scott and Winston,

See comments below in **purple**.

Rob

Robert Lefebvre, P.Eng., LEED® AP, Partner
Goodkey, Weedmark & Associates Limited
Consulting Engineers
1688 Woodward Drive, Ottawa, Ontario, K2C 3R8
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Fax: 613-727-5115
Email: rlefebvre@gwal.com
Web: www.gwal.com

From: Scott Hayward <scott.hayward@pnrarch.com>
Sent: March 25, 2019 3:21 PM
To: Yang, Winston <Winston.Yang@wsp.com>; Robert Lefebvre <rlefebvre@gwal.com>
Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: RE: 56 Steacie Drive - First Round Comments

Hi Robert,
could you help Winston out with his questions below ?

Thanks,

Scott Hayward, B.Arch., OAA, MRAIC, LEED AP
Principal
PYE & RICHARDS ARCHITECTS INC.
200-824 Meath Street,
Ottawa, Ontario. K1Z 6E8
p. 613-724-7700 x.55
e. scott.hayward@pnrarch.com
w. www.pyeandrichardsarchitects.com

From: Yang, Winston <Winston.Yang@wsp.com>
Sent: Monday, March 18, 2019 1:06 PM
To: Scott Hayward <scott.hayward@pnrarch.com>; Robert Lefebvre <rlefebvre@gwal.com>
Cc: Johnston, Jim <James.Johnston@wsp.com>
Subject: 56 Steacie Drive - First Round Comments

Hi Scott and Robert,

After reviewing the first round comments, we have to get the confirmation from you both before addressing the following comments.

For **Servicing Plan**
#4. The proposed storm pipe along the east property line should not be located below the retaining wall to allow future maintenance access to the storm pipe and manholes.
I would recommend to eliminate the curb west to the wall, and relocate the wall to the west.

For **Servicing and Stormwater Management Report**
#37. Can a Watts roof drain be used in parking lot? Please provide manufacturer specifications or recommendations to support the roof drains that are to be used within the parking surface, and associated flow rates.
We will need Robert to confirm and provide the roof top parking drain type for RD6, RD7 and RD8 with controlled release rate at 1.26 l/s, 1.89 l/s and 1.26 l/s respectively. **I am not aware of a parking drain that has flow control in it. Here is a link to the parking drain we would be specifying for the parking areas,** http://media.wattswater.com/ES-WD-FD-490-f-4-CAN.pdf.

#38. Please provide a letter from the mechanical consultant which confirms that the release rates and storage requirements specified for the roof drains can be accommodated by the buildings mechanical design.
We will also need Robert to provide a letter to confirm the rest of the roof drains RD1 to RD 5 on top of the office tower with controlled release rate at 0.32 l/s for each can be accommodated by the buildings mechanical design. **This letter is typically provided during the building permit. Attached is the form that the City usually requires the mechanical and structural engineer to sign. We can do this now if that is the City's preference.**

Should you have any questions please do not hesitate to contact me or Jim.

Yours truly,

Ding Bang (Winston) Yang, P.Eng.
Project Engineer
Infrastructure

wsp

T+ 1 613-690-0538

2611 Queensview Drive, Suite 300
Ottawa, Ontario,
K2B 8K2, Canada

www.wsp.com

-LAEmHhHzdJzBlTWfa4Hgs7pbKl

FLOW CONTROL ROOF DRAINAGE DECLARATION

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

Permit Application No.

Project Name:

Building Location: Municipality:

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

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

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

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

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

PROFESSIONAL SEAL APPLIED BY:

Practitioner's Name:

Firm:

Phone #:

City: Province:

Mechanical Engineer's Seal

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

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

PROFESSIONAL SEAL APPLIED BY:

Practitioner's Name:

Firm:

Phone #:

City: Province:

Structural Engineer's Seal

EABO

Engineers

Architects

Building Officials

A Joint Committee of:

Professional Engineers Ontario

Ontario Association of Architects

Ontario Building Officials Association

c/o Professional Engineers Ontario
Suite 1000
25 Sheppard Avenue West
Toronto, Ontario M2N 6S9
Tel: (416)224-1100
Fax: (416)224-8168

GUIDE TO

THE FLOW CONTROL ROOF DRAINAGE DECLARATION

Why is this form necessary?

The Flow Control Roof Drainage Declaration form provides the Chief Building Official with assurance that the mechanical and structural engineers have coordinated their designs. Because the use of flow control roof drains causes ponding of water on a building's roof the structural engineer must design the roof structure to handle additional loads. There are three possible roof drainage scenarios.

1) System uses no flow control roof drains. There is no additional loading of roof structure.
2) System uses flow control roof drains that meet the criteria specified in M2. The roof structure must include the load accumulated by a 24h rainfall but rain and snow loads do not need to be considered to act simultaneously.
3) System uses a flow control system that does not meet the minimum drainage criteria specified in M2. As a result, rainwater retention on the roof will add loads in excess of an accumulated 24h rainfall. Structural engineers must design the roof to accommodate the actual excess rainfall load and a simultaneous snow load as set out in subsection 4.1.7 of the Ontario Building Code.

Completing the flow control roof drainage declaration

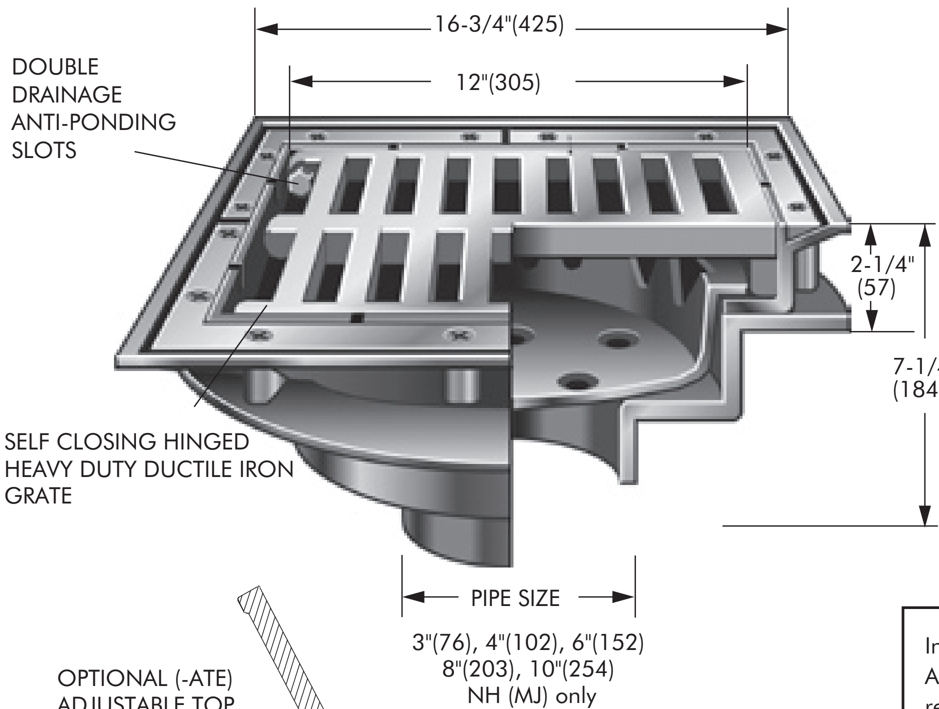
This document must be completed by the professional engineers responsible for the design of the roof structure (Structural Engineer) and the roof drainage system (Mechanical Engineer). In each section the appropriate professional engineer shall check one statement. Select the one that describes the basis for the design submitted for permit.

Both engineers shall affix their seals to the appropriate section. Sign and date the seal in accordance with Section 53 of Regulation 941, Professional Engineers Act.

WATTS®	FD-490-F-4 Tag: ____________	All Cast Iron Parking Area Structure Drain with Heavy Duty Grate and Bucket

SPECIFICATION: Watts Drainage Products FD-490-F Parking Structure Drain, oven cured epoxy coated cast iron body with top membrane clamping flange, anti-ponding device, aluminum sediment bucket and heavy duty ductile iron secured self-closing hinged grate, non-shearing stainless steel hinge pins.

FUNCTION: Recommended for installation in durable parking structures, etc., where a large capacity drain with top membrane clamping flange and the safety of a secured hinged grate is required.

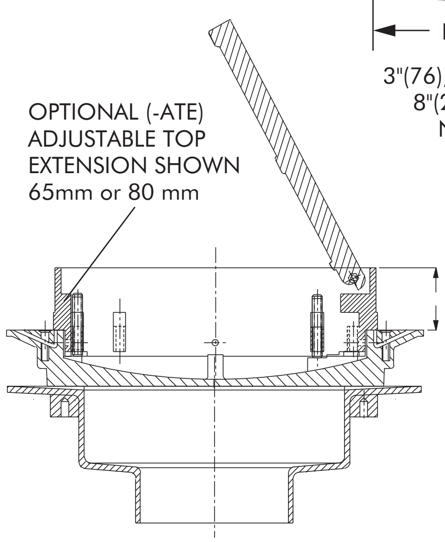


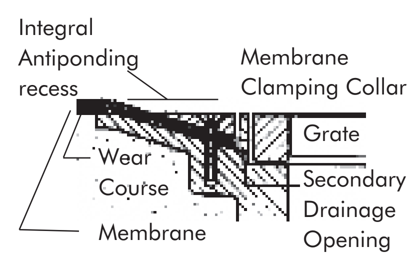
Order Code: FD-49 ☐ F-4- ☐

Ex. FD-493-F-4

Pipe Sizing (Select One)		
Suffix	**Description**	
3	3"(76) Pipe Size	☐
4	4"(102) Pipe Size	☐
6	6"(152) Pipe Size	☐
8	8"(203) Pipe Size	☐
10	10"(254) Pipe Size	☐

Options (Select One or More)		
Suffix	**Description**	
-6	Vandal Proof	☐
-10	Secured Top c/w Phillips screws	☐
-ATE-65	Adjustable Top Extension 65mm	☐
-ATE-80	Adjustable Top Extension 80mm	☐





Standard Top
THIN MEMBRANE SYSTEM

Load Rating & Free Area

Suffix	Load Rating	Free Area Sq. In.
F-4	*XHD	41

* The load classifications are in accordance with the American National Standards ASME A112.21.1M
ASME Ratings are as follows:
XHD - Safe Live Load 7500-10000lbs. (3375-4500kg)
The above categories are given as a guide only.
Please consult factory.

Job Name ____________ **Model No.** ____________

Job Location ____________ Contractor ____________

Engineer ____________ Representative ____________

WATTS®
Specification Drainage Products

CANADA

CANADA: 5435 North Service Road, Burlington, ON, L7L 5H7 TEL: 905-332-6718 TOLL-FREE: 1-888-208-8927 Website: www.wattscanada.ca

WATTS®	**Adjustable Accutrol Weir** **Tag:** ____________	**Adjustable Flow Control for Roof Drains**

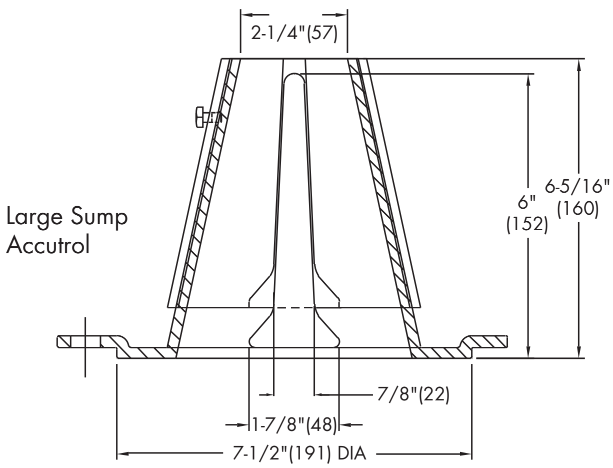
ADJUSTABLE ACCUTROL (for Large Sump Roof Drains only)

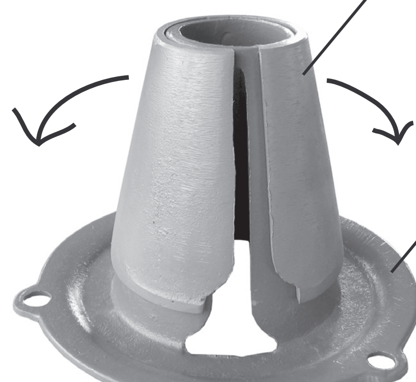
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the flow rate for depths over 2" of head, set the slot in the adjustable upper cone according to the flow rate required. Refer to Table 1 below.
Note: Flow rates are directly proportional to the amount of weir opening that is exposed.

EXAMPLE:

For example, if the adjustable upper cone is set to cover 1/2 of the weir opening, flow rates above 2"of head will be restricted to 2-1/2 gpm per inch of head.

Therefore, at 3"of head, the flow rate through the Accutrol Weir that has 1/2 the slot exposed will be:
[5 gpm (per inch of head) x 2 inches of head] + 2-1/2 gpm (for the third inch of head) = 12-1/2 gpm.





1/2 Weir Opening Exposed Shown Above

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13.75	17.5	21.25	25
1/2	5	10	12.5	15	17.5	20
1/4	5	10	11.25	12.5	13.75	15
Closed	5	5	5	5	5	5

Job Name ____________
Contractor ____________
Job Location ____________
Contractor's P.O. No. ____________
Engineer ____________
Representative ____________

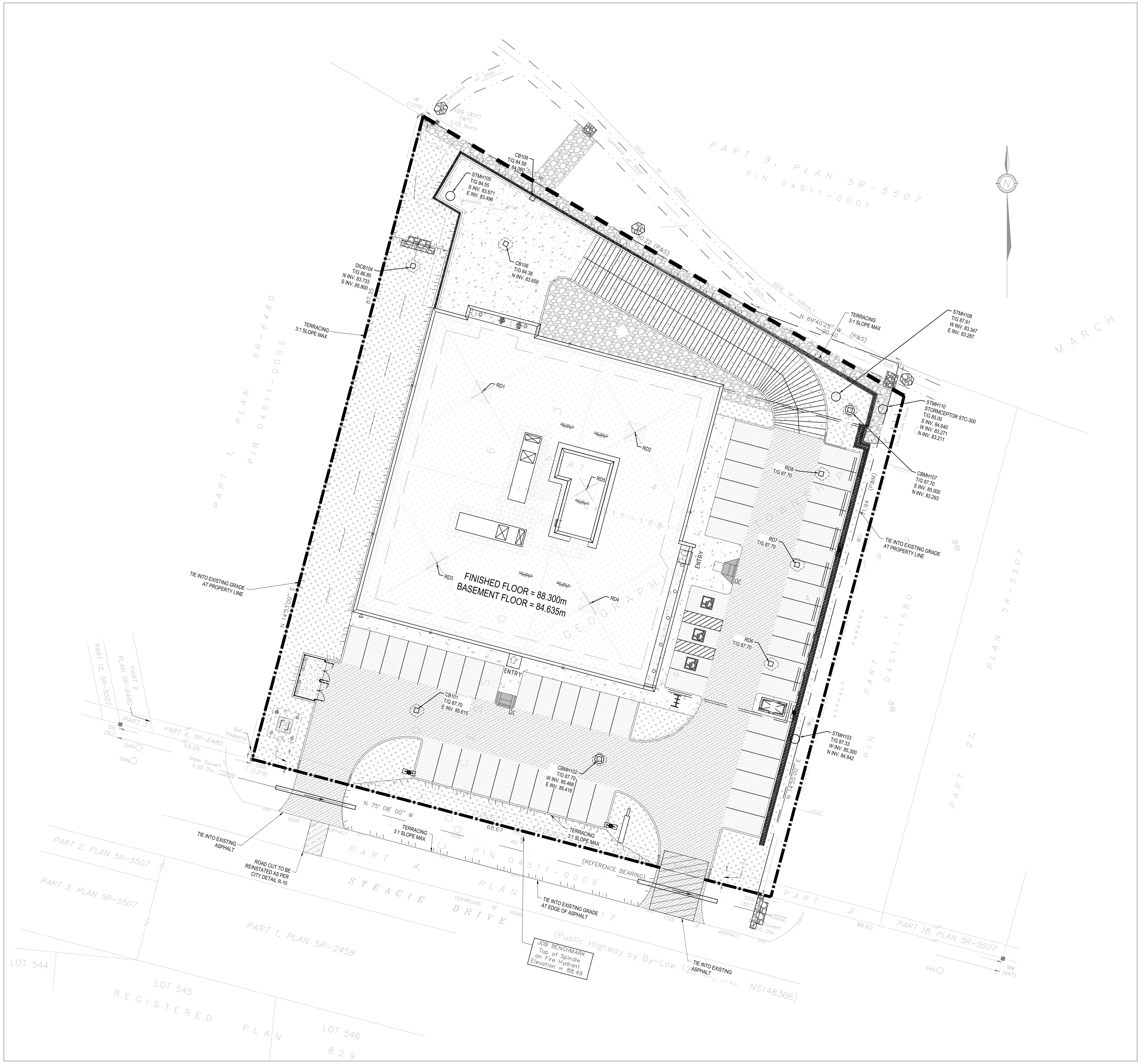
WATTS®
A Watts Water Technologies Company

USA: Tel: (800) 338-2581 • Fax: (828) 248-3929 • Watts.com
Canada: Tel: (905) 332-4090 • Fax: (905) 332-7068 • Watts.ca
Latin America: Tel: (52) 81-1001-8600 • Fax: (52) 81-8000-7091 • Watts.com

APPENDIX

D

- EROSION AND SEDIMENTATION CONTROL PLAN DRAWING NO. C-05



1 C-05 EROSION AND SEDIMENT CONTROL PLAN

SCALE= 1:250

0 5m 10m 20m 25m

SCALE: 1:250

LEGEND

LIGHT DUTY SILT FENCE AS PER OPSD-219.110

HEAVY DUTY SILT FENCE AS PER OPSD-219.113

ROCK CHECK DAM AS PER OPSD-219.211

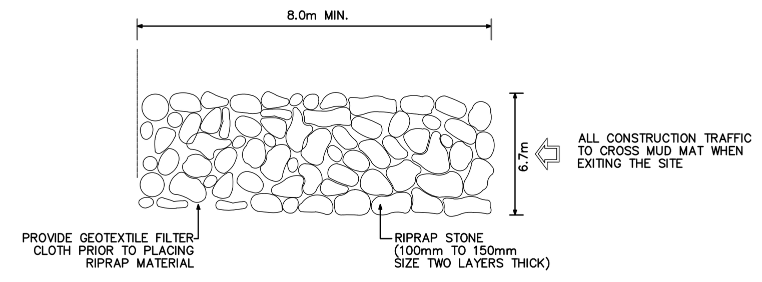
STRAW BALE CHECK DAM AS PER OPSD-219.180

FILTER CLOTH PLACED UNDER CB AND CBMH COVER

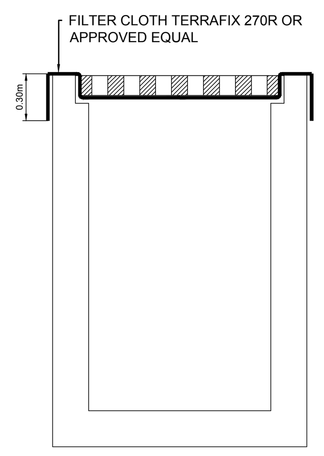
TEMPORARY MUD MAT 0.15m THICK 50mm CLEAR STONE ON NON WOVEN FILTER CLOTH

NOTES: EROSION AND SEDIMENT CONTROL

1. PRIOR TO START OF CONSTRUCTION:
   - 1.1. INSTALL SILT FENCE, ROCK CHECK DAM, MUD MAD AND STRAW BALE CHECK DAM IN LOCATION SHOWN.
   - 1.2. INSPECT MEASURES IMMEDIATELY AFTER INSTALLATION.
2. DURING CONSTRUCTION:
   - 2.1. MINIMIZE THE EXTENT OF DISTURBED AREAS AND THE DURATION OF EXPOSURE AND IMPACTS TO EXISTING GRADING.
   - 2.2. PERIMETER VEGETATION TO REMAIN IN PLACE UNTIL PERMANENT STORM WATER MANAGEMENT IS IN PLACE. OTHERWISE, IMMEDIATELY INSTALL SILT FENCE WHEN THE EXISTING SITE IS DISTURBED AT THE PERIMETER.
   - 2.3. PROTECT DISTURBED AREAS FROM OVERLAND FLOW BY PROVIDING TEMPORARY SWALES TO THE SATISFACTION OF THE FIELD ENGINEER.
   - 2.4. PROVIDE TEMPORARY COVER SUCH AS SEEDING OR MULCHING IF DISTURBED AREA WILL NOT BE REHABILITATED WITHIN 30 DAYS.
   - 2.5. INSTALL AND MAINTAIN FILTER CLOTH SEDIMENT BARRIERS AT CATCHBASINS AND MANHOLES AS THEY ARE PLACED
   - 2.6. INSPECT SILT FENCES, MANHOLE SUMPS AND CATCH BASIN SUMPS WEEKLY AND WITHIN 24 HOURS AFTER A STORM EVENT. CLEAN AND REPAIR WHEN NECESSARY.
   - 2.7. DRAWING TO BE REVIEWED AND REVISED AS REQUIRED DURING CONSTRUCTION.
   - 2.8. EROSION CONTROL FENCING TO BE ALSO INSTALLED AROUND THE BASE OF ALL STOCKPILES.
   - 2.9. DO NOT LOCATE TOPSOIL PILES AND EXCAVATION MATERIAL CLOSER THAN 2.5m FROM ANY PAVED SURFACE, OR ONE WHICH IS TO BE PAVED BEFORE THE PILE IS REMOVED. ALL TOPSOIL PILES ARE TO BE SEEDED IF THEY ARE TO REMAIN ON SITE LONG ENOUGH FOR SEEDS TO GROW (LONGER THAN 30 DAYS).
   - 2.10. CONTROL WIND-BLOWN DUST OFF SITE BY SEEDING TOPSOIL PILES AND OTHER AREAS TEMPORARILY (PROVIDE WATERING AS REQUIRED AND TO THE SATISFACTION OF THE ENGINEER).
   - 2.11. NO ALTERNATE METHODS OF EROSION PROTECTION SHALL BE PERMITTED UNLESS APPROVED BY THE FIELD ENGINEER.
   - 2.12. CITY ROADWAY TO BE CLEANED OF ALL SEDIMENT FROM VEHICULAR TRACKING AS REQUIRED.
   - 2.13. PROVIDE GRAVEL ENTRANCE (MUD MAT) WHEREVER EQUIPMENT LEAVES THE SITE FROM NON-PAVED DRIVEWAYS TO MINIMIZE MUD TRACKING ONTO PAVED SURFACES. IN THE EVENT ADDITIONAL EGRESS POINTS ARE REQUIRED THEY SHOULD BE CONSTRUCTED IN ACCORDANCE WITH THE MUD MAT DETAIL (SEE TYPICAL DETAIL).
   - 2.14. DURING WET CONDITIONS, TIRES OF ALL VEHICLES/EQUIPMENT LEAVING THE SITE ARE TO BE SCRAPED.
   - 2.15. ANY MUD/MATERIAL TRACKED ONTO THE ROAD SHALL BE REMOVED IMMEDIATELY BY HAND OR RUBBER TIRE LOADER.
   - 2.16. TAKE ALL NECESSARY STEPS TO PREVENT BUILDING MATERIAL, CONSTRUCTION DEBRIS OR WASTE BEING SPILLED OR TRACKED ONTO ABUTTING PROPERTIES OR PUBLIC STREETS DURING CONSTRUCTION AND PROCEED IMMEDIATELY TO CLEAN UP ANY AREAS SO AFFECTED.
   - 2.17. ALL EROSION CONTROL MEASURES TO REMAIN IN PLACE UNTIL ALL DISTURBED GROUND SURFACES HAVE BEEN STABILIZED EITHER BY PAVING OR RESTORATION OF VEGETATIVE GROUND COVER. REMOVE ALL MEASURES AT COMPLETION OF WORK.
   - 2.18. THE CONTRACTOR SHALL IMPLEMENT BEST MANAGEMENT PRACTICES, TO PROVIDE FOR PROTECTION OF THE AREA DRAINAGE SYSTEM AND THE RECEIVING WATERCOURSE, DURING CONSTRUCTION ACTIVITIES. THE CONTRACTOR ACKNOWLEDGES THAT FAILURE TO IMPLEMENT APPROPRIATE EROSION AND SEDIMENT CONTROL MEASURES MAY BE SUBJECT TO PENALTIES IMPOSED BY ANY APPLICABLE REGULATORY AGENCY.



MUD MAT DETAIL
(NTS)



FILTER CLOTH CATCHBASIN OR MANHOLE SEDIMENT CONTROL DEVICE
(NTS)

wsp
300-2611 QUEENSVIEW DRIVE
OTTAWA ONTARIO CANADA K2B 8K2
TEL.: 1-613-829-2800 | FAX: 1-613-829-8299 | WWW.WSPGROUP.COM

LOCATION MAP

SEAL

J. C. JOHNSTON 2019-04-03

D. B. YANG 100230568 2019-04-03

Not for construction unless SEALED and SIGNED.

NO.	ISSUE & REVISIONS	DATE
2	SUBMISSION NO. 2	APR 03, 2019
1	ISSUED FOR SITE PLAN APPLICATION	JAN 23, 2019

PROJECT NORTH

P & R
PYE & RICHARDS ARCHITECTS INC
200–824 MEATH STREET OTTAWA ONTARIO K1Z 6E8
TEL: 613–724–7700 FAX: 613–724–1289
EMAIL: staff@pnrarch.com
WEBSITE: www.pyeandrichardsarchitects.com

PROJECT

NEW 2-STOREY OFFICE BUILDING WITH BASEMENT PARKING GARAGE

56 STEACIE DRIVE OTTAWA, ONTARIO

DRAWING

EROSION AND SEDIMENTATION CONTROL PLAN

Do not scale. Refer any dimensional errors and/or possible trade interference/conflict to the architects for clarification prior to commencement of the work. The conditions of the contract apply.

PROJECT NO. 18M-01672-00	DRAWING NO.
SCALE: AS NOTED	C-05
DRAWN: WY	
CHECKED: JJ	
PLOT DATE –2019–04–03	REVISION NO. 1

D07-12-19-0010

#17875

APPENDIX

E

- SUBMISSION CHECK LIST

4.1 General Content

- [x] Executive Summary (for larger reports only).

Comments: Refer to Servicing Report Section 1.1

- [x] Date and revision number of the report.

Comments: *Refer to front page of the Report*

- [x] Location map and plan showing municipal address, boundary, and layout of proposed development.

Comments: *Refer to Figure 1.1 Site Location for Location Map and Plan*

- [x] Plan showing the site and location of all existing services.

Comments: *Refer to drawing C-02*

- [x] 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.

Comments: *Refer to Architectural Site Plan*

- [x] Summary of Pre-consultation Meetings with City and other approval agencies.

Comments: Refer to Appendix B for Pre-Consultation Meeting Notes

- [x] 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.

Comments: *N/A*

- [x] Statement of objectives and servicing criteria.

Comments: Refer to Servicing Report Section 1.7

- [x] Identification of existing and proposed infrastructure available in the immediate area.

Comments: *Refer to drawing C-02*

☒ 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).

Comments: *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.

Comments: *Refer to drawing C-03*

☒ Identification of potential impacts of proposed piped services on private services (such as wells and septic fields on adjacent lands) and mitigation required to address potential impacts.

Comments: *N/A*

☒ Proposed phasing of the development, if applicable.

Comments: *N/A*

☒ Reference to geotechnical studies and recommendations concerning servicing.

Comments: *N/A*

☒ All preliminary and formal site plan submissions should have the following information:

- ☒ Metric scale
- ☒ North arrow (including construction North)
- ☒ Key plan
- ☒ Name and contact information of applicant and property owner
- ☒ Property limits including bearings and dimensions
- ☒ Existing and proposed structures and parking areas
- ☒ Easements, road widening and rights-of-way
- ☒ Adjacent street names

Comments: *Refer to drawing C-02 and C-03*

4.2 Development Servicing Report: Water

☒ Confirm consistency with Master Servicing Study, if available

Comments: *Refer to Servicing Report Section 2.1*

☒ Availability of public infrastructure to service proposed development

Comments: Refer to Servicing Report Section 2.1

☒ Identification of system constraints

Comments: N/A

☒ Identify boundary conditions

Comments: *Refer to Servicing Report Section 2.2*

☒ Confirmation of adequate domestic supply and pressure

Comments: *Refer to Servicing Report Section 2.3*

☒ 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.

Comments: *Refer to Servicing Report Section 2.4*

☒ 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.

Comments: *Refer to Servicing Report Section 2.5*

☒ Definition of phasing constraints. Hydraulic modeling is required to confirm servicing for all defined phases of the project including the ultimate design

Comments: *Refer to Servicing Report Section 2.6*

☒ Address reliability requirements such as appropriate location of shut-off valves

Comments: *Refer to Servicing Report Section 2.7*

☒ Check on the necessity of a pressure zone boundary modification.

Comments: *Refer to Servicing Report Section 2.8*

☒ 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

Comments: *Refer to Servicing Report Section 2.9*

☒ 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.

Comments: *Refer to Servicing Report Section 2.10*

☒ 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.

Comments: *Refer to Servicing Report Section 2.11*

☒ Confirmation that water demands are calculated based on the City of Ottawa Design Guidelines.

Comments: *Refer to Servicing Report Section 2.12*

☒ Provision of a model schematic showing the boundary conditions locations, streets, parcels, and building locations for reference.

Comments: *Refer to Servicing Report Section 2.13*

4.3 Development Servicing Report: Wastewater

- [x] 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).

Comments: *Refer to Servicing Report Section 3.1*

- [x] Confirm consistency with Master Servicing Study and/or justifications for deviations.

Comments: *Refer to Servicing Report Section 3.2*

- [x] 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.

Comments: *Refer to Servicing Report Section 3.3*

- [x] Description of existing sanitary sewer available for discharge of wastewater from proposed development.

Comments: *Refer to Servicing Report Section 3.4*

- [x] 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)

Comments: *Refer to Servicing Report Section 3.5*

- [x] Identification and implementation of the emergency overflow from sanitary pumping stations in relation to the hydraulic grade line to protect against basement flooding.

Comments: Refer to Servicing Report Section 3.9 and 3.11

- [x] Special considerations such as contamination, corrosive environment etc.

Comments: *Refer to Servicing Report Section 3.8*

4.4 Development Servicing Report: Stormwater

- [x] Description of drainage outlets and downstream constraints including legality of outlets (i.e. municipal drain, right-of-way, watercourse, or private property)

Comments: *Refer to Servicing Report Section 4.1*

- [x] Analysis of available capacity in existing public infrastructure.

Comments: *Refer to Servicing Report Section 4.2*

- [x] A drawing showing the subject lands, its surroundings, the receiving watercourse, existing drainage patterns, and proposed drainage pattern.

Comments: *Refer to drawing C-04*

- [x] 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.

Comments: *Refer to Servicing Report Section 4.4*

- [x] Water Quality control objective (basic, normal or enhanced level of protection based on the sensitivities of the receiving watercourse) and storage requirements.

Comments: *Refer to Servicing Report Section 4.5*

- [x] Description of the stormwater management concept with facility locations and descriptions with references and supporting information.

Comments: *Refer to Servicing Report Section 4.6-4.10*

- [x] Set-back from private sewage disposal systems.

Comments: *N/A*

- [x] Watercourse and hazard lands setbacks.

Comments: N/A

- [x] Record of pre-consultation with the Ontario Ministry of Environment and the Conservation Authority that has jurisdiction on the affected watershed.

Comments: Refer to Appendix B for email from Mississippi Valley Authority

☒ Confirm consistency with sub-watershed and Master Servicing Study, if applicable study exists.

Comments: *N/A*

☒ Storage requirements (complete with calculations) and conveyance capacity for minor events (1:5 year return period) and major events (1:100 year return period).

Comments: *Refer to Servicing Report Section 4.6-4.10 and 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.

Comments: *Refer to Servicing Report Section 4.11*

☒ 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.

Comments: *Refer to Servicing Report Section 4.12*

☒ Any proposed diversion of drainage catchment areas from one outlet to another.

Comments: *Refer to Servicing Report Section 4.13*

☒ Proposed minor and major systems including locations and sizes of stormwater trunk sewers, and stormwater management facilities.

Comments: Refer to Servicing Report Section 4.6-4.10, Appendix C and drawing C-02

☒ 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.

Comments: *Refer to Servicing Report Section 4.6-4.10 and Appendix C*

☒ Identification of potential impacts to receiving watercourses

Comments: *Refer to Servicing Report Section 4.15*

☒ Identification of municipal drains and related approval requirements.

Comments: *Refer to Servicing Report Section 4.16*

☒ Descriptions of how the conveyance and storage capacity will be achieved for the development.

Comments: *Refer to Servicing Report Section 4.17*

☒ 100 year flood levels and major flow routing to protect proposed development from flooding for establishing minimum building elevations (MBE) and overall grading.

Comments: *Refer to drawings C-02 and C-04*

☒ Inclusion of hydraulic analysis including hydraulic grade line elevations.

Comments: *Refer to Servicing Report Section 4.18*

☒ Description of approach to erosion and sediment control during construction for the protection of receiving watercourse or drainage corridors.

Comments: *Refer to Servicing Report Section 5.0*

☒ 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.

Comments: *N/A*

☒ Identification of fill constraints related to floodplain and geotechnical investigation.

Comments: *N/A*

4.5 Approval and Permit Requirements: Checklist

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

☐ 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.

Comments:

☐ Application for Certificate of Approval (CofA) under the Ontario Water Resources Act.

Comments:

☐ Changes to Municipal Drains.

Comments:

☐ Other permits (National Capital Commission, Parks Canada, Public Works and Government Services Canada, Ministry of Transportation etc.)

Comments:

4.6 Conclusion Checklist

☐ Clearly stated conclusions and recommendations

Comments:

☐ 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.

Comments:

☐ All draft and final reports shall be signed and stamped by a professional Engineer registered in Ontario

Comments: