APPENDICES

Appendix A WATER SUPPLY SERVICING

A.1 DOMESTIC WATER DEMAND ESTIMATE

740 Springland Drive - Domestic Water Demand Estimates

Densities as per City Guidelines:
Avg Apt 1.8 ppu

Building ID	Units	Population	Daily Rate of Demand	Avg Day Demand		Max Day Demand [1]		Peak Hour Demand [2]	
				(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
A	84	151	350	36.8	0.61	91.9	1.53	202.1	3.37
B	75	135	350	32.8	0.55	82.0	1.37	180.5	3.01
C	72	130	350	31.5	0.53	78.8	1.31	173.3	2.89
Total Site :	**231**	**416**		**101.06**	**1.68**	**252.66**	**4.21**	**555.84**	**9.26**

Average day water demand for residential areas equal to 350 L/cap/d.

The City of Ottawa water demand criteria was used to estimate peak demand rates for residential areas are as follows:

1 maximum day demand rate = 2.5 x average day demand rate for residential

2 maximum hour demand rate = 2.2 x maximum day demand rate for residential

A.2 FIRE FLOW REQUIREMENTS PER FUS

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401483
Project Name: 740 Springland Drive
Date: 6/5/2019
Fire Flow Calculation #: 1
Description: Apartment Building A

Notes:

Step	Task	Notes	Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Ordinary Construction	1	-
2	Determine Ground Floor Area of One Unit	-	1148	-
	Determine Number of Adjoining Units	-	1	-
3	Determine Height in Storeys	Does not include floors >50% below grade or open attic space	4	-
4	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min	-	15000
5	Determine Occupancy Charge	Limited Combustible	-15%	12750
6	Determine Sprinkler Reduction	Conforms to NFPA 13	-30%	-5100
		Standard Water Supply	-10%	
		Not Fully Supervised or N/A	0%	
		% Coverage of Sprinkler System	100%	
7	Determine Increase for Exposures (Max. 75%)	Direction / Exposure Distance (m) / Exposed Length (m) / Exposed Height (Stories) / Length-Height Factor (m x stories) / Construction of Adjacent Wall	-	-
		North: 10.1 to 20 / 17 / 4 / 61-90 / Ordinary or Fire-Resistive with Unprotected Openings	13%	4208
		East: 30.1 to 45 / 58.5 / 1 / 31-60 / Wood Frame or Non-Combustible	5%	
		South: 30.1 to 45 / 17 / 4 / 61-90 / Ordinary or Fire-Resistive with Unprotected Openings	5%	
		West: 20.1 to 30 / 41 / 4 / > 120 / Ordinary or Fire-Resistive with Unprotected Openings	10%	
8	Determine Final Required Fire Flow	**Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min**		**12000**
		Total Required Fire Flow in L/s		**200.0**
		Required Duration of Fire Flow (hrs)		**2.50**
		Required Volume of Fire Flow (m^3)		**1800**

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401483
Project Name: 740 Springland Drive
Date: 6/5/2019
Fire Flow Calculation #: 2
Description: Apartment Building B

Notes:

Step	Task	Notes						Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Ordinary Construction						1	-
2	Determine Ground Floor Area of One Unit	-						1025	-
	Determine Number of Adjoining Units	-						1	-
3	Determine Height in Storeys	Does not include floors >50% below grade or open attic space						4	-
4	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min						-	14000
5	Determine Occupancy Charge	Limited Combustible						-15%	11900
6	Determine Sprinkler Reduction	Conforms to NFPA 13						-30%	-4760
		Standard Water Supply						-10%	
		Not Fully Supervised or N/A						0%	
		% Coverage of Sprinkler System						100%	
7	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	-	-
		North	20.1 to 30	47	4	> 120	Ordinary or Fire-Resistive with Unprotected Openings	10%	4641
		East	10.1 to 20	20	4	61-90	Ordinary or Fire-Resistive with Unprotected Openings	13%	
		South	30.1 to 45	47	1	31-60	Wood Frame or Non-Combustible	5%	
		West	10.1 to 20	8.5	4	31-60	Ordinary or Fire-Resistive with Unprotected Openings	11%	
8	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min							12000
		Total Required Fire Flow in L/s							200.0
		Required Duration of Fire Flow (hrs)							2.50
		Required Volume of Fire Flow (m^3)							1800

Stantec

FUS Fire Flow Calculation Sheet

Stantec Project #: 160401483
Project Name: 740 Springland Drive
Date: 6/5/2019
Fire Flow Calculation #: 3
Description: Apartment Building C

Notes:

Step	Task	Notes						Value Used	Req'd Fire Flow (L/min)
1	Determine Type of Construction	Ordinary Construction						1	-
2	Determine Ground Floor Area of One Unit	-						1157	-
	Determine Number of Adjoining Units	-						1	-
3	Determine Height in Storeys	Does not include floors >50% below grade or open attic space						4	-
4	Determine Required Fire Flow	($F = 220 \times C \times A^{1/2}$). Round to nearest 1000 L/min						-	15000
5	Determine Occupancy Charge	Limited Combustible						-15%	12750
6	Determine Sprinkler Reduction	Conforms to NFPA 13						-30%	-5100
		Standard Water Supply						-10%	
		Not Fully Supervised or N/A						0%	
		% Coverage of Sprinkler System						100%	
7	Determine Increase for Exposures (Max. 75%)	Direction	Exposure Distance (m)	Exposed Length (m)	Exposed Height (Stories)	Length-Height Factor (m x stories)	Construction of Adjacent Wall	-	-
		North	> 45	59	4	> 120	Ordinary or Fire-Resistive with Unprotected Openings	0%	2295
		East	> 45	20	1	0-30	Wood Frame or Non-Combustible	0%	
		South	30.1 to 45	17	1	0-30	Wood Frame or Non-Combustible	5%	
		West	10.1 to 20	20	4	61-90	Ordinary or Fire-Resistive with Unprotected Openings	13%	
8	Determine Final Required Fire Flow	Total Required Fire Flow in L/min, Rounded to Nearest 1000L/min							10000
		Total Required Fire Flow in L/s							166.7
		Required Duration of Fire Flow (hrs)							2.00
		Required Volume of Fire Flow (m^3)							1200

A.3 BOUNDARY CONDITIONS

Odam, Cameron

From: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Sent: Tuesday, June 18, 2019 10:03 AM
To: Odam, Cameron
Cc: Kilborn, Kris
Subject: RE: Boundary Conditions Request - 740 Springland Drive – Norberry Residences
Attachments: 740 Springlnad June 2019.pdf

Cameron,

Please see below for the Boundary Conditions for 740 Springland Drive.

Please refer to Guidelines and Technical bulletin ISDTB-2014-02 concerning basic day demands greater than 0.5 L/s.

The following are boundary conditions, HGL, for hydraulic analysis at 740 Springland (zone 2C) assumed to be connected to the 203mm on Norberry Crescent (see attached PDF for location).

Minimum HGL = 125.0m, same at both connections

Maximum HGL = 133.7m, same at both connections. The maximum pressure is estimated to be close to 80 psi. A pressure check at completion of construction is recommended to determine if pressure control is required.

MaxDay + Fireflow (250L/s) = 108.0m, connection 1

MaxDay + Fireflow (250L/s) = 102.0m, connection 2

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

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

Let me know if you have any further questions or comments.

Regards,

Jeff Shillington, P.Eng.
Project Manager, Development Review, South Branch
Planning, Infrastructure and Economic Development
City of Ottawa

tel: 580-2424 x 16960
email: jeff.shillington@ottawa.ca

From: Odam, Cameron <Cameron.Odam@stantec.com>
Sent: May 29, 2019 11:06 AM
To: Shillington, Jeffrey <jeff.shillington@ottawa.ca>
Cc: Kilborn, Kris <kris.kilborn@stantec.com>
Subject: Boundary Conditions Request - 740 Springland Drive – Norberry Residences

Hi Jeff,

I'm looking to get watermain hydraulic boundary conditions at 2 proposed connection points for 740 Springland Drive – Norberry Residences proposed development. The development consists of adding three additional 4 storey apartment buildings to the existing parcel currently occupied by 3 apartment buildings. The first proposed watermain connection point is to the 200mm watermain at the southwest end of Norberry Crescent and the second connection point to the 200mm watermain pipe at the north end of Norberry Crescent. The connection points are shown on the attached drawing.

The estimated domestic demands and fire flow requirements for the proposed are as follows;

Connection 1:
Average Day= 0.61 L/s
Max Day= 1.53 L/s
Peak Hour= 3.37 L/s
Fire Flow= 15,000L/m (250 L/s)

Connection 2:
Average Day= 1.07 L/s
Max Day= 2.68 L/s
Peak Hour= 5.9 L/s
Fire Flow= 15,000L/m (250 L/s)

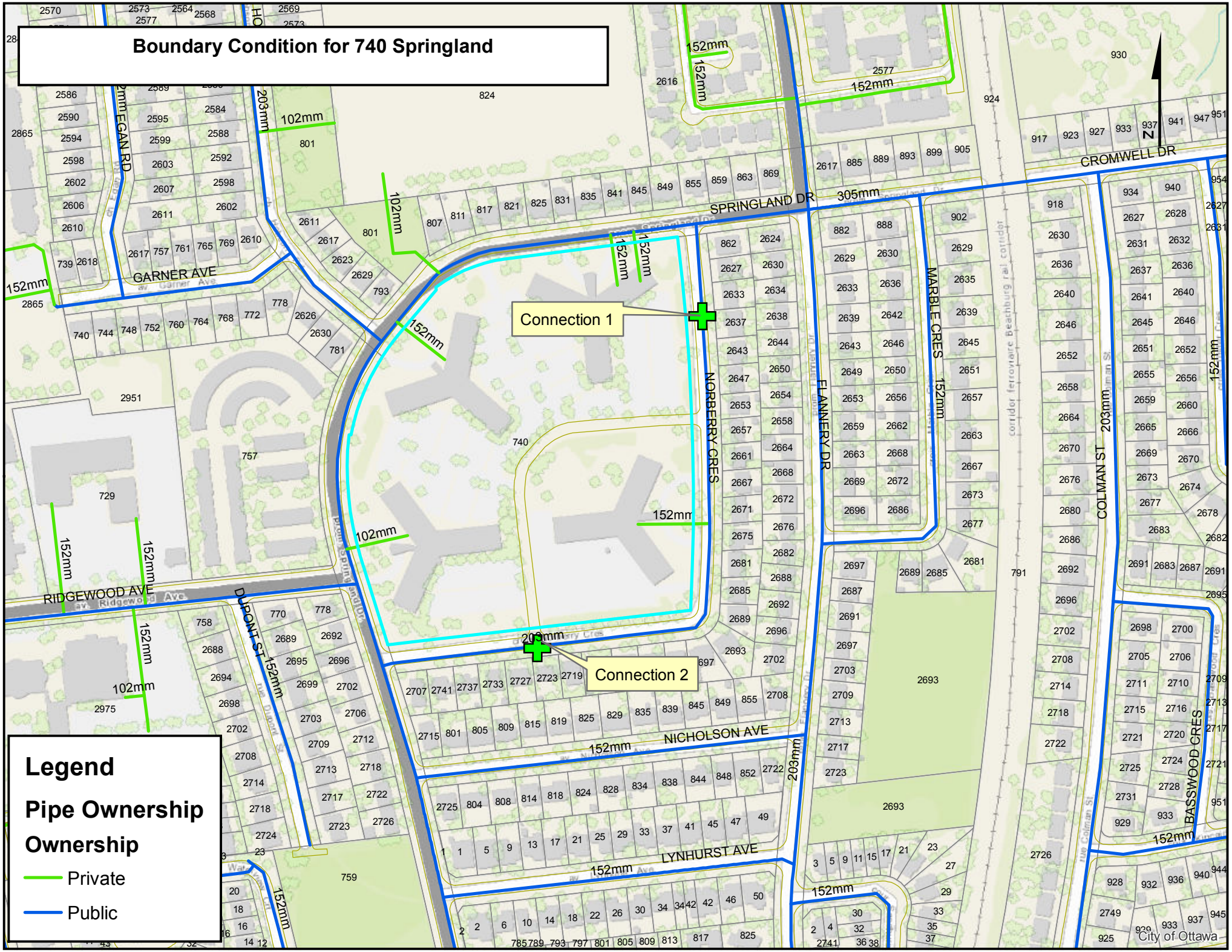
Thanks,

Cameron

Cameron Odam

Direct: +16137244353
Fax: +16137222799
Cameron.Odam@stantec.com

Stantec
400 - 1331 Clyde Avenue
Ottawa ON K2C 3G4


Boundary Condition for 740 Springland
Connection 1
Connection 2
SPRINGLAND DR
NORBERRY CRES
FLANNERY DR
MARBLE CRES
CROMWELL DR
COLMAN ST
BASSWOOD CRES
NICHOLSON AVE
LYNHURST AVE
GARNER AVE
RIDGEWOOD AVE
DUPONT ST
EGAN RD
740
305mm
203mm
152mm
102mm
Legend
Pipe Ownership
Ownership
Private
Public
City of Ottawa

Appendix B WASTEWATER SERVICING

B.1 SANITARY SEWER DESIGN SHEET

Stantec

SUBDIVISION: **NORBERRY RESIDENCES**

DATE: 7/10/2019
REVISION: 1
DESIGNED BY: WAJ
CHECKED BY: -

SANITARY SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401483

DESIGN PARAMETERS

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

LOCATION			RESIDENTIAL AREA AND POPULATION									COMMERCIAL		INDUSTRIAL (L)		INDUSTRIAL (H)		INSTITUTIONAL		GREEN / UNUSED		C+I+I	INFILTRATION			TOTAL	PIPE							
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA	SINGLE	UNITS TOWN	APT	POP.	CUMULATIVE AREA	CUMULATIVE POP.	PEAK FACT.	PEAK FLOW	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	AREA	ACCU. AREA	PEAK FLOW	TOTAL AREA	ACCU. AREA	INFILT. FLOW	**FLOW**	LENGTH	DIA	MATERIAL	CLASS	SLOPE	CAP. (FULL)	CAP. V PEAK FLOW	VEL. (FULL)	VEL. (ACT.)
			(ha)					(ha)			(l/s)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(l/s)	(ha)	(ha)	(l/s)	(l/s)	(m)	(mm)			(%)	(l/s)	(%)	(m/s)	(m/s)
BLDG A	BLDG	1	0.11	0	0	84	151	0.11	151	3.55	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.11	0.11	0.0	1.8	4.1	135	PVC	DR 28	1.00	11.5	**15.42%**	0.80	0.49
	1	EX. MAIN	0.00	0	0	0	0	0.11	151	3.55	1.7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.11	0.0	1.8	11.8	200	PVC	SDR 35	5.85	80.9	**2.20%**	2.54	0.88
																												225							
BLDG B	BLDG	2	0.10	0	0	75	135	0.10	135	3.56	1.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.10	0.10	0.0	1.6	4.3	135	PVC	DR 28	1.00	11.5	**13.82%**	0.80	0.47
	2	EX. MAIN	0.00	0	0	0	0	0.10	135	3.56	1.6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.10	0.0	1.6	11.4	200	PVC	SDR 35	0.32	18.9	**8.42%**	0.60	0.30
																												225							
BLDG C	BLDG	3	0.11	0	0	72	130	0.11	130	3.57	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.11	0.11	0.0	1.5	2.6	135	PVC	DR 28	1.00	11.5	**13.32%**	0.80	0.46
	3	EX. MAIN	0.00	0	0	0	0	0.11	130	3.57	1.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.11	0.0	1.5	12.8	200	PVC	SDR 35	1.55	41.6	**3.69%**	1.31	0.52
																												225							

Appendix C STORMWATER MANAGEMENT

C.1 STORM SEWER DESIGN SHEET

Stantec

NORBERRY RESIDENCES

DATE: 2019-07-10
REVISION: 1
DESIGNED BY: WAJ
CHECKED BY: -

FILE NUMBER: **160401483**

STORM SEWER DESIGN SHEET
(City of Ottawa)

DESIGN PARAMETERS

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

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

MANNING'S n = 0.013
MINIMUM COVER: 2.00 m
TIME OF ENTRY 10 min
BEDDING CLASS = B

LOCATION			DRAINAGE AREA																					PIPE SELECTION											
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETEI (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
BLDGA	BLDG A	EX. MAIN	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	12.8	200	200	CIRCULAR	PVC	SDR 35	1.00	33.3	**0.00%**	1.05	0.00	0.00
																				10.00									200	200									
BLDGB	BLDG B	EX. MAIN	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	12.9	200	200	CIRCULAR	PVC	SDR 35	1.00	33.3	**0.00%**	1.05	0.00	0.00
																				10.00									200	200									
BLDGC, L300A, L301A	BLDG C	EX. MAIN	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	12.1	200	200	CIRCULAR	PVC	SDR 35	1.00	33.3	**0.00%**	1.05	0.00	0.00
																				10.00									200	200									
L103A	STC 103	EX. MAIN	0.00	0.19	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.000	0.000	0.095	0.095	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	27.5	18.3	300	300	CIRCULAR	PVC	SDR 35	5.00	215.0	**12.80%**	3.05	1.74	0.18
																				10.18									300	300									
L102A	STC 102	EX. MAIN	0.00	0.12	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.000	0.084	0.084	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	24.3	13.4	300	300	CIRCULAR	PVC	SDR 35	4.85	211.8	**11.48%**	3.01	1.64	0.14
																				10.14									300	300									
F101A, L101B	101	100	0.00	0.25	0.00	0.11	0.00	0.00	0.49	0.00	0.76	0.000	0.000	0.123	0.123	0.000	0.000	0.084	0.084	10.00	76.81	104.19	122.14	178.56	0.0	0.0	76.9	48.2	375	375	CIRCULAR	PVC	SDR 35	0.25	82.4	**93.33%**	0.78	0.80	1.00
																				11.00									375	375									

C.2 PRE DEVELOPMENT RATIONAL METHOD CALCULATIONS

Stormwater Management Calculations

File No: **160401483**
Project: **Norberry Residences**
Date: **25-Jun-19**

SWM Approach:
Post-development to Pre-development flows

Pre-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table

Catchment Type	Sub-catchment Area ID / Description		Area (ha) "A"		Runoff Coefficient "C"	"A x C"		Overall Runoff Coefficient
Uncontrolled - Tributary	EX-20	Hard	0.003		0.9	0.002		
		Soft	0.187		0.2	0.037		
		Subtotal		0.19			0.0399	0.210
Uncontrolled - Tributary	EX-19	Hard	0.045		0.9	0.041		
		Soft	0.106		0.2	0.021		
		Subtotal		0.151			0.06191	0.410
Uncontrolled - Tributary	EX-18	Hard	0.000		0.9	0.000		
		Soft	0.049		0.2	0.010		
		Subtotal		0.049			0.0098	0.200
Uncontrolled - Tributary	EX-17	Hard	0.408		0.9	0.367		
		Soft	0.000		0.2	0.000		
		Subtotal		0.408			0.3672	0.900
Uncontrolled - Tributary	EX-16	Hard	0.261		0.9	0.235		
		Soft	0.220		0.2	0.044		
		Subtotal		0.481			0.27898	0.580
Uncontrolled - Tributary	EX-15	Hard	0.026		0.9	0.023		
		Soft	0.052		0.2	0.010		
		Subtotal		0.078			0.03354	0.430
Uncontrolled - Tributary	EX-14	Hard	0.072		0.9	0.065		
		Soft	0.265		0.2	0.053		
		Subtotal		0.337			0.11795	0.350
Uncontrolled - Tributary	EX-13	Hard	0.232		0.9	0.209		
		Soft	0.000		0.2	0.000		
		Subtotal		0.232			0.2088	0.900
Uncontrolled - Tributary	EX-12	Hard	0.232		0.9	0.209		
		Soft	0.000		0.2	0.000		
		Subtotal		0.232			0.2088	0.900
Uncontrolled - Tributary	EX-11	Hard	0.032		0.9	0.029		
		Soft	0.101		0.2	0.020		
		Subtotal		0.133			0.04921	0.370
Uncontrolled - Tributary	EX-10	Hard	0.189		0.9	0.170		
		Soft	0.151		0.2	0.030		
		Subtotal		0.34			0.2006	0.590
Uncontrolled - Tributary	EX-9	Hard	0.061		0.9	0.055		
		Soft	0.000		0.2	0.000		
		Subtotal		0.061			0.0549	0.900
Uncontrolled - Tributary	EX-8	Hard	0.511		0.9	0.460		
		Soft	0.177		0.2	0.035		
		Subtotal		0.688			0.49536	0.720
Uncontrolled - Tributary	EX-7	Hard	0.000		0.9	0.000		
		Soft	0.075		0.2	0.015		
		Subtotal		0.0746			0.01492	0.200
Uncontrolled - Tributary	EX-6	Hard	0.277		0.9	0.250		
		Soft	0.145		0.2	0.029		
		Subtotal		0.422			0.27852	0.660
Uncontrolled - Tributary	EX-5	Hard	0.231		0.9	0.208		
		Soft	0.000		0.2	0.000		
		Subtotal		0.231			0.2079	0.900
Uncontrolled - Tributary	EX-4	Hard	0.510		0.9	0.459		
		Soft	0.190		0.2	0.038		
		Subtotal		0.7			0.497	0.710
Uncontrolled - Tributary	EX-3	Hard	0.232		0.9	0.209		
		Soft	0.000		0.2	0.000		
		Subtotal		0.232			0.2088	0.900
Uncontrolled - Tributary	EX-2	Hard	0.058		0.9	0.052		
		Soft	0.211		0.2	0.042		
		Subtotal		0.269			0.09415	0.350
Uncontrolled - Tributary	EX-1	Hard	0.049		0.9	0.044		
		Soft	0.235		0.2	0.047		
		Subtotal		0.284			0.09088	0.320
Total				**5.403**			**3.519**	
Overall Runoff Coefficient= C:								**0.65**

Total Roof Areas	**0.000 ha**
Total Tributary Surface Areas (Controlled and Uncontrolled)	**5.593 ha**
Total Tributary Area to Outlet	**5.593 ha**
Total Uncontrolled Areas (Non-Tributary)	**0.000 ha**
Total Site	**5.593 ha**

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

5 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	998.071
b =	6.053
c =	0.814

t (min)	I (mm/hr)
5	141.18
10	104.19
15	83.56
20	70.25
25	60.90
30	53.93
35	48.52
40	44.18
45	40.63
50	37.65
55	35.12
60	32.94

5 YEAR Predevelopment Target Release from Portion of Site

Subdrainage Area: Predevelopment Tributary Area to Outlet
Area (ha): 5.5926
C: 0.65

Typical Time of Concentration

tc (min)	I (5 yr) (mm/hr)	Qtarget (L/s)
10	104.19	**1055.18**

5 YEAR Modified Rational Method for Entire Site

Subdrainage Area: EX-20 — Uncontrolled - Tributary
Area (ha): 0.19
C: 0.21

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	11.56	11.56		
20	70.25	7.79	7.79		
30	53.93	5.98	5.98		
40	44.18	4.90	4.90		
50	37.65	4.18	4.18		
60	32.94	3.65	3.65		
70	29.37	3.26	3.26		
80	26.56	2.95	2.95		
90	24.29	2.69	2.69		
100	22.41	2.49	2.49		
110	20.82	2.31	2.31		
120	19.47	2.16	2.16		

Subdrainage Area: EX-19 — Uncontrolled - Tributary
Area (ha): 0.15
C: 0.41

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	17.93	17.93		
20	70.25	12.09	12.09		
30	53.93	9.28	9.28		
40	44.18	7.60	7.60		
50	37.65	6.48	6.48		
60	32.94	5.67	5.67		
70	29.37	5.06	5.06		
80	26.56	4.57	4.57		
90	24.29	4.18	4.18		
100	22.41	3.86	3.86		
110	20.82	3.58	3.58		
120	19.47	3.35	3.35		

Subdrainage Area: EX-18 — Uncontrolled - Tributary
Area (ha): 0.05
C: 0.20

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	2.84	2.84		
20	70.25	1.91	1.91		
30	53.93	1.47	1.47		
40	44.18	1.20	1.20		
50	37.65	1.03	1.03		
60	32.94	0.90	0.90		
70	29.37	0.80	0.80		
80	26.56	0.72	0.72		
90	24.29	0.66	0.66		
100	22.41	0.61	0.61		
110	20.82	0.57	0.57		
120	19.47	0.53	0.53		

Subdrainage Area: EX-17 — Uncontrolled - Tributary
Area (ha): 0.41
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	106.36	106.36		
20	70.25	71.71	71.71		
30	53.93	55.05	55.05		
40	44.18	45.10	45.10		
50	37.65	38.44	38.44		
60	32.94	33.63	33.63		
70	29.37	29.98	29.98		
80	26.56	27.11	27.11		
90	24.29	24.79	24.79		
100	22.41	22.87	22.87		
110	20.82	21.26	21.26		
120	19.47	19.87	19.87		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

100 yr Intensity
City of Ottawa

$I = a/(t + b)^c$

a =	1735.688
b =	6.014
c =	0.820

t (min)	I (mm/hr)
5	242.70
10	178.56
15	142.89
20	119.95
25	103.85
30	91.87
35	82.58
40	75.15
45	69.05
50	63.95
55	59.62
60	55.89

100 YEAR Predevelopment Target Release from Portion of Site

Subdrainage Area: Predevelopment Tributary Area to Outlet
Area (ha): 5.5926
C: 0.81

Estimated Time of Concentration

tc (min)	I (100 yr) (mm/hr)	Q100yr (L/s)
10	178.56	**2260.38**

100 YEAR Modified Rational Method for Entire Site

Subdrainage Area: EX-20 — Uncontrolled - Tributary
Area (ha): 0.19
C: 0.26

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	24.76	24.76		
20	119.95	16.63	16.63		
30	91.87	12.74	12.74		
40	75.15	10.42	10.42		
50	63.95	8.87	8.87		
60	55.89	7.75	7.75		
70	49.79	6.90	6.90		
80	44.99	6.24	6.24		
90	41.11	5.70	5.70		
100	37.90	5.26	5.26		
110	35.20	4.88	4.88		
120	32.89	4.56	4.56		

Subdrainage Area: EX-19 — Uncontrolled - Tributary
Area (ha): 0.15
C: 0.51

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	38.41	38.41		
20	119.95	25.81	25.81		
30	91.87	19.76	19.76		
40	75.15	16.17	16.17		
50	63.95	13.76	13.76		
60	55.89	12.03	12.03		
70	49.79	10.71	10.71		
80	44.99	9.68	9.68		
90	41.11	8.84	8.84		
100	37.90	8.15	8.15		
110	35.20	7.57	7.57		
120	32.89	7.08	7.08		

Subdrainage Area: EX-18 — Uncontrolled - Tributary
Area (ha): 0.05
C: 0.25

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	6.08	6.08		
20	119.95	4.08	4.08		
30	91.87	3.13	3.13		
40	75.15	2.56	2.56		
50	63.95	2.18	2.18		
60	55.89	1.90	1.90		
70	49.79	1.70	1.70		
80	44.99	1.53	1.53		
90	41.11	1.40	1.40		
100	37.90	1.29	1.29		
110	35.20	1.20	1.20		
120	32.89	1.12	1.12		

Subdrainage Area: EX-17 — Uncontrolled - Tributary
Area (ha): 0.41
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	202.53	202.53		
20	119.95	136.05	136.05		
30	91.87	104.20	104.20		
40	75.15	85.23	85.23		
50	63.95	72.54	72.54		
60	55.89	63.40	63.40		
70	49.79	56.47	56.47		
80	44.99	51.03	51.03		
90	41.11	46.63	46.63		
100	37.90	42.99	42.99		
110	35.20	39.93	39.93		
120	32.89	37.31	37.31		

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-16 — Uncontrolled - Tributary
Area (ha): 0.48
C: 0.58

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	80.81	80.81		
20	70.25	54.48	54.48		
30	53.93	41.82	41.82		
40	44.18	34.27	34.27		
50	37.65	29.20	29.20		
60	32.94	25.55	25.55		
70	29.37	22.78	22.78		
80	26.56	20.60	20.60		
90	24.29	18.84	18.84		
100	22.41	17.38	17.38		
110	20.82	16.15	16.15		
120	19.47	15.10	15.10		

Subdrainage Area: EX-15 — Uncontrolled - Tributary
Area (ha): 0.08
C: 0.43

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	9.72	9.72		
20	70.25	6.55	6.55		
30	53.93	5.03	5.03		
40	44.18	4.12	4.12		
50	37.65	3.51	3.51		
60	32.94	3.07	3.07		
70	29.37	2.74	2.74		
80	26.56	2.48	2.48		
90	24.29	2.26	2.26		
100	22.41	2.09	2.09		
110	20.82	1.94	1.94		
120	19.47	1.82	1.82		

Subdrainage Area: EX-14 — Uncontrolled - Tributary
Area (ha): 0.34
C: 0.35

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	34.17	34.17		
20	70.25	23.04	23.04		
30	53.93	17.68	17.68		
40	44.18	14.49	14.49		
50	37.65	12.35	12.35		
60	32.94	10.80	10.80		
70	29.37	9.63	9.63		
80	26.56	8.71	8.71		
90	24.29	7.96	7.96		
100	22.41	7.35	7.35		
110	20.82	6.83	6.83		
120	19.47	6.38	6.38		

Subdrainage Area: EX-13 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.48	60.48		
20	70.25	40.78	40.78		
30	53.93	31.30	31.30		
40	44.18	25.65	25.65		
50	37.65	21.86	21.86		
60	32.94	19.12	19.12		
70	29.37	17.05	17.05		
80	26.56	15.42	15.42		
90	24.29	14.10	14.10		
100	22.41	13.01	13.01		
110	20.82	12.09	12.09		
120	19.47	11.30	11.30		

Subdrainage Area: EX-12 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.48	60.48		
20	70.25	40.78	40.78		
30	53.93	31.30	31.30		
40	44.18	25.65	25.65		
50	37.65	21.86	21.86		
60	32.94	19.12	19.12		
70	29.37	17.05	17.05		
80	26.56	15.42	15.42		
90	24.29	14.10	14.10		
100	22.41	13.01	13.01		
110	20.82	12.09	12.09		
120	19.47	11.30	11.30		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-16 — Uncontrolled - Tributary
Area (ha): 0.48
C: 0.73

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	173.11	173.11		
20	119.95	116.29	116.29		
30	91.87	89.06	89.06		
40	75.15	72.85	72.85		
50	63.95	62.00	62.00		
60	55.89	54.19	54.19		
70	49.79	48.27	48.27		
80	44.99	43.62	43.62		
90	41.11	39.86	39.86		
100	37.90	36.75	36.75		
110	35.20	34.13	34.13		
120	32.89	31.89	31.89		

Subdrainage Area: EX-15 — Uncontrolled - Tributary
Area (ha): 0.08
C: 0.54

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	20.81	20.81		
20	119.95	13.98	13.98		
30	91.87	10.71	10.71		
40	75.15	8.76	8.76		
50	63.95	7.45	7.45		
60	55.89	6.51	6.51		
70	49.79	5.80	5.80		
80	44.99	5.24	5.24		
90	41.11	4.79	4.79		
100	37.90	4.42	4.42		
110	35.20	4.10	4.10		
120	32.89	3.83	3.83		

Subdrainage Area: EX-14 — Uncontrolled - Tributary
Area (ha): 0.34
C: 0.44

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	73.19	73.19		
20	119.95	49.16	49.16		
30	91.87	37.65	37.65		
40	75.15	30.80	30.80		
50	63.95	26.21	26.21		
60	55.89	22.91	22.91		
70	49.79	20.41	20.41		
80	44.99	18.44	18.44		
90	41.11	16.85	16.85		
100	37.90	15.54	15.54		
110	35.20	14.43	14.43		
120	32.89	13.48	13.48		

Subdrainage Area: EX-13 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	115.16	115.16		
20	119.95	77.36	77.36		
30	91.87	59.25	59.25		
40	75.15	48.47	48.47		
50	63.95	41.25	41.25		
60	55.89	36.05	36.05		
70	49.79	32.11	32.11		
80	44.99	29.02	29.02		
90	41.11	26.51	26.51		
100	37.90	24.45	24.45		
110	35.20	22.70	22.70		
120	32.89	21.22	21.22		

Subdrainage Area: EX-12 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	115.16	115.16		
20	119.95	77.36	77.36		
30	91.87	59.25	59.25		
40	75.15	48.47	48.47		
50	63.95	41.25	41.25		
60	55.89	36.05	36.05		
70	49.79	32.11	32.11		
80	44.99	29.02	29.02		
90	41.11	26.51	26.51		
100	37.90	24.45	24.45		
110	35.20	22.70	22.70		
120	32.89	21.22	21.22		

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-11 — Uncontrolled - Tributary
Area (ha): 0.13
C: 0.37

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	14.25	14.25		
20	70.25	9.61	9.61		
30	53.93	7.38	7.38		
40	44.18	6.04	6.04		
50	37.65	5.15	5.15		
60	32.94	4.51	4.51		
70	29.37	4.02	4.02		
80	26.56	3.63	3.63		
90	24.29	3.32	3.32		
100	22.41	3.07	3.07		
110	20.82	2.85	2.85		
120	19.47	2.66	2.66		

Subdrainage Area: EX-10 — Uncontrolled - Tributary
Area (ha): 0.34
C: 0.59

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	58.11	58.11		
20	70.25	39.18	39.18		
30	53.93	30.07	30.07		
40	44.18	24.64	24.64		
50	37.65	21.00	21.00		
60	32.94	18.37	18.37		
70	29.37	16.38	16.38		
80	26.56	14.81	14.81		
90	24.29	13.54	13.54		
100	22.41	12.50	12.50		
110	20.82	11.61	11.61		
120	19.47	10.86	10.86		

Subdrainage Area: EX-9 — Uncontrolled - Tributary
Area (ha): 0.06
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	15.90	15.90		
20	70.25	10.72	10.72		
30	53.93	8.23	8.23		
40	44.18	6.74	6.74		
50	37.65	5.75	5.75		
60	32.94	5.03	5.03		
70	29.37	4.48	4.48		
80	26.56	4.05	4.05		
90	24.29	3.71	3.71		
100	22.41	3.42	3.42		
110	20.82	3.18	3.18		
120	19.47	2.97	2.97		

Subdrainage Area: EX-8 — Uncontrolled - Tributary
Area (ha): 0.69
C: 0.72

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	143.48	143.48		
20	70.25	96.74	96.74		
30	53.93	74.26	74.26		
40	44.18	60.85	60.85		
50	37.65	51.85	51.85		
60	32.94	45.37	45.37		
70	29.37	40.45	40.45		
80	26.56	36.58	36.58		
90	24.29	33.45	33.45		
100	22.41	30.86	30.86		
110	20.82	28.67	28.67		
120	19.47	26.81	26.81		

Subdrainage Area: EX-7 — Uncontrolled - Tributary
Area (ha): 0.07
C: 0.20

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	4.32	4.32		
20	70.25	2.91	2.91		
30	53.93	2.24	2.24		
40	44.18	1.83	1.83		
50	37.65	1.56	1.56		
60	32.94	1.37	1.37		
70	29.37	1.22	1.22		
80	26.56	1.10	1.10		
90	24.29	1.01	1.01		
100	22.41	0.93	0.93		
110	20.82	0.86	0.86		
120	19.47	0.81	0.81		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-11 — Uncontrolled - Tributary
Area (ha): 0.13
C: 0.46

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	30.53	30.53		
20	119.95	20.51	20.51		
30	91.87	15.71	15.71		
40	75.15	12.85	12.85		
50	63.95	10.94	10.94		
60	55.89	9.56	9.56		
70	49.79	8.51	8.51		
80	44.99	7.69	7.69		
90	41.11	7.03	7.03		
100	37.90	6.48	6.48		
110	35.20	6.02	6.02		
120	32.89	5.63	5.63		

Subdrainage Area: EX-10 — Uncontrolled - Tributary
Area (ha): 0.34
C: 0.74

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	124.47	124.47		
20	119.95	83.62	83.62		
30	91.87	64.04	64.04		
40	75.15	52.38	52.38		
50	63.95	44.58	44.58		
60	55.89	38.96	38.96		
70	49.79	34.71	34.71		
80	44.99	31.36	31.36		
90	41.11	28.66	28.66		
100	37.90	26.42	26.42		
110	35.20	24.54	24.54		
120	32.89	22.93	22.93		

Subdrainage Area: EX-9 — Uncontrolled - Tributary
Area (ha): 0.06
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	30.28	30.28		
20	119.95	20.34	20.34		
30	91.87	15.58	15.58		
40	75.15	12.74	12.74		
50	63.95	10.85	10.85		
60	55.89	9.48	9.48		
70	49.79	8.44	8.44		
80	44.99	7.63	7.63		
90	41.11	6.97	6.97		
100	37.90	6.43	6.43		
110	35.20	5.97	5.97		
120	32.89	5.58	5.58		

Subdrainage Area: EX-8 — Uncontrolled - Tributary
Area (ha): 0.69
C: 0.90

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	307.37	307.37		
20	119.95	206.48	206.48		
30	91.87	158.14	158.14		
40	75.15	129.35	129.35		
50	63.95	110.09	110.09		
60	55.89	96.22	96.22		
70	49.79	85.71	85.71		
80	44.99	77.45	77.45		
90	41.11	70.77	70.77		
100	37.90	65.25	65.25		
110	35.20	60.60	60.60		
120	32.89	56.62	56.62		

Subdrainage Area: EX-7 — Uncontrolled - Tributary
Area (ha): 0.07
C: 0.25

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	9.26	9.26		
20	119.95	6.22	6.22		
30	91.87	4.76	4.76		
40	75.15	3.90	3.90		
50	63.95	3.32	3.32		
60	55.89	2.90	2.90		
70	49.79	2.58	2.58		
80	44.99	2.33	2.33		
90	41.11	2.13	2.13		
100	37.90	1.97	1.97		
110	35.20	1.83	1.83		
120	32.89	1.71	1.71		

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-6 — Uncontrolled - Tributary
Area (ha): 0.42
C: 0.66

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	80.68	80.68		
20	70.25	54.39	54.39		
30	53.93	41.76	41.76		
40	44.18	34.21	34.21		
50	37.65	29.15	29.15		
60	32.94	25.51	25.51		
70	29.37	22.74	22.74		
80	26.56	20.57	20.57		
90	24.29	18.81	18.81		
100	22.41	17.35	17.35		
110	20.82	16.12	16.12		
120	19.47	15.07	15.07		

Subdrainage Area: EX-5 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.22	60.22		
20	70.25	40.60	40.60		
30	53.93	31.17	31.17		
40	44.18	25.54	25.54		
50	37.65	21.76	21.76		
60	32.94	19.04	19.04		
70	29.37	16.98	16.98		
80	26.56	15.35	15.35		
90	24.29	14.04	14.04		
100	22.41	12.95	12.95		
110	20.82	12.03	12.03		
120	19.47	11.25	11.25		

Subdrainage Area: EX-4 — Uncontrolled - Tributary
Area (ha): 0.70
C: 0.71

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	143.96	143.96		
20	70.25	97.06	97.06		
30	53.93	74.51	74.51		
40	44.18	61.05	61.05		
50	37.65	52.02	52.02		
60	32.94	45.52	45.52		
70	29.37	40.58	40.58		
80	26.56	36.70	36.70		
90	24.29	33.56	33.56		
100	22.41	30.96	30.96		
110	20.82	28.77	28.77		
120	19.47	26.90	26.90		

Subdrainage Area: EX-3 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.48	60.48		
20	70.25	40.78	40.78		
30	53.93	31.30	31.30		
40	44.18	25.65	25.65		
50	37.65	21.86	21.86		
60	32.94	19.12	19.12		
70	29.37	17.05	17.05		
80	26.56	15.42	15.42		
90	24.29	14.10	14.10		
100	22.41	13.01	13.01		
110	20.82	12.09	12.09		
120	19.47	11.30	11.30		

Subdrainage Area: EX-2 — Uncontrolled - Tributary
Area (ha): 0.27
C: 0.35

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	27.27	27.27		
20	70.25	18.39	18.39		
30	53.93	14.11	14.11		
40	44.18	11.56	11.56		
50	37.65	9.86	9.86		
60	32.94	8.62	8.62		
70	29.37	7.69	7.69		
80	26.56	6.95	6.95		
90	24.29	6.36	6.36		
100	22.41	5.86	5.86		
110	20.82	5.45	5.45		
120	19.47	5.10	5.10		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-6 — Uncontrolled - Tributary
Area (ha): 0.42
C: 0.83

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	172.82	172.82		
20	119.95	116.09	116.09		
30	91.87	88.92	88.92		
40	75.15	72.73	72.73		
50	63.95	61.90	61.90		
60	55.89	54.10	54.10		
70	49.79	48.19	48.19		
80	44.99	43.54	43.54		
90	41.11	39.79	39.79		
100	37.90	36.68	36.68		
110	35.20	34.07	34.07		
120	32.89	31.84	31.84		

Subdrainage Area: EX-5 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	114.67	114.67		
20	119.95	77.03	77.03		
30	91.87	59.00	59.00		
40	75.15	48.26	48.26		
50	63.95	41.07	41.07		
60	55.89	35.89	35.89		
70	49.79	31.97	31.97		
80	44.99	28.89	28.89		
90	41.11	26.40	26.40		
100	37.90	24.34	24.34		
110	35.20	22.61	22.61		
120	32.89	21.12	21.12		

Subdrainage Area: EX-4 — Uncontrolled - Tributary
Area (ha): 0.70
C: 0.89

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	308.38	308.38		
20	119.95	207.16	207.16		
30	91.87	158.66	158.66		
40	75.15	129.78	129.78		
50	63.95	110.45	110.45		
60	55.89	96.53	96.53		
70	49.79	85.99	85.99		
80	44.99	77.70	77.70		
90	41.11	71.00	71.00		
100	37.90	65.46	65.46		
110	35.20	60.80	60.80		
120	32.89	56.81	56.81		

Subdrainage Area: EX-3 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	115.16	115.16		
20	119.95	77.36	77.36		
30	91.87	59.25	59.25		
40	75.15	48.47	48.47		
50	63.95	41.25	41.25		
60	55.89	36.05	36.05		
70	49.79	32.11	32.11		
80	44.99	29.02	29.02		
90	41.11	26.51	26.51		
100	37.90	24.45	24.45		
110	35.20	22.70	22.70		
120	32.89	21.22	21.22		

Subdrainage Area: EX-2 — Uncontrolled - Tributary
Area (ha): 0.27
C: 0.44

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	58.42	58.42		
20	119.95	39.24	39.24		
30	91.87	30.06	30.06		
40	75.15	24.59	24.59		
50	63.95	20.92	20.92		
60	55.89	18.29	18.29		
70	49.79	16.29	16.29		
80	44.99	14.72	14.72		
90	41.11	13.45	13.45		
100	37.90	12.40	12.40		
110	35.20	11.52	11.52		
120	32.89	10.76	10.76		

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-1 Uncontrolled - Tributary
Area (ha): 0.28
C: 0.32

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	26.32	26.32		
20	70.25	17.75	17.75		
30	53.93	13.62	13.62		
40	44.18	11.16	11.16		
50	37.65	9.51	9.51		
60	32.94	8.32	8.32		
70	29.37	7.42	7.42		
80	26.56	6.71	6.71		
90	24.29	6.14	6.14		
100	22.41	5.66	5.66		
110	20.82	5.26	5.26		
120	19.47	4.92	4.92		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-1 Uncontrolled - Tributary
Area (ha): 0.28
C: 0.40

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	56.39	56.39		
20	119.95	37.88	37.88		
30	91.87	29.01	29.01		
40	75.15	23.73	23.73		
50	63.95	20.20	20.20		
60	55.89	17.65	17.65		
70	49.79	15.72	15.72		
80	44.99	14.21	14.21		
90	41.11	12.98	12.98		
100	37.90	11.97	11.97		
110	35.20	11.12	11.12		
120	32.89	10.39	10.39		

C.3 POST DEVELOPMENT RATIONAL METHOD CALCULATIONS

File No: **160401483**
Project: **Norberry Residences**
Date: **25-Jun-19**

SWM Approach:
Post-development to Pre-development flows

Post-Development Site Conditions:

Overall Runoff Coefficient for Site and Sub-Catchment Areas

Runoff Coefficient Table

Catchment Type	Sub-catchment Area ID / Description		Area (ha) "A"	Runoff Coefficient "C"	"A x C"		Overall Runoff Coefficient
Controlled - Tributary	L103B	Hard	0.037	0.9	0.034		
		Soft	0.026	0.2	0.005		
		Subtotal	0.064			0.038796	0.610
Controlled - Tributary	L103A	Hard	0.048	0.9	0.043		
		Soft	0.086	0.2	0.017		
		Subtotal	0.134			0.0603	0.450
Controlled - Tributary	L102A	Hard	0.083	0.9	0.075		
		Soft	0.033	0.2	0.007		
		Subtotal	0.116			0.0812	0.700
Uncontrolled - Tributary	F100A	Hard	0.046	0.9	0.041		
		Soft	0.064	0.2	0.013		
		Subtotal	0.110			0.0539	0.490
Roof	BLDGA	Hard	0.115	0.9	0.104		
		Soft	0.000	0.2	0.000		
		Subtotal	0.115			0.1035	0.900
Roof	BLDGC	Hard	0.115	0.9	0.104		
		Soft	0.000	0.2	0.000		
		Subtotal	0.115			0.1035	0.900
Roof	BLDGB	Hard	0.102	0.9	0.092		
		Soft	0.000	0.2	0.000		
		Subtotal	0.102			0.0918	0.900
Controlled - Tributary	L301A	Hard	0.133	0.9	0.120		
		Soft	0.006	0.2	0.001		
		Subtotal	0.139			0.12093	0.870
Controlled - Tributary	L300A	Hard	0.131	0.9	0.118		
		Soft	0.006	0.2	0.001		
		Subtotal	0.137			0.11919	0.870
Controlled - Tributary	L101B	Hard	0.105	0.9	0.094		
		Soft	0.148	0.2	0.030		
		Subtotal	0.253			0.12397	0.490
Uncontrolled - Tributary	F101A	Hard	0.088	0.9	0.079		
		Soft	0.022	0.2	0.004		
		Subtotal	0.110			0.0836	0.760
Uncontrolled - Tributary	UNC-2	Hard	0.008	0.9	0.007		
		Soft	0.046	0.2	0.009		
		Subtotal	0.053			0.01602	0.300
Uncontrolled - Tributary	EX-19	Hard	0.058	0.9	0.053		
		Soft	0.088	0.2	0.018		
		Subtotal	0.146			0.07008	0.480
Uncontrolled - Tributary	EX-18	Hard	0.010	0.9	0.009		
		Soft	0.054	0.2	0.011		
		Subtotal	0.064			0.019716	0.310
Uncontrolled - Tributary	EX-15	Hard	0.026	0.9	0.023		
		Soft	0.052	0.2	0.010		
		Subtotal	0.078			0.03354	0.430
Uncontrolled - Tributary	EX-14	Hard	0.094	0.9	0.085		
		Soft	0.235	0.2	0.047		
		Subtotal	0.329			0.1316	0.400
Uncontrolled - Tributary	EX-13	Hard	0.232	0.9	0.209		
		Soft	0.000	0.2	0.000		
		Subtotal	0.232			0.2088	0.900
Uncontrolled - Tributary	EX-12	Hard	0.232	0.9	0.209		
		Soft	0.000	0.2	0.000		
		Subtotal	0.232			0.2088	0.900
Uncontrolled - Tributary	EX-11	Hard	0.042	0.9	0.038		
		Soft	0.091	0.2	0.018		
		Subtotal	0.133			0.05586	0.420
Uncontrolled - Tributary	EX-10	Hard	0.263	0.9	0.237		
		Soft	0.113	0.2	0.023		
		Subtotal	0.376			0.25944	0.690
Uncontrolled - Tributary	EX-9	Hard	0.061	0.9	0.055		
		Soft	0.000	0.2	0.000		
		Subtotal	0.061			0.05463	0.900
Uncontrolled - Tributary	EX-8	Hard	0.459	0.9	0.413		
		Soft	0.255	0.2	0.051		
		Subtotal	0.714			0.4641	0.650
Uncontrolled - Tributary	EX-7	Hard	0.000	0.9	0.000		
		Soft	0.075	0.2	0.015		
		Subtotal	0.075			0.01492	0.200
Uncontrolled - Tributary	EX-5	Hard	0.231	0.9	0.208		
		Soft	0.000	0.2	0.000		
		Subtotal	0.231			0.2079	0.900
Uncontrolled - Tributary	EX-4	Hard	0.421	0.9	0.379		
		Soft	0.265	0.2	0.053		
		Subtotal	0.686			0.43218	0.630
Uncontrolled - Tributary	EX-3	Hard	0.231	0.9	0.208		
		Soft	0.000	0.2	0.000		
		Subtotal	0.231			0.2079	0.900
Uncontrolled - Tributary	EX-2	Hard	0.065	0.9	0.059		
		Soft	0.204	0.2	0.041		
		Subtotal	0.269			0.09953	0.370
Uncontrolled - Tributary	EX-1	Hard	0.053	0.9	0.047		
		Soft	0.231	0.2	0.046		
		Subtotal	0.284			0.09372	0.330
Total			**5.588**			**3.559**	
Overall Runoff Coefficient= C:							**0.64**

Total Roof Areas	**0.332 ha**
Total Tributary Surface Areas (Controlled and Uncontrolled)	**5.256 ha**
Total Tributary Area to Outlet	**5.588 ha**
Total Uncontrolled Areas (Non-Tributary)	**0.000 ha**
Total Site	**5.588 ha**

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

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

a =	998.071
b =	6.053
c =	0.814

t (min)	I (mm/hr)
5	141.18
10	104.19
15	83.56
20	70.25
25	60.90
30	53.93
35	48.52
40	44.18
45	40.63
50	37.65
55	35.12
60	32.94

Predevelopment Release from Entire Site

Subdrainage Area: Predevelopment Tributary Area to Outlet
Area (ha): 5.59
C: 0.65

Typical Time of Concentration

tc (min)	I (5 yr) (mm/hr)	Qtarget (L/s)	I (100 yr) (mm/hr)	Qtarget (L/s)
10	104.19	**1055.2**	178.56	**2260.4**

5 YEAR Modified Rational Method for Entire Site

Subdrainage Area: L103B — Controlled - Tributary
Area (ha): 0.06
C: 0.61

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	11.2	9.7	1.5	**0.9**
20	70.25	7.6	9.7	0.0	0.0
30	53.93	5.8	9.7	0.0	0.0
40	44.18	4.8	9.7	0.0	0.0
50	37.65	4.1	9.7	0.0	0.0
60	32.94	3.6	9.7	0.0	0.0
70	29.37	3.2	9.7	0.0	0.0
80	26.56	2.9	9.7	0.0	0.0
90	24.29	2.6	9.7	0.0	0.0
100	22.41	2.4	9.7	0.0	0.0
110	20.82	2.2	9.7	0.0	0.0
120	19.47	2.1	9.7	0.0	0.0

Storage: e Above CE

Orifice Diameter: LMF 95 mm
Invert Elevation 75.57 m
T/G Elevation 76.95 m
Max Ponding Depth 0.10 m
Downstream W/L 75.42 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Leve	77.05	1.48	9.7	0.9	16.0	OK

Subdrainage Area: L103A — Controlled - Tributary
Area (ha): 0.13
C: 0.45

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	17.5	5.4	12.1	7.2
20	70.25	11.8	5.4	6.4	**7.6**
30	53.93	9.0	5.4	3.6	6.5
40	44.18	7.4	5.4	2.0	4.8
50	37.65	6.3	5.4	0.9	2.7
60	32.94	5.5	5.4	0.1	0.4
70	29.37	4.9	5.4	0.0	0.0
80	26.56	4.5	5.4	0.0	0.0
90	24.29	4.1	5.4	0.0	0.0
100	22.41	3.8	5.4	0.0	0.0
110	20.82	3.5	5.4	0.0	0.0
120	19.47	3.3	5.4	0.0	0.0

Storage: e Above CE

Orifice Equation: Q = CdA(2gh)^0.5 Where C = 0.61
Orifice Diameter: 83.00 mm
Invert Elevation 75.57 m
T/G Elevation 76.95 m
Max Ponding Depth 0.20 m
Downstream W/L 75.42 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Leve	77.15	1.58	5.4	7.6	14.3	OK

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

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

a =	1735.688
b =	6.014
c =	0.820

t (min)	I (mm/hr)
5	242.70
10	178.56
15	142.89
20	119.95
25	103.85
30	91.87
35	82.58
40	75.15
45	69.05
50	63.95
55	59.62
60	55.89

5-YEAR Predevelopment Release from Redeveloped Portions of Site

Subdrainage Area: Redeveloped Site Area
Area (ha): 1.55
C: 0.63

Typical Time of Concentration

tc (min)	I (5 yr) (mm/hr)	Qtarget (L/s)
10	104.19	**282.3**

100 YEAR Modified Rational Method for Entire Site

Subdrainage Area: L103B — Controlled - Tributary
Area (ha): 0.06
C: 0.76

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	24.1	10.2	13.9	**8.3**
20	119.95	16.2	10.2	6.0	7.2
30	91.87	12.4	10.2	2.2	4.0
40	75.15	10.1	10.2	0.0	0.0
50	63.95	8.6	10.2	0.0	0.0
60	55.89	7.5	10.2	0.0	0.0
70	49.79	6.7	10.2	0.0	0.0
80	44.99	6.1	10.2	0.0	0.0
90	41.11	5.5	10.2	0.0	0.0
100	37.90	5.1	10.2	0.0	0.0
110	35.20	4.7	10.2	0.0	0.0
120	32.89	4.4	10.2	0.0	0.0

Storage: Surface Storage Above CB

Orifice: LMF 95 CB Storage: 0.71 m3
Invert Elevation 75.57 m
T/G Elevation 76.95 m
Max Ponding Depth 0.25 m
Downstream W/L 75.42 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Leve	77.20	1.63	10.2	8.3	16.0	OK
					7.68	

Subdrainage Area: L103A — Controlled - Tributary
Area (ha): 0.13
C: 0.56

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	37.4	18.7	18.8	**11.3**
20	119.95	25.1	18.7	6.5	7.8
30	91.87	19.3	18.7	0.6	1.1
40	75.15	15.7	18.7	0.0	0.0
50	63.95	13.4	18.7	0.0	0.0
60	55.89	11.7	18.7	0.0	0.0
70	49.79	10.4	18.7	0.0	0.0
80	44.99	9.4	18.7	0.0	0.0
90	41.11	8.6	18.7	0.0	0.0
100	37.90	7.9	18.7	0.0	0.0
110	35.20	7.4	18.7	0.0	0.0
120	32.89	6.9	18.7	0.0	0.0

Storage: Surface Storage Above CB

Orifice Equation: Q = CdA(2gh)^0.5 Where C = 0.61
Orifice Diameter: 83.00 mm CB Storage: 0.71 m3
Invert Elevation 75.57 m
T/G Elevation 76.95 m
Max Ponding Depth 0.25 m
Downstream W/L 75.42 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Leve	77.20	1.63	18.7	11.3	14.3	OK
					3.06	

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: L102A — Controlled - Tributary
Area (ha): 0.12
C: 0.70

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	23.5	7.1	16.4	9.9
20	70.25	15.9	7.1	8.8	**10.5**
30	53.93	12.2	7.1	5.1	9.1
40	44.18	10.0	7.1	2.9	6.9
50	37.65	8.5	7.1	1.4	4.2
60	32.94	7.4	7.1	0.3	1.2
70	29.37	6.6	7.1	0.0	0.0
80	26.56	6.0	7.1	0.0	0.0
90	24.29	5.5	7.1	0.0	0.0
100	22.41	5.1	7.1	0.0	0.0
110	20.82	4.7	7.1	0.0	0.0
120	19.47	4.4	7.1	0.0	0.0

Storage: e Above CE

Orifice Diameter: LMF 80
Invert Elevation 75.44 m
T/G Elevation 76.82 m
Max Ponding Depth 0.16 m
Downstream W/L 75.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Leve	76.98	1.54	7.1	10.5	53.9	OK

Subdrainage Area: F100A — Uncontrolled - Tributary
Area (ha): 0.11
C: 0.49

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	15.6	15.6		
20	70.25	10.5	10.5		
30	53.93	8.1	8.1		
40	44.18	6.6	6.6		
50	37.65	5.6	5.6		
60	32.94	4.9	4.9		
70	29.37	4.4	4.4		
80	26.56	4.0	4.0		
90	24.29	3.6	3.6		
100	22.41	3.4	3.4		
110	20.82	3.1	3.1		
120	19.47	2.9	2.9		

Subdrainage Area: BLDGA — Roof
Area (ha): 0.12 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	30.0	6.3	23.6	14.2	101.1	0.00
20	70.25	20.2	6.4	13.8	**16.5**	105.6	0.00
30	53.93	15.5	6.4	9.1	16.3	105.2	0.00
40	44.18	12.7	6.4	6.3	15.2	103.0	0.00
50	37.65	10.8	6.3	4.5	13.6	99.9	0.00
60	32.94	9.5	6.2	3.3	11.9	94.5	0.00
70	29.37	8.5	6.0	2.4	10.2	89.0	0.00
80	26.56	7.6	5.9	1.8	8.4	83.4	0.00
90	24.29	7.0	5.8	1.2	6.7	77.9	0.00
100	22.41	6.4	5.6	0.9	5.2	71.4	0.00
110	20.82	6.0	5.4	0.6	3.9	63.8	0.00
120	19.47	5.6	5.2	0.4	2.8	56.7	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Leve	105.56	0.11	6.4	16.5	46.0	0.00

Subdrainage Area: BLDGC — Roof
Area (ha): 0.12 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	30.0	6.3	23.6	14.2	101.1	0.00
20	70.25	20.2	6.4	13.8	**16.5**	105.6	0.00
30	53.93	15.5	6.4	9.1	16.3	105.2	0.00
40	44.18	12.7	6.4	6.3	15.2	103.0	0.00
50	37.65	10.8	6.3	4.5	13.6	99.9	0.00
60	32.94	9.5	6.2	3.3	11.9	94.5	0.00
70	29.37	8.5	6.0	2.4	10.2	89.0	0.00
80	26.56	7.6	5.9	1.8	8.4	83.4	0.00
90	24.29	7.0	5.8	1.2	6.7	77.9	0.00
100	22.41	6.4	5.6	0.9	5.2	71.4	0.00
110	20.82	6.0	5.4	0.6	3.9	63.8	0.00
120	19.47	5.6	5.2	0.4	2.8	56.7	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Leve	105.56	0.11	6.4	16.5	46.0	0.00

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: L102A — Controlled - Tributary
Area (ha): 0.12
C: 0.88

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	50.4	7.4	43.0	25.8
20	119.95	33.8	7.4	26.5	31.8
30	91.87	25.9	7.4	18.6	**33.4**
40	75.15	21.2	7.4	13.8	33.2
50	63.95	18.0	7.4	10.7	32.0
60	55.89	15.8	7.4	8.4	30.3
70	49.79	14.0	7.4	6.7	28.1
80	44.99	12.7	7.4	5.3	25.6
90	41.11	11.6	7.4	4.2	22.9
100	37.90	10.7	7.4	3.3	20.0
110	35.20	9.9	7.4	2.6	17.0
120	32.89	9.3	7.4	1.9	13.8

Storage: Surface Storage Above CB

CB Storage: 0.71 m3

Orifice Diameter: LMF 80
Invert Elevation 75.44 m
T/G Elevation 76.82 m
Max Ponding Depth 0.28 m
Downstream W/L 75.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Leve	77.10	1.66	7.4	33.4	53.9	OK
					20.50	

Subdrainage Area: F100A — Uncontrolled - Tributary
Area (ha): 0.11
C: 0.61

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	33.4	33.4		
20	119.95	22.5	22.5		
30	91.87	17.2	17.2		
40	75.15	14.1	14.1		
50	63.95	12.0	12.0		
60	55.89	10.5	10.5		
70	49.79	9.3	9.3		
80	44.99	8.4	8.4		
90	41.11	7.7	7.7		
100	37.90	7.1	7.1		
110	35.20	6.6	6.6		
120	32.89	6.2	6.2		

Subdrainage Area: BLDGA — Roof
Area (ha): 0.12 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	57.1	7.1	50.0	30.0	129.4	0.00
20	119.95	38.3	7.3	31.1	37.3	138.7	0.00
30	91.87	29.4	7.4	22.0	39.6	141.8	0.00
40	75.15	24.0	7.4	16.6	**40.0**	142.2	0.00
50	63.95	20.4	7.4	13.1	39.3	141.3	0.00
60	55.89	17.9	7.3	10.6	38.0	139.7	0.00
70	49.79	15.9	7.3	8.7	36.4	137.6	0.00
80	44.99	14.4	7.2	7.2	34.5	135.2	0.00
90	41.11	13.1	7.1	6.0	32.5	132.5	0.00
100	37.90	12.1	7.1	5.1	30.3	129.8	0.00
110	35.20	11.3	7.0	4.3	28.1	127.0	0.00
120	32.89	10.5	6.9	3.6	26.0	123.8	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Leve	142.21	0.14	7.4	40.0	46.0	0.00

Subdrainage Area: BLDGC — Roof
Area (ha): 0.12 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	57.1	7.1	50.0	30.0	129.4	0.00
20	119.95	38.3	7.3	31.1	37.3	138.7	0.00
30	91.87	29.4	7.4	22.0	39.6	141.8	0.00
40	75.15	24.0	7.4	16.6	**40.0**	142.2	0.00
50	63.95	20.4	7.4	13.1	39.3	141.3	0.00
60	55.89	17.9	7.3	10.6	38.0	139.7	0.00
70	49.79	15.9	7.3	8.7	36.4	137.6	0.00
80	44.99	14.4	7.2	7.2	34.5	135.2	0.00
90	41.11	13.1	7.1	6.0	32.5	132.5	0.00
100	37.90	12.1	7.1	5.1	30.3	129.8	0.00
110	35.20	11.3	7.0	4.3	28.1	127.0	0.00
120	32.89	10.5	6.9	3.6	26.0	123.8	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Leve	142.21	0.14	7.4	40.0	46.0	0.00

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: BLDGB — Roof
Area (ha): 0.10 — Maximum Storage Depth: 150 mm
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	104.19	26.6	6.3	20.3	12.2	100.2	0.00
20	70.25	17.9	6.4	11.5	**13.8**	103.8	0.00
30	53.93	13.8	6.4	7.4	13.3	102.6	0.00
40	44.18	11.3	6.3	5.0	12.0	99.5	0.00
50	37.65	9.6	6.2	3.5	10.4	93.8	0.00
60	32.94	8.4	6.0	2.4	8.7	87.8	0.00
70	29.37	7.5	5.8	1.7	6.9	81.6	0.00
80	26.56	6.8	5.7	1.1	5.2	75.5	0.00
90	24.29	6.2	5.5	0.7	3.9	66.8	0.00
100	22.41	5.7	5.3	0.5	2.7	58.5	0.00
110	20.82	5.3	5.1	0.2	1.6	50.8	0.00
120	19.47	5.0	4.8	0.2	1.4	47.3	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
5-year Water Leve	103.78	0.10	6.4	13.8	40.8	0.00

Subdrainage Area: L301A — Controlled - Tributary
Area (ha): 0.14
C: 0.87

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	35.0	40.2	0.0	**0.0**
20	70.25	23.6	40.2	0.0	**0.0**
30	53.93	18.1	40.2	0.0	**0.0**
40	44.18	14.9	40.2	0.0	**0.0**
50	37.65	12.7	40.2	0.0	**0.0**
60	32.94	11.1	40.2	0.0	**0.0**
70	29.37	9.9	40.2	0.0	**0.0**
80	26.56	8.9	40.2	0.0	**0.0**
90	24.29	8.2	40.2	0.0	**0.0**
100	22.41	7.5	40.2	0.0	**0.0**
110	20.82	7.0	40.2	0.0	**0.0**
120	19.47	6.5	40.2	0.0	**0.0**

Storage: e Above CE

Orifice Equation: CdA(2gh)^0.5 — Where C = 0.61
Orifice Diameter: 127.00 mm
Invert Elevation 77.99 m
T/G Elevation 79.37 m
Max Ponding Depth 0.00 m
Downstream W/L 75.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Leve	79.37	1.38	40.2	0.0	16.8	OK

Subdrainage Area: L300A — Controlled - Tributary
Area (ha): 0.14
C: 0.87

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	34.5	40.2	0.0	**0.0**
20	70.25	23.3	40.2	0.0	**0.0**
30	53.93	17.9	40.2	0.0	**0.0**
40	44.18	14.6	40.2	0.0	**0.0**
50	37.65	12.5	40.2	0.0	**0.0**
60	32.94	10.9	40.2	0.0	**0.0**
70	29.37	9.7	40.2	0.0	**0.0**
80	26.56	8.8	40.2	0.0	**0.0**
90	24.29	8.0	40.2	0.0	**0.0**
100	22.41	7.4	40.2	0.0	**0.0**
110	20.82	6.9	40.2	0.0	**0.0**
120	19.47	6.5	40.2	0.0	**0.0**

Storage: e Above CE

Orifice Equation: CdA(2gh)^0.5 — Where C = 0.61
Orifice Diameter: 127.00 mm
Invert Elevation 77.89 m
T/G Elevation 79.27 m
Max Ponding Depth 0.00 m
Downstream W/L 75.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Leve	79.27	1.38	40.2	0.0	18.7	OK

Subdrainage Area: L101B — Controlled - Tributary
Area (ha): 0.25
C: 0.49

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	35.9	11.1	24.8	14.9
20	70.25	24.2	11.1	13.1	**15.8**
30	53.93	18.6	11.1	7.5	13.5
40	44.18	15.2	11.1	4.2	10.0
50	37.65	13.0	11.1	1.9	5.7
60	32.94	11.4	11.1	0.3	1.0
70	29.37	10.1	11.1	0.0	0.0
80	26.56	9.2	11.1	0.0	0.0
90	24.29	8.4	11.1	0.0	0.0
100	22.41	7.7	11.1	0.0	0.0
110	20.82	7.2	11.1	0.0	0.0
120	19.47	6.7	11.1	0.0	0.0

Storage: e Above CE

Orifice Diameter: 102.00
Invert Elevation 75.63 m
T/G Elevation 76.75 m
Max Ponding Depth 0.16 m
Downstream W/L 75.23 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
5-year Water Leve	76.91	1.28	11.1	15.8	31.9	OK

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: BLDGB — Roof
Area (ha): 0.10 — Maximum Storage Depth: 150 mm
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
10	178.56	50.6	7.0	43.6	26.2	128.7	0.00
20	119.95	34.0	7.3	26.8	32.1	137.4	0.00
30	91.87	26.1	7.3	18.7	**33.7**	139.7	0.00
40	75.15	21.3	7.3	14.0	33.6	139.5	0.00
50	63.95	18.1	7.3	10.9	32.6	138.1	0.00
60	55.89	15.8	7.2	8.6	31.1	135.9	0.00
70	49.79	14.1	7.1	7.0	29.3	133.2	0.00
80	44.99	12.8	7.1	5.7	27.3	130.3	0.00
90	41.11	11.7	7.0	4.7	25.2	127.3	0.00
100	37.90	10.7	6.9	3.8	23.0	123.8	0.00
110	35.20	10.0	6.8	3.2	21.0	119.4	0.00
120	32.89	9.3	6.7	2.6	19.0	115.0	0.00

Storage: Roof Storage

	Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check
100-year Water Leve	139.72	0.14	7.3	33.7	40.8	0.00

Subdrainage Area: L301A — Controlled - Tributary
Area (ha): 0.14
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	69.0	42.8	26.2	**15.7**
20	119.95	46.4	42.8	3.6	4.3
30	91.87	35.5	42.8	0.0	0.0
40	75.15	29.0	42.8	0.0	0.0
50	63.95	24.7	42.8	0.0	0.0
60	55.89	21.6	42.8	0.0	0.0
70	49.79	19.2	42.8	0.0	0.0
80	44.99	17.4	42.8	0.0	0.0
90	41.11	15.9	42.8	0.0	0.0
100	37.90	14.6	42.8	0.0	0.0
110	35.20	13.6	42.8	0.0	0.0
120	32.89	12.7	42.8	0.0	0.0

Storage: Surface Storage Above CB

Orifice Equation: Q = CdA(2gh)^0.5 — Where C = 0.61
Orifice Diameter: 127.00 mm — CB Storage: 0.71 m3
Invert Elevation 77.99 m
T/G Elevation 79.37 m
Max Ponding Depth 0.18 m
Downstream W/L 75.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Leve	79.55	1.56	42.8	15.7	16.8	OK
						1.06

Subdrainage Area: L300A — Controlled - Tributary
Area (ha): 0.14
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	68.0	42.8	25.3	**15.2**
20	119.95	45.7	42.8	2.9	3.5
30	91.87	35.0	42.8	0.0	0.0
40	75.15	28.6	42.8	0.0	0.0
50	63.95	24.4	42.8	0.0	0.0
60	55.89	21.3	42.8	0.0	0.0
70	49.79	19.0	42.8	0.0	0.0
80	44.99	17.1	42.8	0.0	0.0
90	41.11	15.7	42.8	0.0	0.0
100	37.90	14.4	42.8	0.0	0.0
110	35.20	13.4	42.8	0.0	0.0
120	32.89	12.5	42.8	0.0	0.0

Storage: Surface Storage Above CB

Orifice Equation: Q = CdA(2gh)^0.5 — Where C = 0.61
Orifice Diameter: 127.00 mm — CB Storage: 0.71 m3
Invert Elevation 77.89 m
T/G Elevation 79.27 m
Max Ponding Depth 0.18 m
Downstream W/L 75.30 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Leve	79.45	1.56	42.8	15.2	18.7	OK
						3.56

Subdrainage Area: L101B — Controlled - Tributary
Area (ha): 0.25
C: 0.61

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	76.9	25.4	51.6	30.9
20	119.95	51.7	25.4	26.3	**31.6**
30	91.87	39.6	25.4	14.2	25.6
40	75.15	32.4	25.4	7.0	16.8
50	63.95	27.6	25.4	2.2	6.6
60	55.89	24.1	25.4	0.0	0.0
70	49.79	21.4	25.4	0.0	0.0
80	44.99	19.4	25.4	0.0	0.0
90	41.11	17.7	25.4	0.0	0.0
100	37.90	16.3	25.4	0.0	0.0
110	35.20	15.2	25.4	0.0	0.0
120	32.89	14.2	25.4	0.0	0.0

Storage: Surface Storage Above CB

Orifice Equation: Q = CdA(2gh)^0.5 — Where C = 0.61
Orifice Diameter: 102.00 mm — CB Storage: 0.62 m3
Invert Elevation 75.63 m
T/G Elevation 76.75 m
Max Ponding Depth 0.20 m
Downstream W/L 75.23 m

	Stage	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Volume Check
100-year Water Leve	76.95	1.32	25.4	31.6	31.9	OK
						0.35

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: F101A — Uncontrolled - Tributary
Area (ha): 0.11
C: 0.76

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	24.2	24.2		
20	70.25	16.3	16.3		
30	53.93	12.5	12.5		
40	44.18	10.3	10.3		
50	37.65	8.8	8.8		
60	32.94	7.7	7.7		
70	29.37	6.8	6.8		
80	26.56	6.2	6.2		
90	24.29	5.6	5.6		
100	22.41	5.2	5.2		
110	20.82	4.8	4.8		
120	19.47	4.5	4.5		

Subdrainage Area: UNC-2 — Uncontrolled - Tributary
Area (ha): 0.05
C: 0.30

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	4.6	4.6		
20	70.25	3.1	3.1		
30	53.93	2.4	2.4		
40	44.18	2.0	2.0		
50	37.65	1.7	1.7		
60	32.94	1.5	1.5		
70	29.37	1.3	1.3		
80	26.56	1.2	1.2		
90	24.29	1.1	1.1		
100	22.41	1.0	1.0		
110	20.82	0.9	0.9		
120	19.47	0.9	0.9		

Subdrainage Area: EX-19 — Uncontrolled - Tributary
Area (ha): 0.15
C: 0.48

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	20.3	20.3		
20	70.25	13.7	13.7		
30	53.93	10.5	10.5		
40	44.18	8.6	8.6		
50	37.65	7.3	7.3		
60	32.94	6.4	6.4		
70	29.37	5.7	5.7		
80	26.56	5.2	5.2		
90	24.29	4.7	4.7		
100	22.41	4.4	4.4		
110	20.82	4.1	4.1		
120	19.47	3.8	3.8		

Subdrainage Area: EX-18 — Uncontrolled - Tributary
Area (ha): 0.06
C: 0.31

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	5.7	5.7		
20	70.25	3.9	3.9		
30	53.93	3.0	3.0		
40	44.18	2.4	2.4		
50	37.65	2.1	2.1		
60	32.94	1.8	1.8		
70	29.37	1.6	1.6		
80	26.56	1.5	1.5		
90	24.29	1.3	1.3		
100	22.41	1.2	1.2		
110	20.82	1.1	1.1		
120	19.47	1.1	1.1		

Subdrainage Area: EX-15 — Uncontrolled - Tributary
Area (ha): 0.08
C: 0.43

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	9.7	9.7		
20	70.25	6.6	6.6		
30	53.93	5.0	5.0		
40	44.18	4.1	4.1		
50	37.65	3.5	3.5		
60	32.94	3.1	3.1		
70	29.37	2.7	2.7		
80	26.56	2.5	2.5		
90	24.29	2.3	2.3		
100	22.41	2.1	2.1		
110	20.82	1.9	1.9		
120	19.47	1.8	1.8		

Subdrainage Area: EX-14 — Uncontrolled - Tributary
Area (ha): 0.33
C: 0.40

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	38.1	38.1		
20	70.25	25.7	25.7		
30	53.93	19.7	19.7		
40	44.18	16.2	16.2		
50	37.65	13.8	13.8		
60	32.94	12.1	12.1		
70	29.37	10.7	10.7		
80	26.56	9.7	9.7		
90	24.29	8.9	8.9		
100	22.41	8.2	8.2		
110	20.82	7.6	7.6		
120	19.47	7.1	7.1		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: F101A — Uncontrolled - Tributary
Area (ha): 0.11
C: 0.95

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	51.9	51.9		
20	119.95	34.8	34.8		
30	91.87	26.7	26.7		
40	75.15	21.8	21.8		
50	63.95	18.6	18.6		
60	55.89	16.2	16.2		
70	49.79	14.5	14.5		
80	44.99	13.1	13.1		
90	41.11	11.9	11.9		
100	37.90	11.0	11.0		
110	35.20	10.2	10.2		
120	32.89	9.6	9.6		

Subdrainage Area: UNC-2 — Uncontrolled - Tributary
Area (ha): 0.05
C: 0.38

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	9.9	9.9		
20	119.95	6.7	6.7		
30	91.87	5.1	5.1		
40	75.15	4.2	4.2		
50	63.95	3.6	3.6		
60	55.89	3.1	3.1		
70	49.79	2.8	2.8		
80	44.99	2.5	2.5		
90	41.11	2.3	2.3		
100	37.90	2.1	2.1		
110	35.20	2.0	2.0		
120	32.89	1.8	1.8		

Subdrainage Area: EX-19 — Uncontrolled - Tributary
Area (ha): 0.15
C: 0.60

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	43.5	43.5		
20	119.95	29.2	29.2		
30	91.87	22.4	22.4		
40	75.15	18.3	18.3		
50	63.95	15.6	15.6		
60	55.89	13.6	13.6		
70	49.79	12.1	12.1		
80	44.99	11.0	11.0		
90	41.11	10.0	10.0		
100	37.90	9.2	9.2		
110	35.20	8.6	8.6		
120	32.89	8.0	8.0		

Subdrainage Area: EX-18 — Uncontrolled - Tributary
Area (ha): 0.06
C: 0.39

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	12.2	12.2		
20	119.95	8.2	8.2		
30	91.87	6.3	6.3		
40	75.15	5.1	5.1		
50	63.95	4.4	4.4		
60	55.89	3.8	3.8		
70	49.79	3.4	3.4		
80	44.99	3.1	3.1		
90	41.11	2.8	2.8		
100	37.90	2.6	2.6		
110	35.20	2.4	2.4		
120	32.89	2.3	2.3		

Subdrainage Area: EX-15 — Uncontrolled - Tributary
Area (ha): 0.08
C: 0.54

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	20.8	20.8		
20	119.95	14.0	14.0		
30	91.87	10.7	10.7		
40	75.15	8.8	8.8		
50	63.95	7.5	7.5		
60	55.89	6.5	6.5		
70	49.79	5.8	5.8		
80	44.99	5.2	5.2		
90	41.11	4.8	4.8		
100	37.90	4.4	4.4		
110	35.20	4.1	4.1		
120	32.89	3.8	3.8		

Subdrainage Area: EX-14 — Uncontrolled - Tributary
Area (ha): 0.33
C: 0.50

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	81.7	81.7		
20	119.95	54.9	54.9		
30	91.87	42.0	42.0		
40	75.15	34.4	34.4		
50	63.95	29.2	29.2		
60	55.89	25.6	25.6		
70	49.79	22.8	22.8		
80	44.99	20.6	20.6		
90	41.11	18.8	18.8		
100	37.90	17.3	17.3		
110	35.20	16.1	16.1		
120	32.89	15.0	15.0		

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-13 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.5	60.5		
20	70.25	40.8	40.8		
30	53.93	31.3	31.3		
40	44.18	25.6	25.6		
50	37.65	21.9	21.9		
60	32.94	19.1	19.1		
70	29.37	17.0	17.0		
80	26.56	15.4	15.4		
90	24.29	14.1	14.1		
100	22.41	13.0	13.0		
110	20.82	12.1	12.1		
120	19.47	11.3	11.3		

Subdrainage Area: EX-12 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.5	60.5		
20	70.25	40.8	40.8		
30	53.93	31.3	31.3		
40	44.18	25.6	25.6		
50	37.65	21.9	21.9		
60	32.94	19.1	19.1		
70	29.37	17.0	17.0		
80	26.56	15.4	15.4		
90	24.29	14.1	14.1		
100	22.41	13.0	13.0		
110	20.82	12.1	12.1		
120	19.47	11.3	11.3		

Subdrainage Area: EX-11 — Uncontrolled - Tributary
Area (ha): 0.13
C: 0.42

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	16.2	16.2		
20	70.25	10.9	10.9		
30	53.93	8.4	8.4		
40	44.18	6.9	6.9		
50	37.65	5.8	5.8		
60	32.94	5.1	5.1		
70	29.37	4.6	4.6		
80	26.56	4.1	4.1		
90	24.29	3.8	3.8		
100	22.41	3.5	3.5		
110	20.82	3.2	3.2		
120	19.47	3.0	3.0		

Subdrainage Area: EX-10 — Uncontrolled - Tributary
Area (ha): 0.38
C: 0.69

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	75.1	75.1		
20	70.25	50.7	50.7		
30	53.93	38.9	38.9		
40	44.18	31.9	31.9		
50	37.65	27.2	27.2		
60	32.94	23.8	23.8		
70	29.37	21.2	21.2		
80	26.56	19.2	19.2		
90	24.29	17.5	17.5		
100	22.41	16.2	16.2		
110	20.82	15.0	15.0		
120	19.47	14.0	14.0		

Subdrainage Area: EX-9 — Uncontrolled - Tributary
Area (ha): 0.06
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	15.8	15.8		
20	70.25	10.7	10.7		
30	53.93	8.2	8.2		
40	44.18	6.7	6.7		
50	37.65	5.7	5.7		
60	32.94	5.0	5.0		
70	29.37	4.5	4.5		
80	26.56	4.0	4.0		
90	24.29	3.7	3.7		
100	22.41	3.4	3.4		
110	20.82	3.2	3.2		
120	19.47	3.0	3.0		

Subdrainage Area: EX-8 — Uncontrolled - Tributary
Area (ha): 0.71
C: 0.65

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	134.4	134.4		
20	70.25	90.6	90.6		
30	53.93	69.6	69.6		
40	44.18	57.0	57.0		
50	37.65	48.6	48.6		
60	32.94	42.5	42.5		
70	29.37	37.9	37.9		
80	26.56	34.3	34.3		
90	24.29	31.3	31.3		
100	22.41	28.9	28.9		
110	20.82	26.9	26.9		
120	19.47	25.1	25.1		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-13 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	115.2	115.2		
20	119.95	77.4	77.4		
30	91.87	59.3	59.3		
40	75.15	48.5	48.5		
50	63.95	41.2	41.2		
60	55.89	36.0	36.0		
70	49.79	32.1	32.1		
80	44.99	29.0	29.0		
90	41.11	26.5	26.5		
100	37.90	24.4	24.4		
110	35.20	22.7	22.7		
120	32.89	21.2	21.2		

Subdrainage Area: EX-12 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	115.2	115.2		
20	119.95	77.4	77.4		
30	91.87	59.3	59.3		
40	75.15	48.5	48.5		
50	63.95	41.2	41.2		
60	55.89	36.0	36.0		
70	49.79	32.1	32.1		
80	44.99	29.0	29.0		
90	41.11	26.5	26.5		
100	37.90	24.4	24.4		
110	35.20	22.7	22.7		
120	32.89	21.2	21.2		

Subdrainage Area: EX-11 — Uncontrolled - Tributary
Area (ha): 0.13
C: 0.53

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	34.7	34.7		
20	119.95	23.3	23.3		
30	91.87	17.8	17.8		
40	75.15	14.6	14.6		
50	63.95	12.4	12.4		
60	55.89	10.8	10.8		
70	49.79	9.7	9.7		
80	44.99	8.7	8.7		
90	41.11	8.0	8.0		
100	37.90	7.4	7.4		
110	35.20	6.8	6.8		
120	32.89	6.4	6.4		

Subdrainage Area: EX-10 — Uncontrolled - Tributary
Area (ha): 0.38
C: 0.86

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	161.0	161.0		
20	119.95	108.1	108.1		
30	91.87	82.8	82.8		
40	75.15	67.7	67.7		
50	63.95	57.7	57.7		
60	55.89	50.4	50.4		
70	49.79	44.9	44.9		
80	44.99	40.6	40.6		
90	41.11	37.1	37.1		
100	37.90	34.2	34.2		
110	35.20	31.7	31.7		
120	32.89	29.7	29.7		

Subdrainage Area: EX-9 — Uncontrolled - Tributary
Area (ha): 0.06
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	30.1	30.1		
20	119.95	20.2	20.2		
30	91.87	15.5	15.5		
40	75.15	12.7	12.7		
50	63.95	10.8	10.8		
60	55.89	9.4	9.4		
70	49.79	8.4	8.4		
80	44.99	7.6	7.6		
90	41.11	6.9	6.9		
100	37.90	6.4	6.4		
110	35.20	5.9	5.9		
120	32.89	5.6	5.6		

Subdrainage Area: EX-8 — Uncontrolled - Tributary
Area (ha): 0.71
C: 0.81

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	288.0	288.0		
20	119.95	193.4	193.4		
30	91.87	148.2	148.2		
40	75.15	121.2	121.2		
50	63.95	103.1	103.1		
60	55.89	90.1	90.1		
70	49.79	80.3	80.3		
80	44.99	72.6	72.6		
90	41.11	66.3	66.3		
100	37.90	61.1	61.1		
110	35.20	56.8	56.8		
120	32.89	53.1	53.1		

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-7 — Uncontrolled - Tributary
Area (ha): 0.07
C: 0.20

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	4.3	4.3		
20	70.25	2.9	2.9		
30	53.93	2.2	2.2		
40	44.18	1.8	1.8		
50	37.65	1.6	1.6		
60	32.94	1.4	1.4		
70	29.37	1.2	1.2		
80	26.56	1.1	1.1		
90	24.29	1.0	1.0		
100	22.41	0.9	0.9		
110	20.82	0.9	0.9		
120	19.47	0.8	0.8		

Subdrainage Area: EX-5 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.2	60.2		
20	70.25	40.6	40.6		
30	53.93	31.2	31.2		
40	44.18	25.5	25.5		
50	37.65	21.8	21.8		
60	32.94	19.0	19.0		
70	29.37	17.0	17.0		
80	26.56	15.4	15.4		
90	24.29	14.0	14.0		
100	22.41	13.0	13.0		
110	20.82	12.0	12.0		
120	19.47	11.3	11.3		

Subdrainage Area: EX-4 — Uncontrolled - Tributary
Area (ha): 0.69
C: 0.63

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	125.2	125.2		
20	70.25	84.4	84.4		
30	53.93	64.8	64.8		
40	44.18	53.1	53.1		
50	37.65	45.2	45.2		
60	32.94	39.6	39.6		
70	29.37	35.3	35.3		
80	26.56	31.9	31.9		
90	24.29	29.2	29.2		
100	22.41	26.9	26.9		
110	20.82	25.0	25.0		
120	19.47	23.4	23.4		

Subdrainage Area: EX-3 — Uncontrolled - Tributary
Area (ha): 0.23
C: 0.90

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	60.2	60.2		
20	70.25	40.6	40.6		
30	53.93	31.2	31.2		
40	44.18	25.5	25.5		
50	37.65	21.8	21.8		
60	32.94	19.0	19.0		
70	29.37	17.0	17.0		
80	26.56	15.4	15.4		
90	24.29	14.0	14.0		
100	22.41	13.0	13.0		
110	20.82	12.0	12.0		
120	19.47	11.3	11.3		

Subdrainage Area: EX-2 — Uncontrolled - Tributary
Area (ha): 0.27
C: 0.37

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	28.8	28.8		
20	70.25	19.4	19.4		
30	53.93	14.9	14.9		
40	44.18	12.2	12.2		
50	37.65	10.4	10.4		
60	32.94	9.1	9.1		
70	29.37	8.1	8.1		
80	26.56	7.3	7.3		
90	24.29	6.7	6.7		
100	22.41	6.2	6.2		
110	20.82	5.8	5.8		
120	19.47	5.4	5.4		

Subdrainage Area: EX-1 — Uncontrolled - Tributary
Area (ha): 0.28
C: 0.33

tc (min)	I (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	104.19	27.1	27.1		
20	70.25	18.3	18.3		
30	53.93	14.1	14.1		
40	44.18	11.5	11.5		
50	37.65	9.8	9.8		
60	32.94	8.6	8.6		
70	29.37	7.7	7.7		
80	26.56	6.9	6.9		
90	24.29	6.3	6.3		
100	22.41	5.8	5.8		
110	20.82	5.4	5.4		
120	19.47	5.1	5.1		

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

Subdrainage Area: EX-7 — Uncontrolled - Tributary
Area (ha): 0.07
C: 0.25

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	9.3	9.3		
20	119.95	6.2	6.2		
30	91.87	4.8	4.8		
40	75.15	3.9	3.9		
50	63.95	3.3	3.3		
60	55.89	2.9	2.9		
70	49.79	2.6	2.6		
80	44.99	2.3	2.3		
90	41.11	2.1	2.1		
100	37.90	2.0	2.0		
110	35.20	1.8	1.8		
120	32.89	1.7	1.7		

Subdrainage Area: EX-5 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	114.7	114.7		
20	119.95	77.0	77.0		
30	91.87	59.0	59.0		
40	75.15	48.3	48.3		
50	63.95	41.1	41.1		
60	55.89	35.9	35.9		
70	49.79	32.0	32.0		
80	44.99	28.9	28.9		
90	41.11	26.4	26.4		
100	37.90	24.3	24.3		
110	35.20	22.6	22.6		
120	32.89	21.1	21.1		

Subdrainage Area: EX-4 — Uncontrolled - Tributary
Area (ha): 0.69
C: 0.79

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	268.2	268.2		
20	119.95	180.1	180.1		
30	91.87	138.0	138.0		
40	75.15	112.9	112.9		
50	63.95	96.0	96.0		
60	55.89	83.9	83.9		
70	49.79	74.8	74.8		
80	44.99	67.6	67.6		
90	41.11	61.7	61.7		
100	37.90	56.9	56.9		
110	35.20	52.9	52.9		
120	32.89	49.4	49.4		

Subdrainage Area: EX-3 — Uncontrolled - Tributary
Area (ha): 0.23
C: 1.00

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	114.7	114.7		
20	119.95	77.0	77.0		
30	91.87	59.0	59.0		
40	75.15	48.3	48.3		
50	63.95	41.1	41.1		
60	55.89	35.9	35.9		
70	49.79	32.0	32.0		
80	44.99	28.9	28.9		
90	41.11	26.4	26.4		
100	37.90	24.3	24.3		
110	35.20	22.6	22.6		
120	32.89	21.1	21.1		

Subdrainage Area: EX-2 — Uncontrolled - Tributary
Area (ha): 0.27
C: 0.46

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	61.8	61.8		
20	119.95	41.5	41.5		
30	91.87	31.8	31.8		
40	75.15	26.0	26.0		
50	63.95	22.1	22.1		
60	55.89	19.3	19.3		
70	49.79	17.2	17.2		
80	44.99	15.6	15.6		
90	41.11	14.2	14.2		
100	37.90	13.1	13.1		
110	35.20	12.2	12.2		
120	32.89	11.4	11.4		

Subdrainage Area: EX-1 — Uncontrolled - Tributary
Area (ha): 0.28
C: 0.41

tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10	178.56	58.2	58.2		
20	119.95	39.1	39.1		
30	91.87	29.9	29.9		
40	75.15	24.5	24.5		
50	63.95	20.8	20.8		
60	55.89	18.2	18.2		
70	49.79	16.2	16.2		
80	44.99	14.7	14.7		
90	41.11	13.4	13.4		
100	37.90	12.3	12.3		
110	35.20	11.5	11.5		
120	32.89	10.7	10.7		

Stormwater Management Calculations

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

5 YEAR SUMMARY TO OUTLET

Tributary Area	1.17 ha
Total 5yr Flow to Sewer	133.0 L/s
Non-Tributary Area	0.34 ha
Total 5yr Flow Uncontrolled	50.2 L/s
Total Area	1.51 ha
Total 5yr Flow	183.2 L/s
Target	282.3 L/s

Project #160401483, Norberry Residences
Modified Rational Method Calculatons for Storage

100 YEAR SUMMARY TO OUTLET

***Proposed Redeveloped Areas of The Site**

Controlled Tributary Area	1.17 ha
Total 100yr Flow to Sewer	169.1 L/s
Uncontrolled Tributary Area	0.34 ha
Total 100yr Flow Uncontrolled	107.5 L/s
Total Area	1.51 ha
Total 100yr Flow	276.6 L/s
Target	282.3 L/s

***Existing Areas of The Site to Remain**

Post Development

Tributary Area	4.076 ha
Total 100yr Flow to Sewer	1,517 L/s

Pre Development

Tributary Area	4.040 ha
Total 100yr Flow to Sewer	1,518 L/s

Project #160401483, Norberry Residences
Roof Drain Design Sheet, Area BLDGA
Standard Watts Model R1100 Accutrol Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0025	0	0.025	26	0	0	0.025
0.050	0.0006	0.0050	2	0.050	102	1	2	0.050
0.075	0.0007	0.0057	6	0.075	230	4	6	0.075
0.100	0.0008	0.0063	14	0.100	409	8	14	0.100
0.125	0.0009	0.0069	27	0.125	639	13	27	0.125
0.150	0.0009	0.0076	46	0.150	920	19	46	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
1.5	295.4	1.5	0.08204
5.5	712.6	4.0	0.27999
13.4	1248.9	7.9	0.62692
26.4	1871.9	13.0	1.14689
45.8	2559.8	19.4	1.85794

Rooftop Storage Summary

Total Building Area (sq.m)		1150
Assume Available Roof Area (sq.m)	80%	920
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		8
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		46
Estimated 100 Year Drawdown Time (h)		1.6

115

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

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

Calculation Results	5yr	100yr	Available
Qresult (cu.m/s)	0.006	0.007	-
Depth (m)	0.106	0.142	0.150
Volume (cu.m)	16.5	40.0	46.0
Draintime (hrs)	0.8	1.6	

From Watts Drain Catalogue

Head (m)	L/s Open	75%	50%	**25%**	Closed
0.025	0.31545	0.31545	0.31545	**0.31545**	0.31545
0.050	0.6309	0.6309	0.6309	**0.6309**	0.31545
0.075	0.94635	0.86749	0.78863	**0.70976**	0.31545
0.100	1.2618	1.10408	0.94635	**0.78863**	0.31545
0.125	1.57726	1.34067	1.10408	**0.86749**	0.31545
0.150	1.89271	1.57726	1.2618	**0.94635**	0.31545

Project #160401483, Norberry Residences
Roof Drain Design Sheet, Area BLDGB
Standard Watts Model R1100 Accutrol Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0025	0	0.025	23	0	0	0.025
0.050	0.0006	0.0050	2	0.050	91	1	2	0.050
0.075	0.0007	0.0057	5	0.075	204	4	5	0.075
0.100	0.0008	0.0063	12	0.100	363	7	12	0.100
0.125	0.0009	0.0069	24	0.125	567	12	24	0.125
0.150	0.0009	0.0076	41	0.150	816	17	41	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
1.3	262.0	1.3	0.07277
4.9	632.1	3.6	0.24834
11.9	1107.8	7.0	0.55605
23.4	1660.3	11.5	1.01724
40.6	2270.4	17.2	1.64791

Rooftop Storage Summary

Total Building Area (sq.m)		1020
Assume Available Roof Area (sq.	80%	816
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		8
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		41
Estimated 100 Year Drawdown Time (h)		1.4

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

From Watts Drain Catalogue

Head (m)	L/s Open	75%	50%	**25%**	Closed
0.025	0.3155	0.3155	0.3155	**0.3155**	0.3155
0.050	0.6309	0.6309	0.6309	**0.6309**	0.3155
0.075	0.9464	0.8675	0.7886	**0.7098**	0.3155
0.100	1.2618	1.1041	0.9464	**0.7886**	0.3155
0.125	1.5773	1.3407	1.1041	**0.8675**	0.3155
0.150	1.8927	1.5773	1.2618	**0.9464**	0.3155

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

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.006	0.007	-
Depth (m)	0.104	0.140	0.150
Volume (cu.m)	13.8	33.7	40.8
Draintime (hrs)	0.6	1.4	

Project #160401483, Norberry Residences
Roof Drain Design Sheet, Area BLDGC
Standard Watts Model R1100 Accutrol Roof Drain

Rating Curve				Volume Estimation				
Elevation (m)	Discharge Rate (cu.m/s)	Outlet Discharge (cu.m/s)	Storage (cu. m)	Elevation (m)	Area (sq. m)	Volume (cu. m) Increment	Volume (cu. m) Accumulated	Water Depth (m)
0.000	0.0000	0.0000	0	0.000	0	0	0	0.000
0.025	0.0003	0.0025	0	0.025	26	0	0	0.025
0.050	0.0006	0.0050	2	0.050	102	1	2	0.050
0.075	0.0007	0.0057	6	0.075	230	4	6	0.075
0.100	0.0008	0.0063	14	0.100	409	8	14	0.100
0.125	0.0009	0.0069	27	0.125	639	13	27	0.125
0.150	0.0009	0.0076	46	0.150	920	19	46	0.150

Drawdown Estimate			
Total Volume (cu.m)	Total Time (sec)	Vol (cu.m)	Detention Time (hr)
0.0	0.0	0.0	0
1.5	295.4	1.5	0.08204
5.5	712.6	4.0	0.27999
13.4	1248.9	7.9	0.62692
26.4	1871.9	13.0	1.14689
45.8	2559.8	19.4	1.85794

Rooftop Storage Summary

Total Building Area (sq.m)		1150
Assume Available Roof Area (sq.	80%	920
Roof Imperviousness		0.99
Roof Drain Requirement (sq.m/Notch)		232
Number of Roof Notches*		8
Max. Allowable Depth of Roof Ponding (m)		0.15
Max. Allowable Storage (cu.m)		46
Estimated 100 Year Drawdown Time (h)		1.6

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

From Watts Drain Catalogue

Head (m)	L/s Open	75%	50%	**25%**	Closed
0.025	0.3155	0.3155	0.3155	**0.3155**	0.3155
0.050	0.6309	0.6309	0.6309	**0.6309**	0.3155
0.075	0.9464	0.8675	0.7886	**0.7098**	0.3155
0.100	1.2618	1.1041	0.9464	**0.7886**	0.3155
0.125	1.5773	1.3407	1.1041	**0.8675**	0.3155
0.150	1.8927	1.5773	1.2618	**0.9464**	0.3155

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

Calculation Results	**5yr**	**100yr**	**Available**
Qresult (cu.m/s)	0.006	0.007	-
Depth (m)	0.106	0.142	0.150
Volume (cu.m)	16.5	40.0	46.0
Draintime (hrs)	0.8	1.6	

WATTS® DRAINAGE

Adjustable Accutrol Weir

Tag: _____

Adjustable Flow Control for Roof Drains

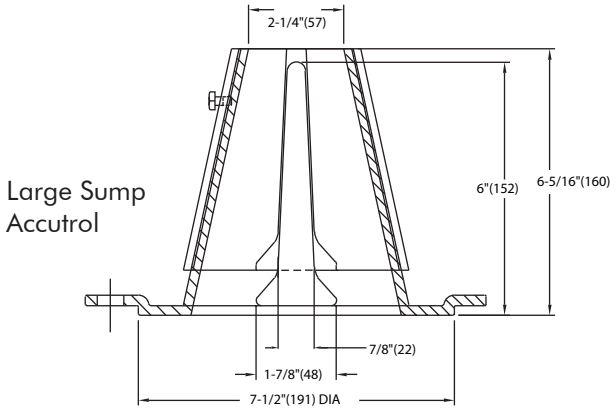
ADJUSTABLE ACCUTROL(for Large Sump Roof Drains only)

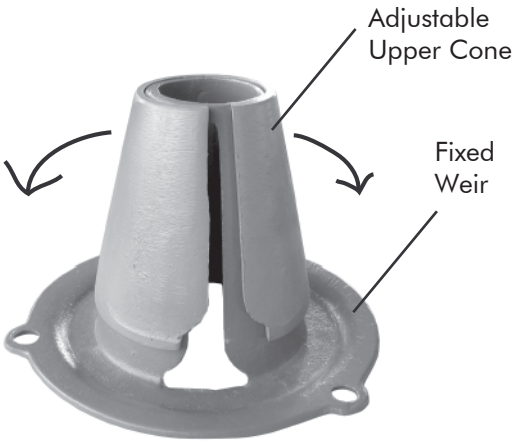
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the 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	Head of Water					
	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	10	10	10	10	10

Job Name _____ Contractor _____

Job Location _____ Contractor's P.O. No. _____

Engineer _____ Representative _____

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

C.4 OIL/GRIT SEPARATOR SIZING CALCULATIONS

Detailed Stormceptor Sizing Report – STC 101

Project Information & Location			
Project Name	Norberry Crescent	**Project Number**	160401483
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	7/10/2019
Designer Information		**EOR Information (optional)**	
Name	Cameron Odam	**Name**	
Company	Stantec Consulting Ltd.	**Company**	
Phone #	613-724-4353	**Phone #**	
Email	cameron.odam@stantec.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	STC 101
Recommended Stormceptor Model	STC 300
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	80
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	80	97
STC 750	87	99
STC 1000	88	99
STC 1500	89	99
STC 2000	91	100
STC 3000	92	100
STC 4000	94	100
STC 5000	94	100
STC 6000	95	100
STC 9000	97	100
STC 10000	97	100
STC 14000	98	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)**	977.6
Elevation (ft)	370	**Total Infiltration (mm)**	9814.3
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	10186.2

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

Drainage Area	
Total Area (ha)	0.364
Imperviousness %	53.1

Up Stream Storage	
Storage (ha-m)	Discharge (cms)
0.000	0.000
0.002	0.035
0.003	0.077

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

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

Design Details	
Stormceptor Inlet Invert Elev (m)	
Stormceptor Outlet Invert Elev (m)	
Stormceptor Rim Elev (m)	
Normal Water Level Elevation (m)	
Pipe Diameter (mm)	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

Site Name	STC 101

Site Details

Drainage Area

Total Area (ha)	0.364
Imperviousness %	53.1

Surface Characteristics

Width (m)	121.00
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	

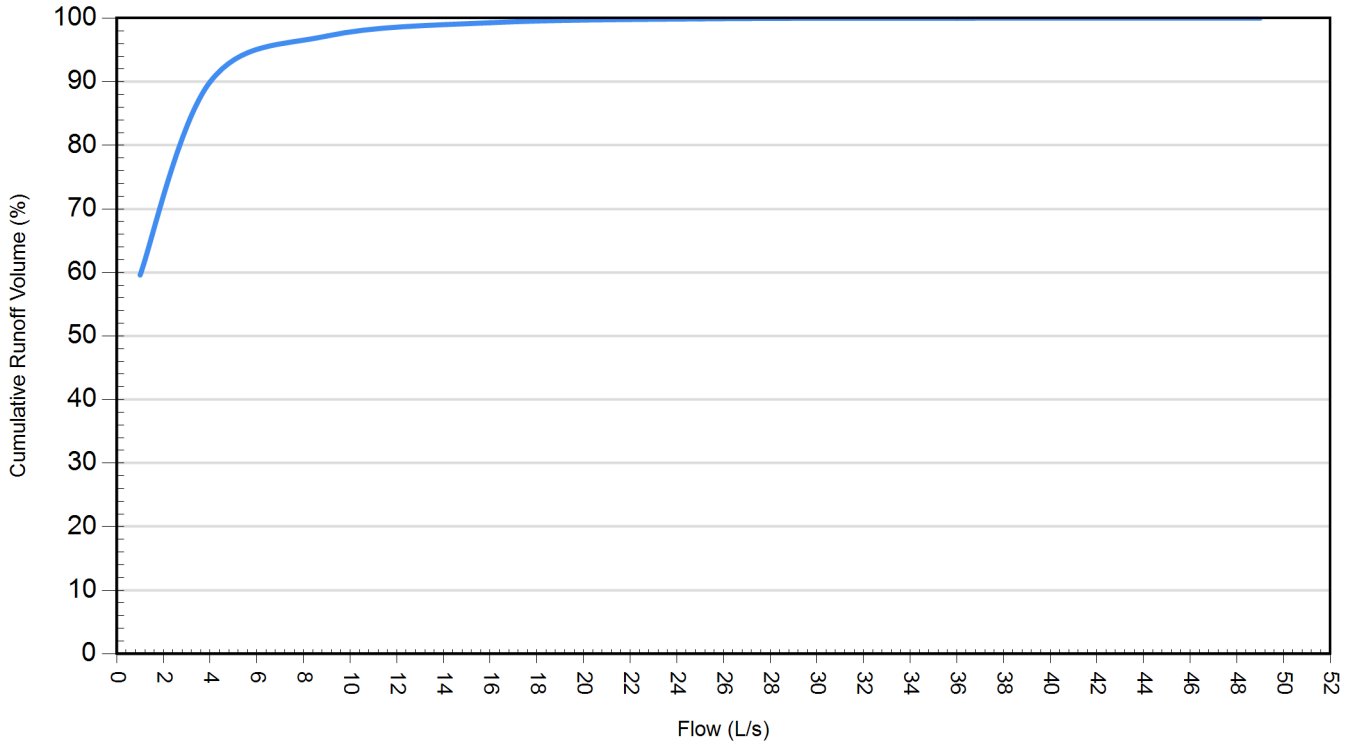
TSS Availability Parameters

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

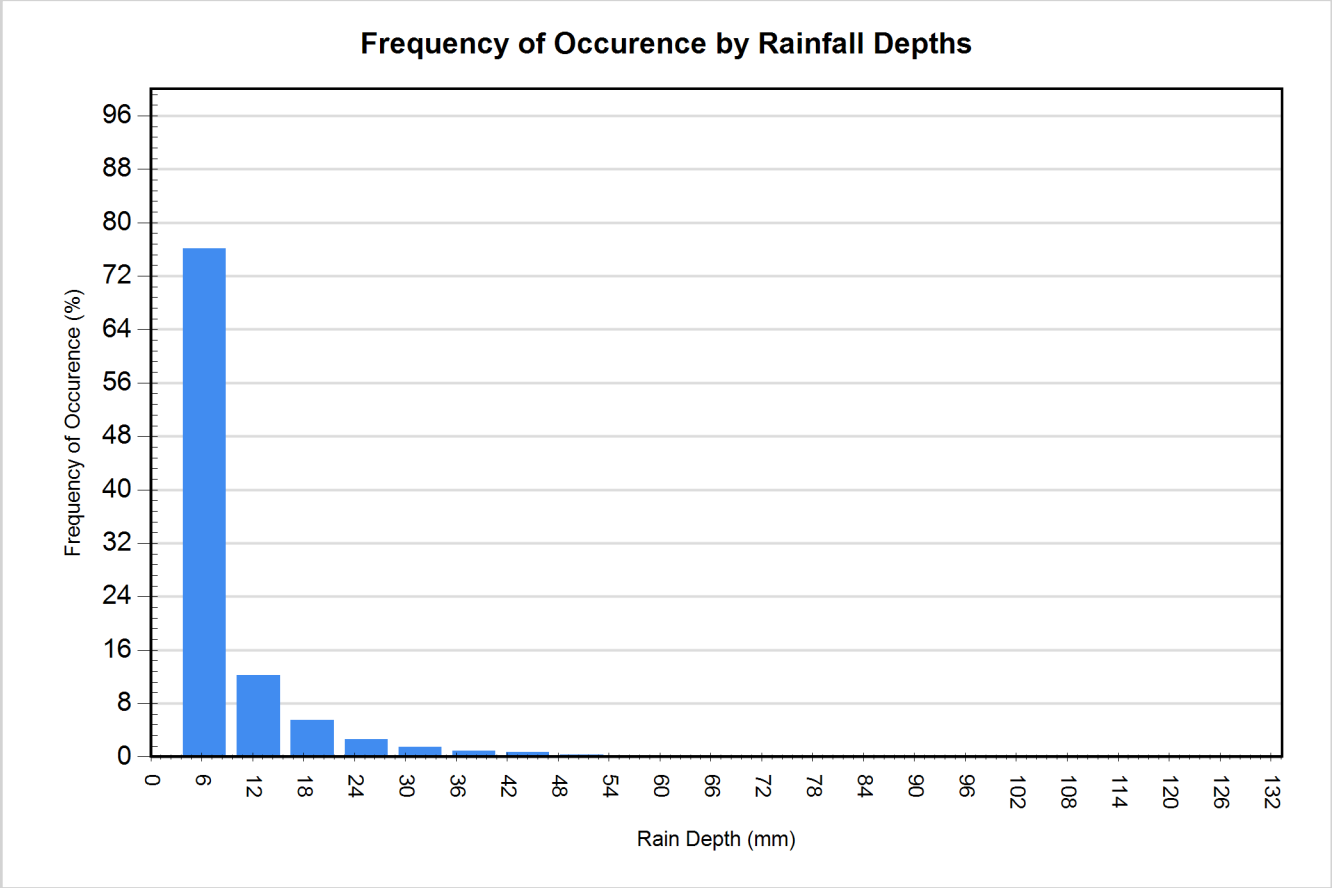
Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m^3)	Volume Over (m^3)	Cumulative Runoff Volume (%)
1	22271	15072	59.6
4	33593	3753	90.0
9	36302	1044	97.2
16	37068	278	99.3
25	37296	50	99.9
36	37343	3	100.0
49	37346	0	100.0

Cumulative Runoff Volume by Runoff Rate

For area: 0.364(ha), imperviousness: 53.1%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A



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



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

Detailed Stormceptor Sizing Report – Norberry 102

Project Information & Location			
Project Name	Norberry Crescent	**Project Number**	160401483
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	7/10/2019
Designer Information		**EOR Information (optional)**	
Name	Dustin Thiffault	**Name**	
Company	Stantec Consulting Ltd.	**Company**	
Phone #	613-724-4420	**Phone #**	
Email	dustin.thiffault@stantec.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	Norberry 102
Recommended Stormceptor Model	STC 300
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	86
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	86	100
STC 750	92	100
STC 1000	93	100
STC 1500	93	100
STC 2000	95	100
STC 3000	96	100
STC 4000	97	100
STC 5000	97	100
STC 6000	98	100
STC 9000	98	100
STC 10000	98	100
STC 14000	99	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)**	1287.3
Elevation (ft)	370	**Total Infiltration (mm)**	5979.4
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	13711.4

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)	0.12
Imperviousness %	71.4

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

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

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

Design Details	
Stormceptor Inlet Invert Elev (m)	75.30
Stormceptor Outlet Invert Elev (m)	75.25
Stormceptor Rim Elev (m)	77.12
Normal Water Level Elevation (m)	74.52
Pipe Diameter (mm)	300
Pipe Material	PVC - plastic
Multiple Inlets (Y/N)	No
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

Site Name	Norberry 102

Site Details

Drainage Area

Total Area (ha)	0.12
Imperviousness %	71.4

Surface Characteristics

Width (m)	69.00
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	

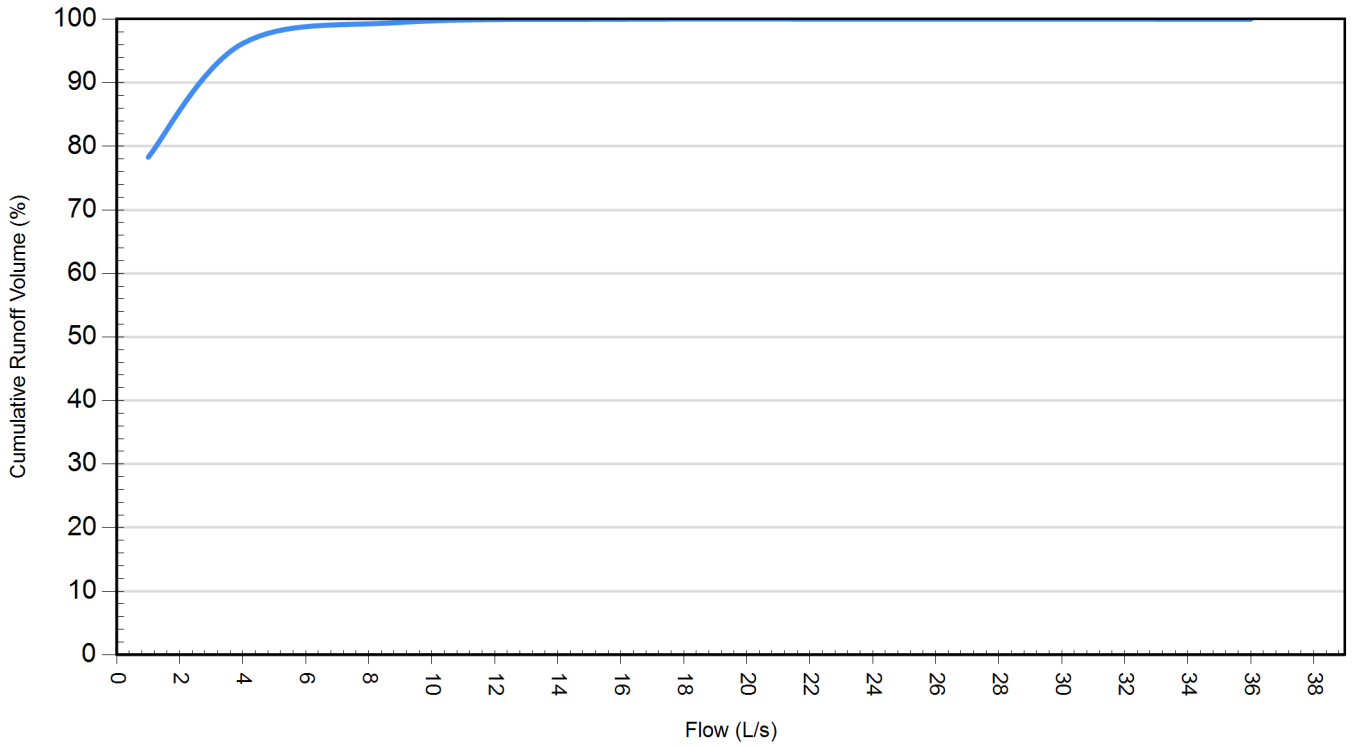
TSS Availability Parameters

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

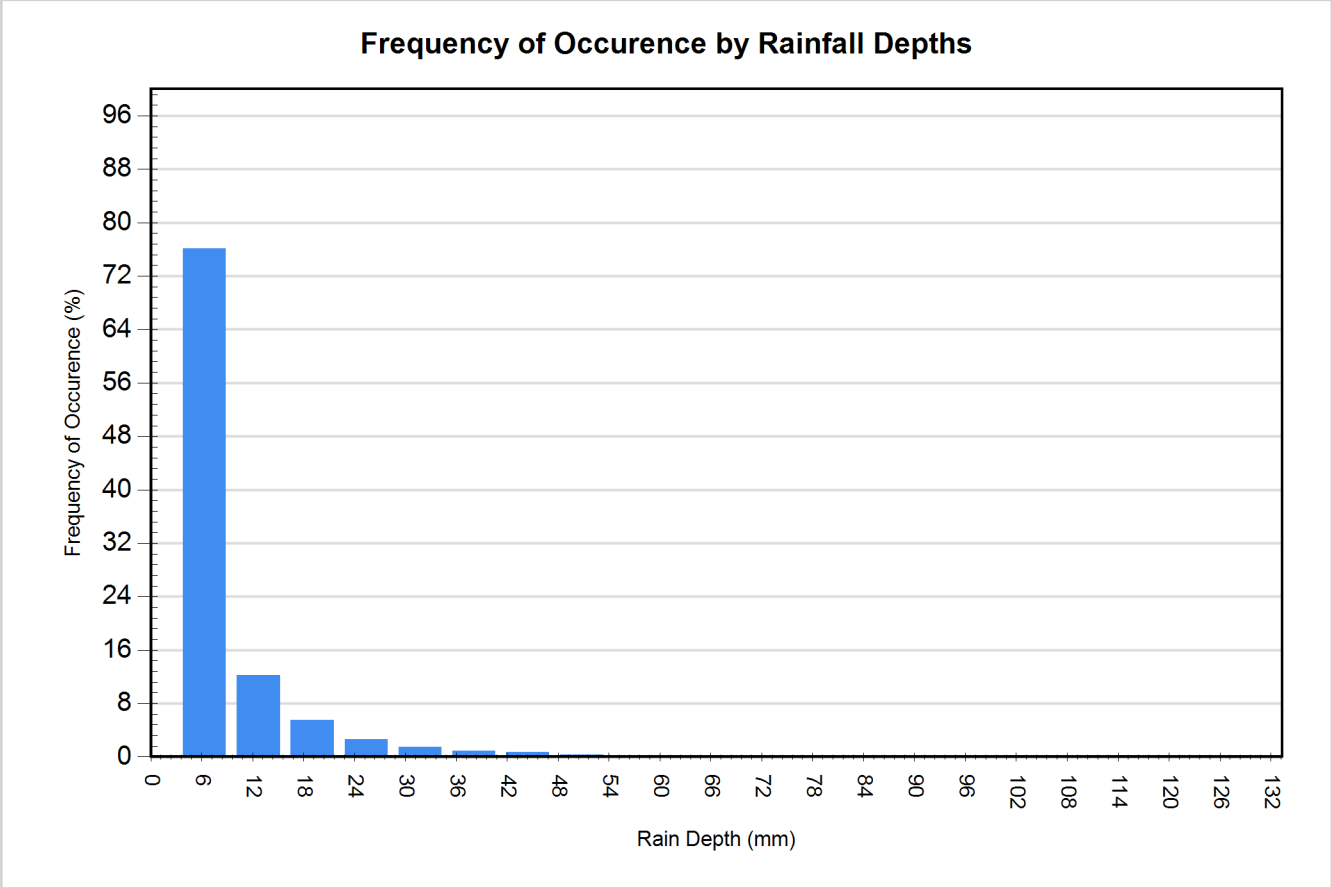
Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m^3)	Volume Over (m^3)	Cumulative Runoff Volume (%)
1	12990	3594	78.3
4	15954	631	96.2
9	16501	84	99.5
16	16583	2	100.0
25	16585	0	100.0
36	16585	0	100.0

Cumulative Runoff Volume by Runoff Rate

For area: 0.12(ha), imperviousness: 71.4%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A



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



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

Detailed Stormceptor Sizing Report – STC 103

Project Information & Location			
Project Name	Norberry Crescent	**Project Number**	160401483
City	Ottawa	**State/ Province**	Ontario
Country	Canada	**Date**	7/10/2019
Designer Information		**EOR Information (optional)**	
Name	Cameron Odam	**Name**	
Company	Stantec Consulting Ltd.	**Company**	
Phone #	613-724-4353	**Phone #**	
Email	cameron.odam@stantec.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	STC 103
Recommended Stormceptor Model	STC 300
Target TSS Removal (%)	80.0
TSS Removal (%) Provided	86
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	86	99
STC 750	92	100
STC 1000	93	100
STC 1500	93	100
STC 2000	95	100
STC 3000	96	100
STC 4000	97	100
STC 5000	97	100
STC 6000	98	100
STC 9000	98	100
STC 10000	98	100
STC 14000	99	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)**	767.6
Elevation (ft)	370	**Total Infiltration (mm)**	11935.8
Years of Rainfall Data	37	**Total Rainfall that is Runoff (mm)**	8274.7

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)	0.198
Imperviousness %	42.9

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

Water Quality Objective	
TSS Removal (%)	80.0
Runoff Volume Capture (%)	90.00
Oil Spill Capture Volume (L)	
Peak Conveyed Flow Rate (L/s)	
Water Quality Flow Rate (L/s)	

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

Design Details	
Stormceptor Inlet Invert Elev (m)	75.42
Stormceptor Outlet Invert Elev (m)	75.37
Stormceptor Rim Elev (m)	77.23
Normal Water Level Elevation (m)	74.52
Pipe Diameter (mm)	300
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

Site Name	STC 103

Site Details

Drainage Area

Total Area (ha)	0.198
Imperviousness %	42.9

Surface Characteristics

Width (m)	89.00
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	

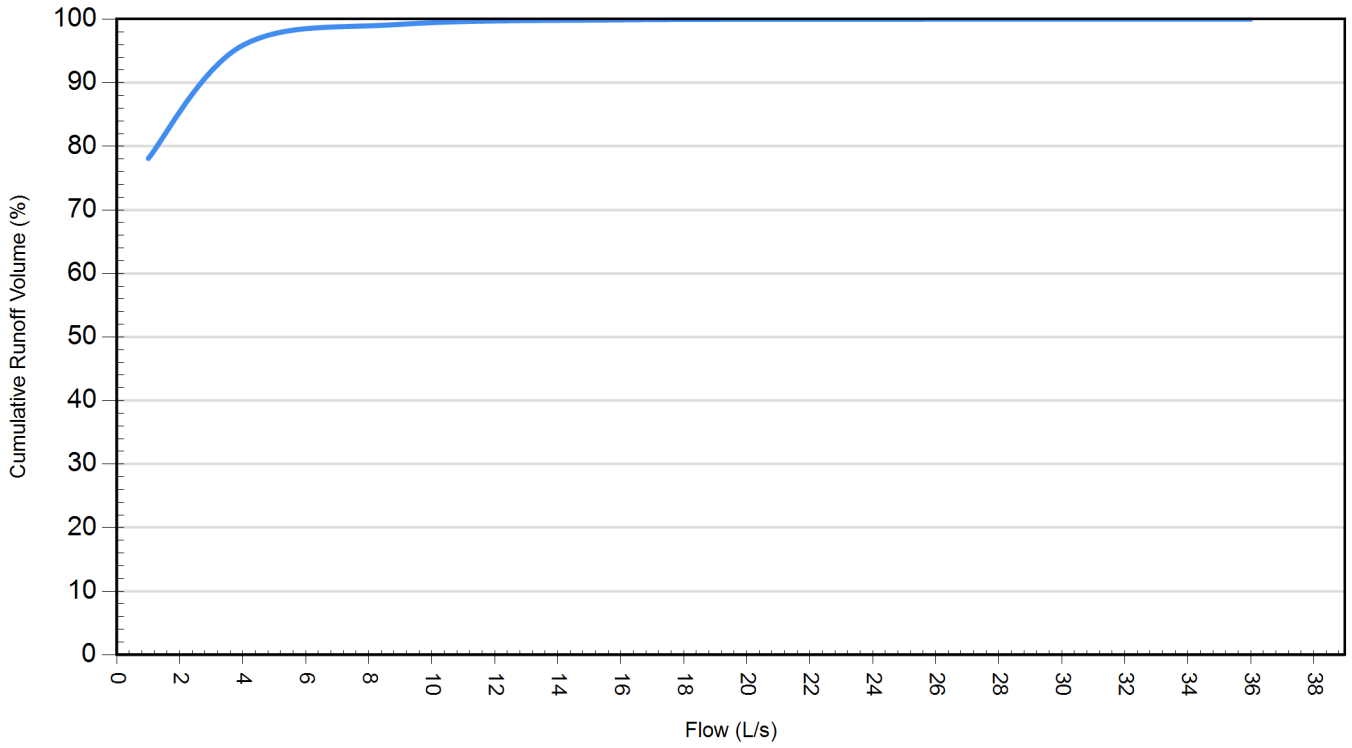
TSS Availability Parameters

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

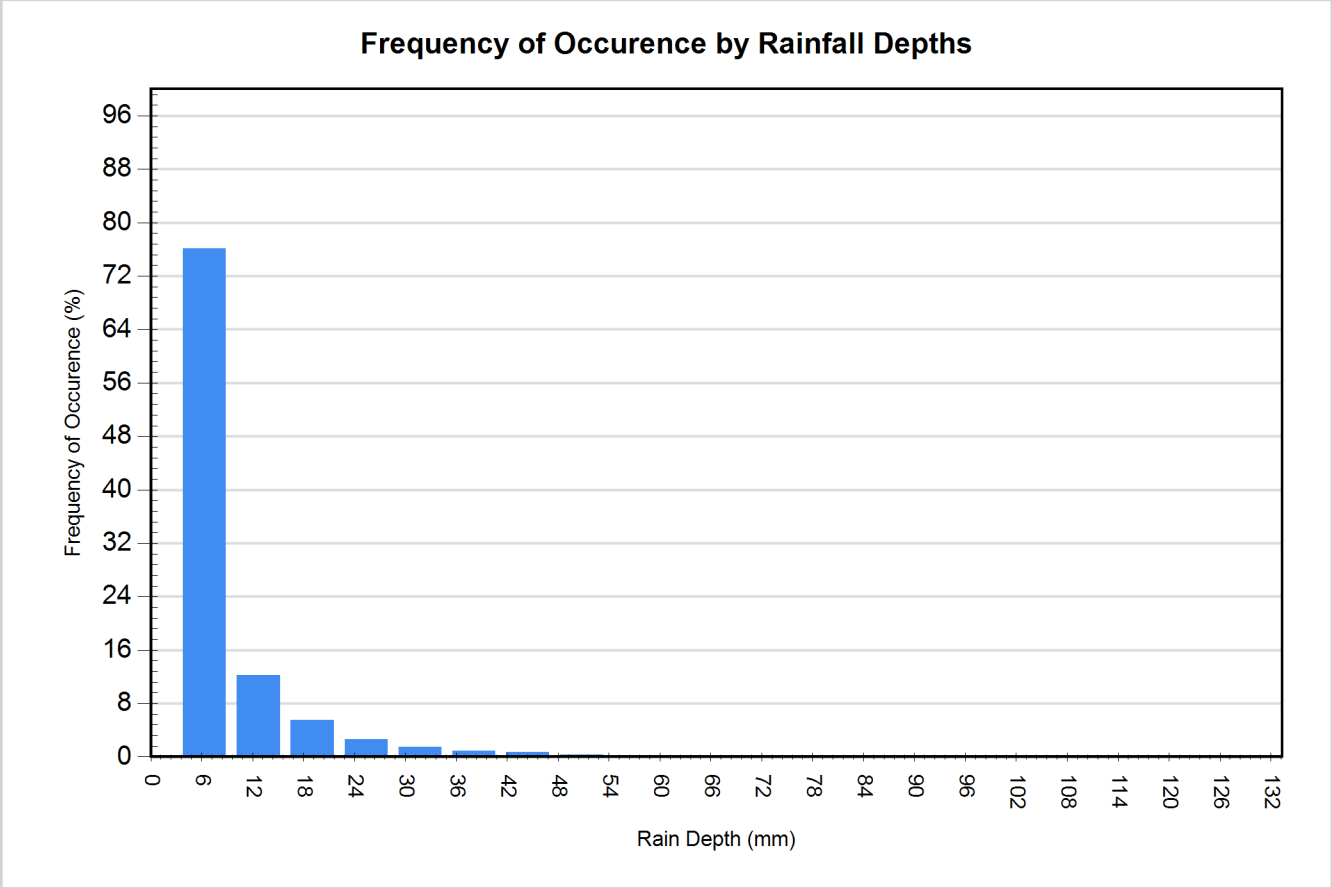
Cumulative Runoff Volume by Runoff Rate			
Runoff Rate (L/s)	Runoff Volume (m^3)	Volume Over (m^3)	Cumulative Runoff Volume (%)
1	12901	3626	78.1
4	15856	672	95.9
9	16402	125	99.2
16	16516	11	99.9
25	16527	0	100.0
36	16527	0	100.0

Cumulative Runoff Volume by Runoff Rate

For area: 0.198(ha), imperviousness: 42.9%, rainfall station: OTTAWA MACDONALD-CARTIER INT'L A



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



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

Appendix D GEOTECHNICAL INVESTIGATION

Geotechnical Engineering

Environmental Engineering

Hydrogeology

Geological Engineering

Materials Testing

Building Science

Archaeological Services

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

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

patersongroup

Geotechnical Investigation

Proposed Multi-Storey Buildings
Norberry Crescent
Ottawa, Ontario

Prepared For

Greatwise Developments

March 27, 2019

Report PG4834-1

Table of Contents

Appendices

1.0 Introduction

Paterson Group (Paterson) was commissioned by Greatwise Developments to conduct a geotechnical investigation for the proposed multi-storey residential development to be located at Norberry Crescent in the City of Ottawa, Ontario (refer to Figure 1 - Key Plan in Appendix 2 of this report).

The objectives of the current investigation were to:

- ❑ Determine the subsurface conditions by means of boreholes.
- ❑ Provide geotechnical recommendations pertaining to design of the proposed development including construction considerations which may affect the design.

The following report has been prepared specifically and solely for the aforementioned project which is described herein. The report contains Paterson's findings and includes geotechnical recommendations pertaining to the design and construction of the subject development as understood at the time of writing this report.

2.0 Proposed Development

Based on the available drawings, it is our understanding that the proposed development will consist of three, four (4) storey residential slab-on-grade buildings along with associated at-grade parking areas, access lanes, and landscaped areas. It is anticipated that the proposed development will be municipally serviced.

3.0 Method of Investigation

3.1 Field Investigation

The field program for the current investigation was completed on February 25 and 26, 2019. At that time, nine (9) boreholes were advanced to a maximum depth of 6.8 m below existing grade. The borehole locations were distributed in a manner to provide general coverage of the proposed development taking into consideration existing site features. The locations of the boreholes are shown on Drawing PG4834-1 - Test Hole Location Plan included in Appendix 2.

The boreholes were completed using a truck-mounted auger drill rig operated by a two-person crew. All fieldwork was conducted with the full-time supervision of Paterson personnel under the direction of a senior engineer. The test hole procedure consisted of augering to the required depths at the selected locations, and sampling and testing the overburden.

Sampling and In-situ Testing

Soil samples were recovered with a 50 mm diameter split-spoon sample or from the auger flights. The split-spoon and auger samples were classified on site and placed in sealed plastic bags. All samples were transported to Paterson's laboratory. The depths at which the split-spoon and auger samples were recovered from the boreholes are presented as SS and AU, respectively, on the Soil Profile and Test Data sheets in Appendix 1.

The Standard Penetration Test (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.

Overburden thickness was also evaluated during the course of the investigation by dynamic cone penetration testing (DCPT) at BH 4. 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.

Undrained shear strength tests were conducted in cohesive soils with a field vane apparatus.

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

Groundwater

Flexible polyethylene standpipes were installed in a number of boreholes to permit monitoring of the groundwater levels subsequent to the completion of the current sampling program. The groundwater observations are discussed in Subsection 4.3 and presented in the Soil Profile and Test Data Sheets in Appendix 1.

3.2 Field Survey

The boreholes completed during the field investigation were selected in the field and surveyed by Paterson personnel. The ground surface elevations at the borehole locations were referenced to a temporary benchmark (TBM), consisting of a catch basin cover located within the eastern parking area adjacent to 840 Springland Drive. An arbitrary elevation of 100.00 m was assigned to the TBM. The locations of the boreholes and the ground surface elevation at each borehole location are presented on Drawing PG4834-1 - Test Hole Location Plan in Appendix 2.

3.3 Laboratory Testing

Soil samples recovered from the subject site were visually examined in our laboratory to review the field logs. All samples will be stored in the laboratory for a period of one (1) month after the issuance of this report. They will then be discarded unless we are otherwise directed.

3.4 Analytical Testing

One (1) soil sample was submitted for analytical testing to assess the potential for exposed ferrous metals and the sulphate potential against subsurface concrete structures. The results are discussed further in Subsection 6.7.

4.0 Observations

4.1 Surface Conditions

The subject site is presently occupied by four existing multi-storey residential buildings, a parking structure with one level of above-grade parking situated between the existing building at 660 Norberry Crescent and Norberry Crescent, a central slab-on-grade recreational building, accompanying access lanes and at-grade parking.

The ground surface across the subject site is relatively flat and at grade with Norberry Crescent and Springland Drive. The majority of the site is surfaced with asphalt parking areas and grass/tree covered landscaped areas. The subject site is bordered by Norberry Crescent along the south and east, and Springland Drive along the north and west borders.

4.2 Subsurface Profile

Overburden

The subsurface profile at the borehole locations consists of asphaltic concrete followed by a silty sand with gravel fill overlying a hard to stiff silty clay crust and a grey, very stiff to firm silty clay deposit. Glacial till was encountered below the above noted layers consisting of dense to compact silty clay with sand to sandy silt with clay, gravel, cobbles and boulders.

Practical refusal to augering on inferred bedrock was encountered in BH 2 to BH 5 and BH 8 at depths ranging between 5.3 to 7.0 m. Specific details of the soil profile at each test hole location are presented on the Soil Profile and Test Data sheets provided in Appendix 1.

Bedrock

Based on available geological mapping, the subject site is located in an area where the bedrock consists of limestone of the Bobcaygeon Formation. The overburden drift thickness is anticipated to be between 5 to 10 m in depth.

Atterberg Limit Testing

A total of 4 atterberg limit tests, as well as associated moisture content tests, were completed on the recovered silty clay samples at selected locations throughout the subject site. The results of the Atterberg limits tests are presented in Table 1 and on the Atterberg Limits Results sheet in Appendix 1. The tested silty clay samples classify as inorganic clay of low plasticity (CL), inorganic clay of high plasticity (CH) and inorganic clay and silt of low plasticity (CL-ML) in accordance with the Unified Soil Classification System.

Table 1 - Atterberg Limits Results

Sample	Depth (m)	LL (%)	PL (%)	PI (%)	w (%)	Classification
BH 1	1.5	44	18.0	26	18.2	CL
BH 2	0.75	26	15	11	14.9	CL
BH 4	2.3	53	18	35	18.1	CH
BH 5	0.75	22	15	6	15.2	CL-ML

Notes: LL: Liquid Limit; PL: Plastic Limit; PI: Plasticity Index; w: water content;
CH: Inorganic Clay of High Plasticity CL: Inorganic Clay of Low Plasticity
CL-ML: Inorganic Clay and Silt of Low Plasticity

Shrinkage Testing

The results of the shrinkage limit test indicate a shrinkage limit of 18% and a shrinkage ratio of 1.92.

4.3 Groundwater

Groundwater levels were measured in the piezometers at the borehole locations on March 5, 2019. The measured groundwater level (GWL) readings are presented in Table 2 below.

Table 2 - Groundwater Measurements at Monitoring Well Locations			
Test Hole Location	**Ground Surface Elevation (m)**	**GW Level Reading (m)**	**GW Level Elev. (m)**
BH 1	**100.13**	**2.04**	**98.09**
BH 2	**99.99**	**1.31**	**98.68**
BH 3	**100.05**	**BLOCKED**	**n/a**
BH 4	**99.56**	**3.33**	**96.23**
BH 5	**100.30**	**BLOCKED**	**n/a**
BH 6	**100.20**	**1.15**	**99.05**
BH 7	**100.12**	**1.69**	**98.43**
BH 8	**100.64**	**1.75**	**98.89**
BH 9	**100.87**	**1.30**	**99.57**

It should be noted that groundwater measurements can be influenced by surface water infiltrating the backfilled boreholes and moisture perched within the silty clay deposit. The long-term groundwater table can also be estimated based on consistency, moisture levels and colour of the recovered soil samples. Based on our field observations and experience with the local area, it is expected that the long-term groundwater level will be at a depth ranging between 2.5 to 3.5 m below existing grade. It should be noted that the groundwater level is subject to seasonal fluctuations. Therefore, groundwater could vary at the time of construction.

5.0 Discussion

5.1 Geotechnical Assessment

From a geotechnical perspective, the subject site is considered suitable for the proposed development. The proposed multi-storey buildings are anticipated to be founded on shallow footings placed on an undisturbed hard to stiff brown to grey silty clay, glacial till, or engineered fill placed over an undisturbed bearing medium.

Due to the presence of a sensitive silty clay layer at the site, the proposed development will be subjected to grade raise restrictions. Permissible grade raise recommendations are discussed in Subsection 5.3.

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

5.2 Site Grading and Preparation

Stripping Depth

Topsoil and deleterious fill, such as those containing organic materials, should be stripped from under the proposed building, paved areas, pipe bedding and other settlement sensitive structures.

Consideration could be given to leaving the existing fill free of significant amounts of deleterious fill and other construction remnants under the proposed buildings floor slabs outside the lateral support of the proposed footings. However, it is recommended that the existing fill for the slab-on-grade be approved by the geotechnical consultant at the time of construction. It is recommended that the existing fill be proof-rolled using an adequate compaction equipment making several passes. Any poor performance areas should be sub-excavated and replaced with OPSS Granular A crushed stone or Granular B Type II and compacted to 98% of the material's SPMDD.

Fill Placement

Fill placed for grading beneath the structure(s) or other settlement sensitive areas should consist, unless otherwise specified, of clean imported granular fill, such as Ontario Provincial Standard Specifications (OPSS) Granular A or Granular B Type II. This material should be tested and approved prior to delivery to the site. The engineered fill should be placed in maximum 300 mm thick lifts and compacted to 98% of the material's standard Proctor maximum dry density (SPMDD).

Non-specified existing fill along with site-excavated soil can be placed as general landscaping fill where surface settlement is a minor concern. The backfill materials should be spread in thin lifts and at a minimum compacted by the tracks of the spreading equipment to minimize voids. If the non-specified backfill is to be placed to increase the subgrade level for areas to be paved, the fill should be compacted in maximum 300 mm lifts and compacted to 95% of the material's SPMDD. Non-specified existing fill and site-excavated soils are not suitable for placement as backfill against foundation walls unless a composite drainage blanket connected to a perimeter drainage system is provided.

5.3 Foundation Design

Shallow Foundation

Footings placed on an undisturbed, hard to stiff brown silty clay bearing surface or compact glacial till can be designed using a bearing resistance value at Serviceability Limit States (SLS) of **150 kPa** and a factored bearing resistance value at Ultimate Limit States (ULS) of **250 kPa**. A geotechnical resistance factor of 0.5 was applied to the above noted bearing resistance value at ULS. Footings founded on engineered fill placed on undisturbed bearing medium can be designed using the above noted bearing resistance values.

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.

Settlement

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

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 the in-situ bearing medium soils above the groundwater table when a plane extending down and out from the bottom edge of the footing at a minimum of 1.5H:1V passes only through in situ soil of the same or higher capacity as the bearing medium soil.

Permissible Grade Raise

Based on the existing borehole coverage and results of the undrained shear strength testing completed within the underlying cohesive soils, a permissible grade raise restriction of **1.0 m** is provided for design purposes for the subject site.

5.4 Design for Earthquakes

The site class for seismic site response can be taken as **Class C** for the foundations considered at this site. The soils underlying the subject site are not susceptible to liquefaction. Refer to the latest revision of the Ontario Building Code for a full discussion of the earthquake design requirements.

5.5 Slab-on-Grade Construction

With the removal of topsoil and deleterious fill, such as those containing organic materials, within the footprint of the proposed building, the native soil or approved fill is 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 A or Granular B Type II, with a maximum particle size of 50 mm, are recommended for backfilling below the floor slab.

It is recommended that the upper 200 mm of sub-floor fill consist of Granular A crushed stone. All backfill materials within the footprint of the proposed building should be placed in maximum 300 mm thick loose layers and compacted to at least 98% of its SPMDD.

5.6 Pavement Structure

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

Table 3 - Recommended Flexible Pavement Structure - 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, OPSS Granular B Type II material placed over in situ soil or fill	

Table 4 - Recommended Flexible 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
300	**SUBBASE** - OPSS Granular B Type II
SUBGRADE - Either fill 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 100% of the material's SPMDD.

Pavement Structure Drainage

Satisfactory performance of the pavement structure is largely dependent on 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 load carrying capacity.

Due to the impervious nature of the subgrade materials consideration should be provided to installing subdrains during the pavement construction. The subdrains should extend in four orthogonal directions and 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 shaped to promote water flow to the drainage lines.

6.0 Design and Construction Precautions

6.1 Foundation Drainage and Backfill

Foundation Drainage

A perimeter foundation drainage system is optional for the proposed structures. However, it is still recommended that a perimeter foundation system be used where structures susceptible to frost heave such as sidewalks, are proposed within the perimeter of the proposed building. The system should consist of a 100 to 150 mm diameter perforated corrugated plastic pipe, surrounded on all sides by 150 mm of 19 mm clear stone, placed at the footing level around the exterior perimeter of the structure. The clear stone or the pipe itself should be wrapped in a non-woven geotextile. The pipe should have a positive outlet, such as a gravity connection to the storm sewer.

Foundation Backfill

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 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 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 of 1.5 m of soil cover alone, or a combination of soil cover and foundation insulation, should be provided. More details regarding foundation insulation can be provided, if requested.

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 heated structure and require additional protection, such as soil cover of 2.1 m or an equivalent combination of soil cover and foundation insulation.

6.3 Excavation Side Slopes

The side slopes of excavations in the soil and fill overburden materials should either be excavated at acceptable slopes or should be 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 excavated at 1H:1V or shallower. Below the groundwater lever, flatter slopes, such as 3H:1V, could be required due to the presence of loose silty and/or sandy silt. The subsurface soils are considered to be a Type 2 and 3 soil according to the Occupational Health and Safety Act and Regulations for Construction Projects. The side slopes of excavations in bedrock can be cut quasi-vertically (i.e. 1H:10V).

Excavated soil should not be stockpiled directly at the top of excavations and heavy equipment should be kept away 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 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 fry and compactable 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

It is anticipated that groundwater infilitration into the excavations should be controllable using open sumps. Pumping from open sumps should be sufficient to control the groundwater influx through the sides of shallow excavations. 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 Environment, Conservation and Parks (MECP) permit to take water (PTTW) may be required if more than 400,000 L/day are to be pumped during the construction phase. At least 4 to 5 months should be allowed for completion of the application and issuance of the permit by the MECP.

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 MECP review of the PTTW application.

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.

6.7 Corrosion Potential and Sulphate

The results on analytical testing show that the sulphate content is less than 0.1%. The results are indicative that Type 10 Portland Cement (Type GU) would be appropriate for this site. The chloride content and the pH of the sample indicate that they are not significant factors in creating a corrosive environment for exposed ferrous metals at this site, whereas the resistivity in indicative of a moderate to very aggressive corrosive environment.

6.8 Landscaping Considerations

Tree Planting Restrictions

In accordance with the City of Ottawa Tree Planting in Sensitive Marine Clay Soils (2017 Guidelines), Paterson completed a soils review of the site to determine applicable tree planting setbacks. Atterberg limits testing was completed for recovered silty clay samples at selected locations within the north portion of the subject site. Sieve analysis testing was also completed on selected soil samples. The above noted soil samples were recovered from elevations below the anticipated design underside of footing elevation and 3.5 m depth below anticipated finished grade. The results of our testing are presented in Subsection 4.2 and in Appendix 1.

Area 1 - Glacial Till (Building B)

No tree planting restrictions are required for the subject area (Building B) due to the absence of a silty clay deposit within the future location of the proposed residential building (southwest portion of the site).

Area 2 - Low to Medium Sensitivity Area (Buildings A and C)

A low to medium sensitivity clay soil was encountered across the remainder of the subject site. Based on our Atterberg Limits test results, the modified plasticity limit does not exceed 40% in all the boreholes locations where silty clay was encountered. The following tree planting setbacks are recommended for the low to medium sensitivity area. Large trees (mature height over 14 m) can be planted within these areas provided a tree to foundation setback equal to the full mature height of the tree can be provided (e.g. in a park or other green space). Tree planting setback limits may be reduced to 4.5 m for small (mature tree height up to 7.5m) and medium size trees (mature tree height 7.5 m to 14 m) provided that the conditions noted below are met.

7.0 Recommendations

A materials testing and observation services program is a requirement for the provided foundation design data to be applicable. The following aspects of the program should be performed by the geotechnical consultant:

- ❑ Review of the grading plan from a geotechnical perspective.
- ❑ Observation of all bearing surfaces prior to the placement of concrete.
- ❑ Sampling and testing of the concrete and fill materials used.
- ❑ Periodic observation of the condition of unsupported excavation side slope 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 that these works have been conducted in general accordance with our 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 provided in this report are in accordance with our present understanding of the project. We request permission to review our recommendations when the drawings and specifications are completed.

A soils investigation is a limited sampling of a site. Should any conditions at the site be encountered which differ from those at the test locations, we request immediate notification to permit reassessment of our recommendations.

The recommendations provided herein should only be used by the design professionals associated with this project. They are not intended for contractors bidding on or undertaking the work. The latter should evaluate the factual information provided in this report and determine its suitability and completeness for their intended construction schedule and methods. Additional testing may be required for their purposes.

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 Greatwise Developments or their agents is not authorized without review by Paterson for the applicability of our recommendations to the alternative use of the report.

Paterson Group Inc.

Drew Petahtegoose, EIT

Faisal Abou-Seido, P.Eng.

Report Distribution:

- ❑ Greatwise Developments (4 copies)
- ❑ Paterson Group (1 copy)

APPENDIX 1

SOIL PROFILE AND TEST DATA SHEETS

SYMBOLS AND TERMS

ANALYTICAL TESTING RESULTS

ATTERBERG LIMIT TESTING RESULTS

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

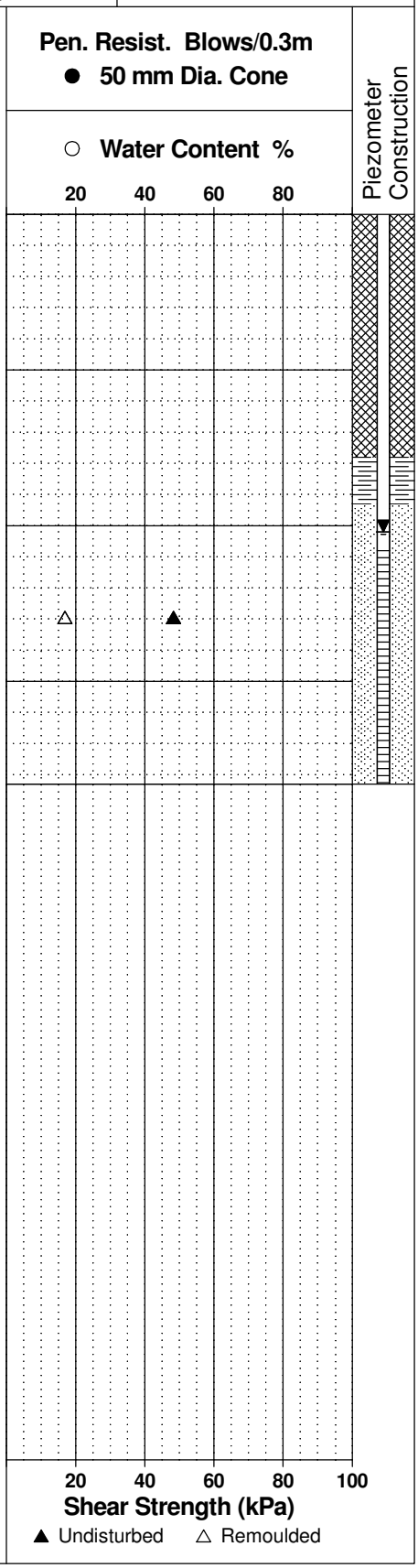
REMARKS

FILE NO. PG4834

HOLE NO. BH 1

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.13
Asphaltic concrete 0.08		AU	1				
FILL: Brown silty sand with gravel		SS	2	56	50+	1	99.13
1.37							
Stiff, brown **SILTY CLAY**		SS	2	88	5	2	98.13
- firm and grey by 2.1m depth							
3.05						3	97.13
GLACIAL TILL: Loose, grey silty sand with clay and gravel 3.66		SS	3	54	8		
End of Borehole							
(GWL @ 2.04m - March 5, 2019)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

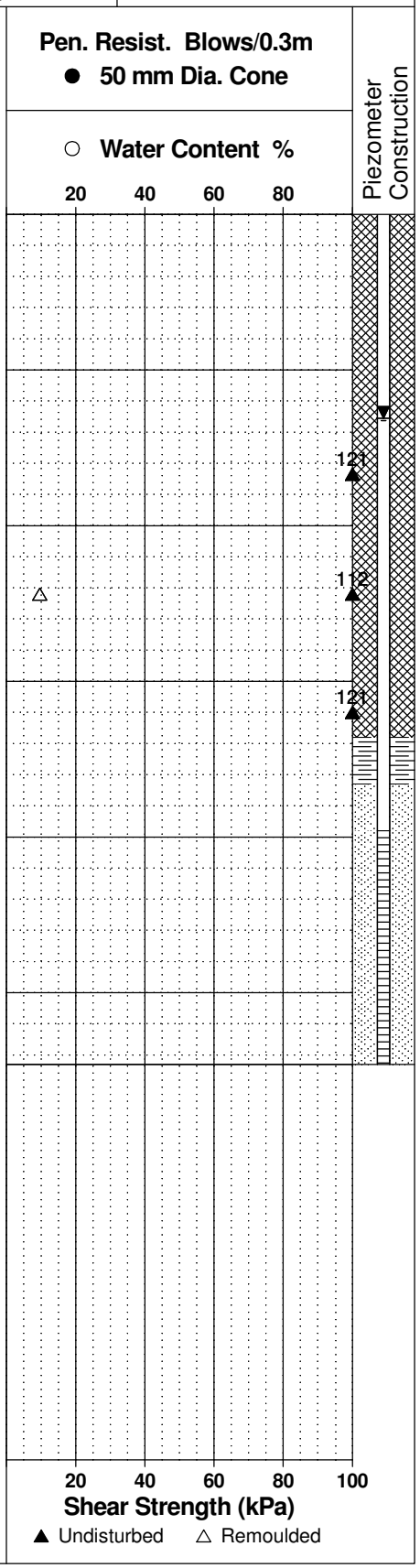
REMARKS

FILE NO. PG4834

HOLE NO. BH 2

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	99.99
Asphaltic concrete 0.08							
FILL: Brown silty sand with gravel		AU	1				
0.76						1	98.99
Compact, brown **SANDY SILT,** trace clay		SS	2		11		
1.37							
Very stiff, brown **SILTY CLAY**						2	97.99
- grey by 2.1m depth							
3.05						3	96.99
GLACIAL TILL: Loose, grey silt with clay, gravel, cobbles and boulders		SS	3	67	3	4	95.99
		SS	4	79	6	5	94.99
5.46		SS	5		50+		
End of Borehole							
Practical refusal to augering at 5.46m depth							
(GWL @ 1.31m - March 5, 2019)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

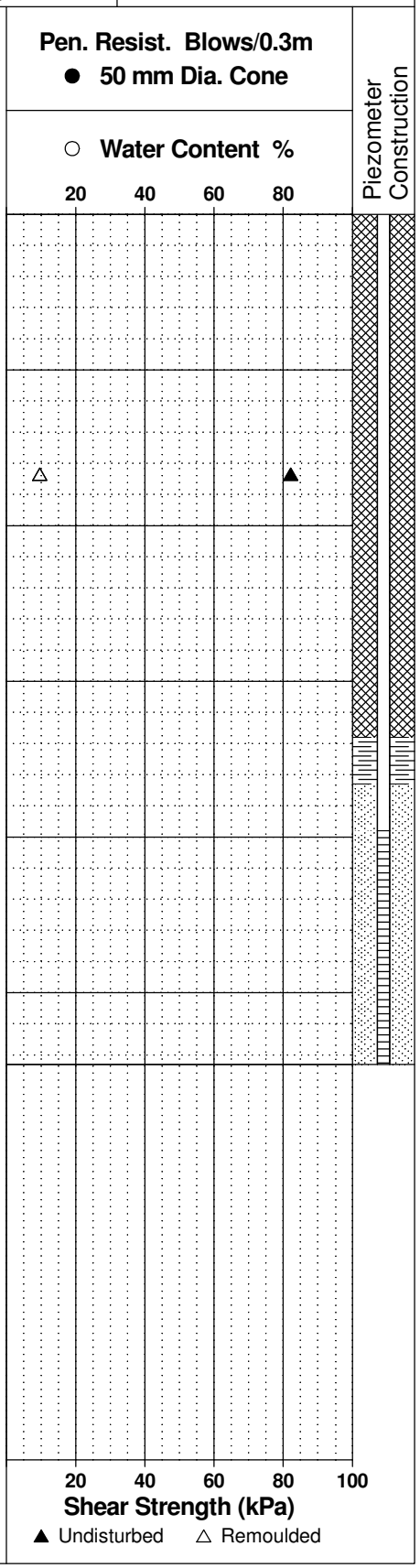
REMARKS

FILE NO. PG4834

HOLE NO. BH 3

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Asphaltic concrete 0.08						0	100.05
FILL: Brown silty sand with gravel and crushed stone 0.60		AU	1				
Stiff, brown **SILTY CLAY**		SS	2	75	11	1	99.05
1.98						2	98.05
GLACIAL TILL: Loose to compact, grey sandy silt with gravel, cobbles and boulders		SS	3	54	13	3	97.05
		SS	4	33	8		
		SS	5	46	11	4	96.05
		SS	6	0	50+	5	95.05
5.46		SS	7	100	50+		
End of Borehole							
Practical refusal to augering at 5.46m depth							
(Piezometer blocked at 0.50m depth - March 5, 2019)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

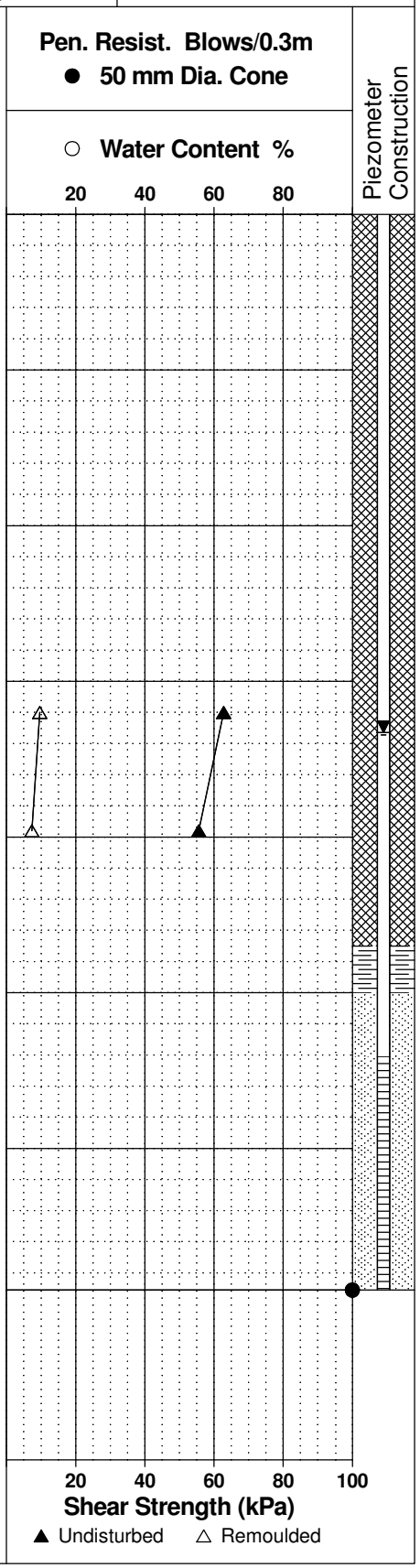
REMARKS

FILE NO. PG4834

HOLE NO. BH 4

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE							
Asphaltic concrete 0.05						0	99.56
Concrete 0.15		AU	1				
FILL: Brown silty sand with gravel		SS	2	72	50+	1	98.56
1.52							
Compact to loose, brown **SILTY SAND,** with gravel, trace clay		SS	3		11	2	97.56
2.44							
		SS	4	71	4	3	96.56
Stiff, grey **SILTY CLAY**						4	95.56
4.47							
		SS	5		3	5	94.56
GLACIAL TILL: Very loose, grey clayey silt with sand and gravel		SS	6		P	6	93.56
		SS	7		3		
6.70							
Dynamic Cone Penetration Test commenced at 6.70m depth. 6.91							
End of Borehole							
Practical DCPT refusal at 6.91m depth							
(GWL @ 3.33m - March 5, 2019)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS

FILE NO. PG4834

HOLE NO. BH 5

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	100.30		
Asphaltic concrete 0.08		AU	1						
FILL: Brown silty sand with gravel									
1.07		SS	2	46	8	1	99.30		
Very stiff to stiff, brown **SILTY CLAY** with sand		SS	3	67	10	2	98.30		
- grey by 2.1m depth		SS	4	50	10				
3.35		SS	5	67	10	3	97.30		
		SS	6	100	11	4	96.30		
GLACIAL TILL: Loose to compact, grey sandy silt with gravel, cobbles and boulders		SS	7	100	12	5	95.30		
		SS	8	100	4	6	94.30		
		SS	9	71	12				
6.81									
End of Borehole									
Practical refusal to augering at 6.81m depth									
(Piezometer blocked - March 5, 2019)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS TBM.

FILE NO. PG4834

HOLE NO. BH 6

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	100.20		
Asphaltic concrete 0.08									
FILL: Brown silty sand with gravel		AU	1						
0.76									
Firm to stiff, brown **SILTY CLAY**		SS	2	62	11	1	99.20		
- grey by 1.4m depth						2	98.20		
						3	97.20	106	
3.35									
End of Borehole									
(Piezometer blocked at 1.15m depth - March 5, 2019)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded

patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

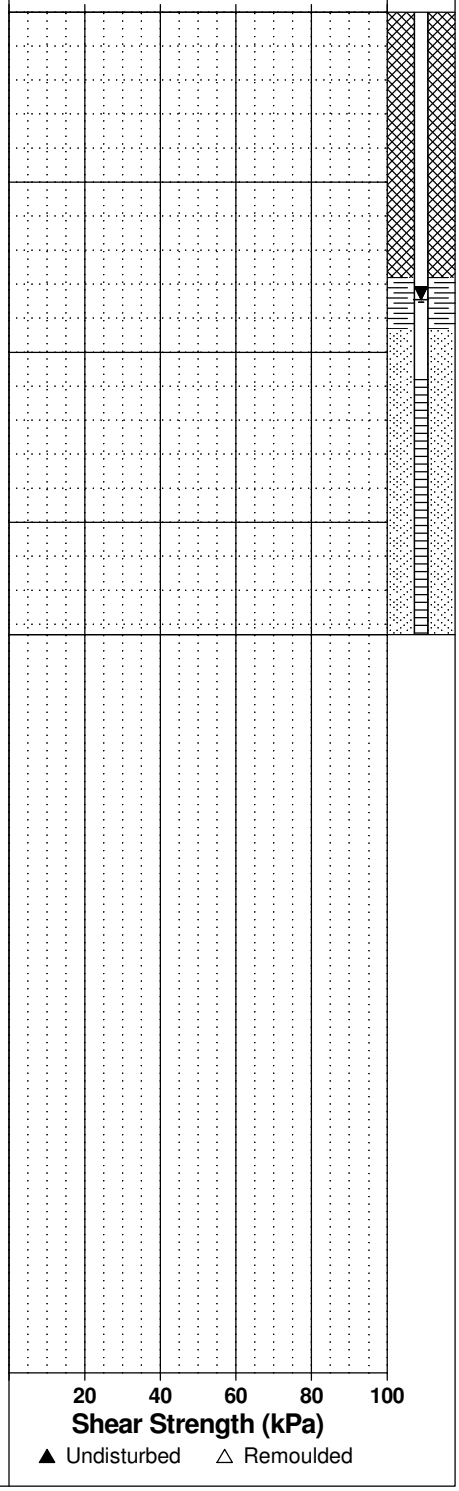
REMARKS

FILE NO. PG4834

HOLE NO. BH 7

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)
GROUND SURFACE						0	100.12
Asphaltic concrete 0.08		AU	1				
FILL: Brown silty sand with gravel		SS	2	67	58	1	99.12
1.37							
Grey **SILTY CLAY**		SS	3	83	3	2	98.12
1.88							
GLACIAL TILL: Loose, grey silty clay with sand, gravel, cobbles and boulders		SS	4	75	7	3	97.12
		SS	5	29	10		
3.66							
End of Borehole							
(GWL @ 1.69m - March 5, 2019)							



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

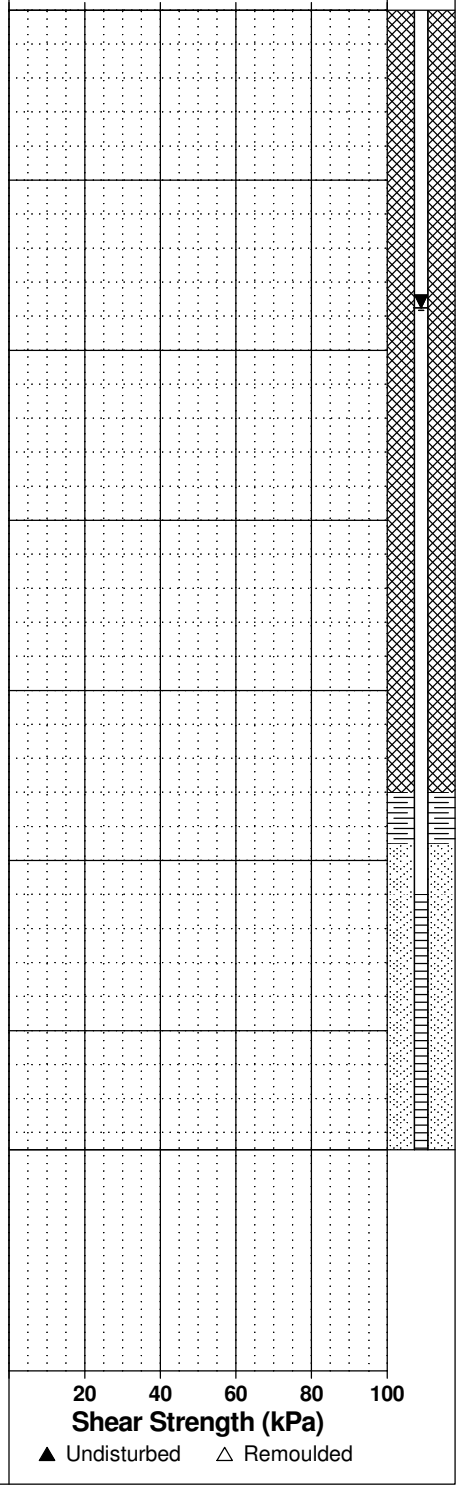
REMARKS TBM.

FILE NO. PG4834

HOLE NO. BH 8

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE						0	100.64		
Asphaltic concrete 0.08		AU	1						
FILL: Brown silty sand with gravel		SS	2	50	50+	1	99.64		
1.37									
		SS	3	33	9	2	98.64		
		SS	4	46	9				
		SS	5	75	8	3	97.64		
GLACIAL TILL: Loose to compact, brown silty clay with sand and gravel		SS	6	50	11	4	96.64		
		SS	7	33	5	5	95.64		
		SS	8	29	13				
		SS	9	83	2	6	94.64		
6.70									
End of Borehole									
(GWL @ 1.75m - March 5, 2019)									



patersongroup Consulting Engineers

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

SOIL PROFILE AND TEST DATA

Geotechnical Investigation
Proposed Multi-Storey Buildings - Norberry Crescent
Ottawa, Ontario

DATUM TBM - Top of catchbasin cover located within the eastern parking area, adjacent to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the TBM.

REMARKS TBM.

FILE NO. PG4834

HOLE NO. BH 9

BORINGS BY CME 55 Power Auger **DATE** February 25, 2019

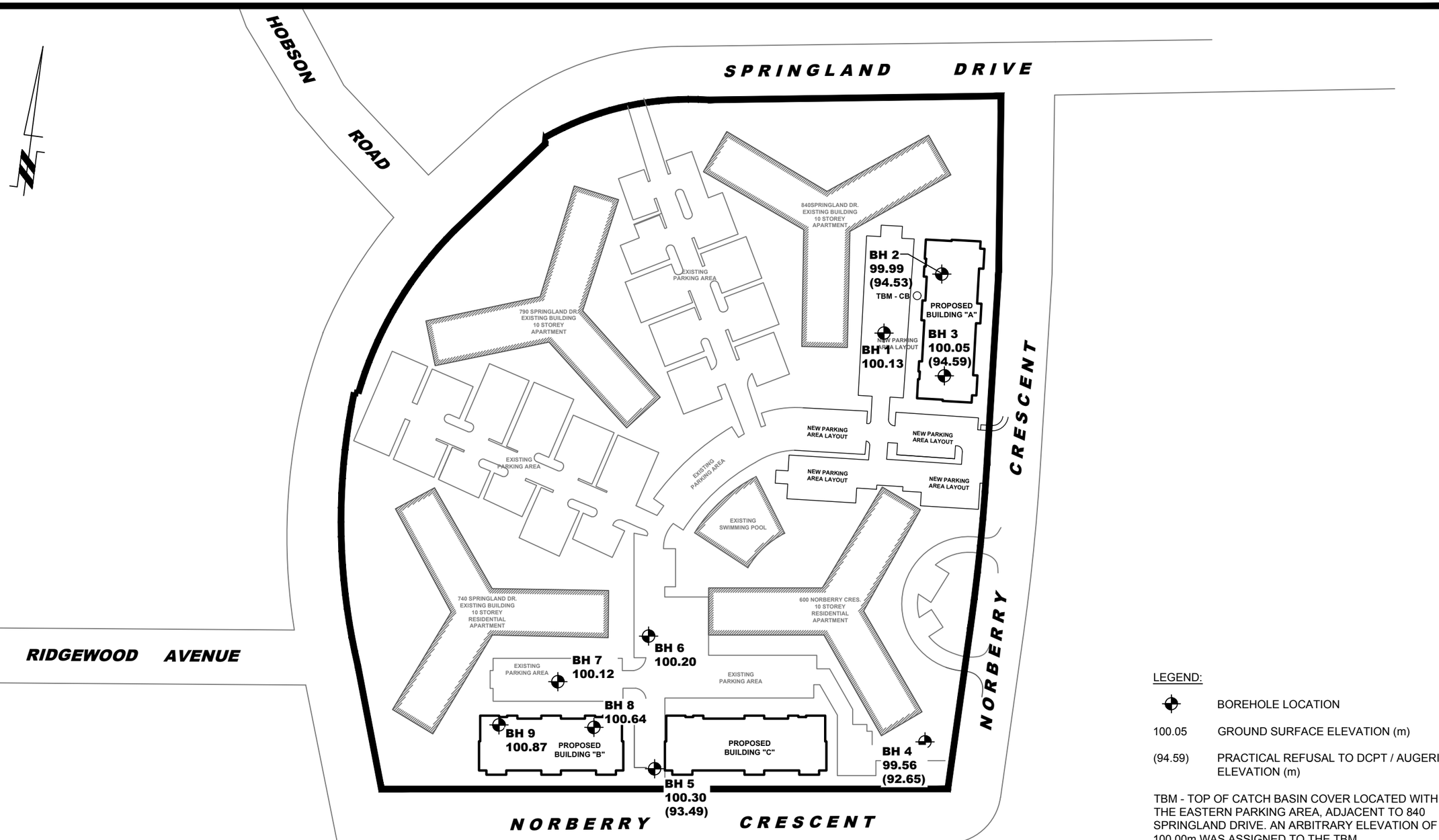
SOIL DESCRIPTION	STRATA PLOT	SAMPLE TYPE	SAMPLE NUMBER	SAMPLE % RECOVERY	SAMPLE N VALUE or RQD	DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m ● 50 mm Dia. Cone ○ Water Content %	Piezometer Construction
GROUND SURFACE									
Asphaltic concrete 0.08		AU	1			0	100.87		
FILL: Brown silty sand with gravel		SS	2		50+	1	99.87		
1.37		SS	3	38	10	2	98.87		
		SS	4	67	8	3	97.87		
GLACIAL TILL: Loose, grey silty clay with sand and gravel		SS	5	33	7	4	96.87		
		SS	6	33	6	5	95.87		
		SS	7	50	7	6	94.87		
		SS	8	21	3				
		SS	9	50	7				
6.70									
End of Borehole									
(GWL @ 1.30m - March 5, 2019)									

Pen. Resist. Blows/0.3m: 20 40 60 80

Water Content %: 20 40 60 80

Shear Strength (kPa): 20 40 60 80 100

▲ Undisturbed △ Remoulded



LEGEND:

⊕	BOREHOLE LOCATION
100.05	GROUND SURFACE ELEVATION (m)
(94.59)	PRACTICAL REFUSAL TO DCPT / AUGERING ELEVATION (m)

TBM - TOP OF CATCH BASIN COVER LOCATED WITHIN THE EASTERN PARKING AREA, ADJACENT TO 840 SPRINGLAND DRIVE. AN ARBITRARY ELEVATION OF 100.00m WAS ASSIGNED TO THE TBM

SCALE: 1:1500

0 25 50 75 100m

patersongroup
consulting engineers

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

NO.	REVISIONS	DATE	INITIAL

GREATWISE DEVELOPMENTS

GEOTECHNICAL INVESTIGATION
PROP. MULTI-STOREY BUILDINGS - NORBERRY CRESCENT

OTTAWA, ONTARIO

Title:

TEST HOLE LOCATION PLAN

Scale: 1:1500	Date: 03/2019
Drawn by: MPG	Report No.: PG4834-1
Checked by: NC	PG4834-1
Approved by: DJG	Revision No.:

p:\autocad drawings\geotechnical\pg48xx\pg4834\pg4834-1 thtp.dwg

Appendix E DRAWINGS