# SERVICING AND STORMWATER MANAGEMENT REPORT - NORBERRY RESIDENCES - 740 SPRINGLAND DRIVE

# **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 ppu

1.8

Total Site :	231	416	1	101.06	1.68	252.66	4.21	555.84	9.26
С	72	130	350	31.5	0.53	78.8	1.31	173.3	2.89
В	75	135	350	32.8	0.55	82.0	1.37	180.5	3.01
A	84	151	350	36.8	0.61	91.9	1.53	202.1	3.37
			Demand	(L/min)	(L/s)	(L/min)	(L/s)	(L/min)	(L/s)
Building ID	Units	Population	Daily Rate of	9 = ,		Max Day		Peak Hour	

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

- 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

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

# SERVICING AND STORMWATER MANAGEMENT REPORT - NORBERRY RESIDENCES - 740 SPRINGLAND DRIVE

### A.2 FIRE FLOW REQUIREMENTS PER FUS





#### **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			O	dinary Cons	truction		1	-
2	Determine Ground Floor Area of One Unit				-			1148	-
1	Determine Number of Adjoining Units				-			1	-
3	Determine Height in Storeys		Does not in	nclude floors	>50% belov	v grade or o	pen attic space	4	-
4	Determine Required Fire Flow		(F =	= 220 x C x A	<sup>1/2</sup> ). Round to	o nearest 10	00 L/min	-	15000
5	Determine Occupancy Charge			Li	mited Comb	ustible		-15%	12750
				С	onforms to N	IFPA 13		-30%	
١,	Determine Sprinkler Reduction			Sto	ındard Wate	r Supply		-10%	-5100
6	Determine spirikler kedocilon			Not F	ully Supervis	sed or N/A		0%	-3100
				% Cove	erage of Spri	nkler System	l	100%	
		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%	
7	Determine Increase for Exposures (Max. 75%)	East	30.1 to 45	58.5	1	31-60	Wood Frame or Non-Combustible	5%	4208
		South	30.1 to 45	17	4	61-90	Ordinary or Fire-Resistive with Unprotected Openings	5%	4200
		West	20.1 to 30	41	4	> 120	Ordinary or Fire-Resistive with Unprotected Openings	10%	
			Tot	al Required	Fire Flow in L	/min, Round	led to Nearest 1000L/min		12000
8	Determine Final Required Fire Flow				Total Requ	vired Fire Flo	w in L/s		200.0
ľ	betermine final Required file flow				Required Du	ration of Fire	Flow (hrs)		2.50
					Required Vo	lume of Fire	Flow (m³)		1800



#### **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			Or	dinary Cons	truction		1	-
2	Determine Ground Floor Area of One Unit				-			1025	-
	Determine Number of Adjoining Units				-			1	-
3	Determine Height in Storeys		Does not in	clude floors	>50% belov	v grade or c	ppen attic space	4	-
4	Determine Required Fire Flow		(F =	220 x C x A	<sup>1/2</sup> ). Round to	o nearest 10	000 L/min	-	14000
5	Determine Occupancy Charge			Li	mited Comb	ustible		-15%	11900
				С	onforms to N	IFPA 13		-30%	
6	Determine Sprinkler Reduction			Sto	ındard Wate	r Supply		-10%	-4760
•	Determine Spirikler Reduction			Not F	ully Supervis	sed or N/A		0%	-47 60
				% Cove	erage of Spri	nkler System	١	100%	
		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%	
7	Determine Increase for Exposures (Max. 75%)	East	10.1 to 20	20	4	61-90	Ordinary or Fire-Resistive with Unprotected Openings	13%	4641
		South	30.1 to 45	47	1	31-60	Wood Frame or Non-Combustible	5%	4041
		West	10.1 to 20	8.5	4	31-60	Ordinary or Fire-Resistive with Unprotected Openings	11%	
			Tot	al Required	Fire Flow in L	/min, Round	led to Nearest 1000L/min		12000
8	Determine Final Required Fire Flow				Total Requ	ired Fire Flo	w in L/s		200.0
ľ	Determine final Required file flow				Required Dui	ration of Fire	Flow (hrs)		2.50
					Required Vo	lume of Fire	Flow (m <sup>3</sup> )		1800



#### **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			Or	dinary Cons	truction		1	-
2	Determine Ground Floor Area of One Unit				-			1157	-
2	Determine Number of Adjoining Units				-			1	-
3	Determine Height in Storeys		Does not in	clude floors	>50% below	grade or c	pen attic space	4	-
4	Determine Required Fire Flow		(F =	220 x C x A	$^{1/2}$ ). Round to	o nearest 10	00 L/min	1	15000
5	Determine Occupancy Charge			Li	mited Comb	ustible		-15%	12750
				С	onforms to N	FPA 13		-30%	
6	Determine Sprinkler Reduction			Sto	ındard Wate	r Supply		-10%	-5100
•	Determine sprinkler keduction			Not F	ully Supervis	ed or N/A		0%	-5100
				% Cove	erage of Spri	nkler System	1	100%	
		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%	
7	Determine Increase for Exposures (Max. 75%)	East	> 45	20	1	0-30	Wood Frame or Non-Combustible	0%	2295
		South	30.1 to 45	17	1	0-30	Wood Frame or Non-Combustible	5%	2275
		West	10.1 to 20	20	4	61-90	Ordinary or Fire-Resistive with Unprotected Openings	13%	
			Tot	al Required	Fire Flow in L	/min, Round	led to Nearest 1000L/min		10000
8	Determine Final Required Fire Flow				Total Requ	ired Fire Flo	w in L/s		166.7
°	perettille tillar kedolleg tile flow				Required Dur	ation of Fire	Flow (hrs)		2.00
					Required Vo	lume of Fire	Flow (m <sup>3</sup> )		1200

# SERVICING AND STORMWATER MANAGEMENT REPORT - NORBERRY RESIDENCES - 740 SPRINGLAND DRIVE

### 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

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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

Stanted

400 - 1331 Clyde Avenue Ottawa ON K2C 3G4

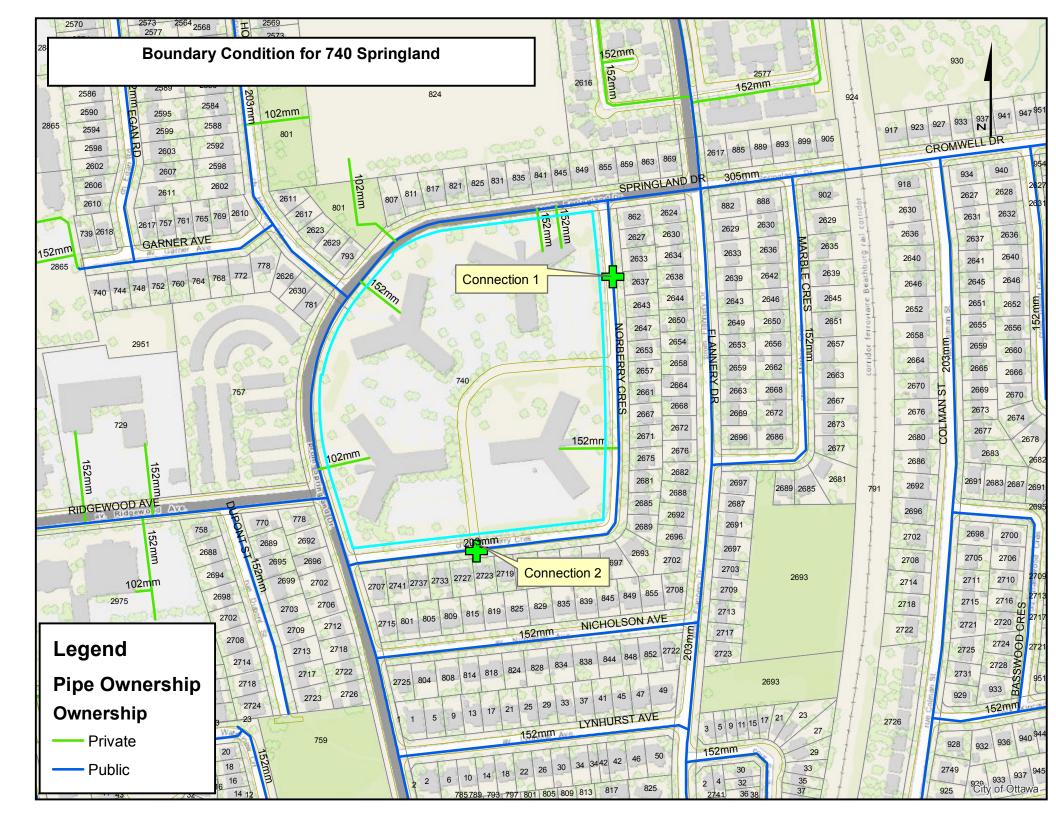




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## Appendix B WASTEWATER SERVICING

### **B.1** SANITARY SEWER DESIGN SHEET



Stantec DATE:
REVISION:
DESIGNED BY:
OHECKED BY:

SANITARY SEWER NORBERRY RESIDENCES DESIGN SHEET (City of Ottawa)

7/10/2019 1

WAJ

CHECKED BY:

FILE NUMBER: 160401483

DESIGN PARAMETERS

MAX PEAK FACTOR (RES.)= AVG. DAILY FLOW / PERSON MINIMUM VELOCITY 280 l/p/day 0.60 m/s MIN PEAK FACTOR (RES.)= 2.0 28,000 I/ha/day 3.00 m/s COMMERCIAL MAXIMUM VELOCITY PEAKING FACTOR (INDUSTRIAL): 2.4 INDUSTRIAL (HEAVY) 55,000 I/ha/day MANNINGS n 0.013 PEAKING FACTOR (ICI >20%): INDUSTRIAL (LIGHT) 35,000 I/ha/day BEDDING CLASS PERSONS / SINGLE 3.4 INSTITUTIONAL 28,000 I/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																	
LOCAT	TION					RESIDENTIA	AL AREA AND	POPULATION	N			COMM	ERCIAL	INDUS'	TRIAL (L)	INDUST	RIAL (H)	INSTITU	ITIONAL	GREEN /	UNUSED	C+I+I		INFILTRATION	N	TOTAL				PIF	E				
AREA ID	FROM	TO	AREA		UNITS		POP.	CUML	JLATIVE	PEAK	PEAK	AREA	ACCU.	AREA	ACCU.	AREA	ACCU.	AREA	ACCU.	AREA	ACCU.	PEAK	TOTAL	ACCU.	INFILT.	FLOW	LENGTH	DIA	MATERIAL	CLASS	SLOPE	CAP.	CAP. V	VEL.	VEL.
NUMBER	M.H.	M.H.		SINGLE	TOWN	APT		AREA	POP.	FACT.	FLOW		AREA		AREA		AREA		AREA		AREA	FLOW	AREA	AREA	FLOW							(FULL)	PEAK FLOW	(FULL)	(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



<b>Stantec</b>	NORBERRY  DATE: REVISION: DESIGNED BY: CHECKED BY:	2019	-07-10 1 /AJ	FILE NUN		STORM DESIGN (City of 16040148	N SHEE <sup>*</sup> Ottawa)	Т		I = a / (t+l	·	1:5 yr	1:10 yr 1174.184 6.014		MANNING MINIMUM	'S n = COVER:	0.013 2.00	m min	BEDDING (	CLASS =	В																	
LOCATION												-	DR	AINAGE AR	EA																	PIPE SELEC	TION					
AREA ID NUMBER	FROM TO M.H. M.H.	AREA (2-YEAR)	AREA (5-YEAR)	AREA (10-YEAR)	, ,	AREA (ROOF)	C (2-YEAR)	C (5-YEAR)	C (10-YEAR)	C (100-YEAR)	A x C (2-YEAR)	ACCUM AxC (2YR)	A x C (5-YEAR)	ACCUM. AxC (5YR)	A x C (10-YEAR)	ACCUM. AxC (10YR)	A x C (100-YEAR)	ACCUM. AxC (100YR)	T of C	I <sub>2-YEAR</sub>	I <sub>5-YEAR</sub>	I <sub>10-YEAR</sub>	I <sub>100-YEAR</sub>	Q <sub>CONTROL</sub>	ACCUM. Q <sub>CONTROL</sub>	Q <sub>ACT</sub> (CIA/360)		PIPE WIDTH OR DIAMETER	PIPE	PIPE SHAPE	MATERIAL	CLASS	SLOPE	Q <sub>CAP</sub> (FULL)	% FULL	VEL. (FULL)	(ACT)	TIME OF FLOW
		(ha)	(ha)	(ha)	(ha)	(ha)	(-)	(-)	(-)	(-)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(ha)	(min)	(mm/h)	(mm/h)	(mm/h)	(mm/h)	(L/s)	(L/s)	(L/s)	(m)	(mm)	(mm)	(-)	(-)	(-)	%	(L/s)	(-)	(m/s)	(m/s)	(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 <b>10.00</b>	76.81	104.19	122.14	178.56	0.0	0.0	0.0	12.8	200 200	200 200	CIRCULAR	PVC	SDR 35	1.00	33.3	0.00%	1.05	0.00	0.00
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 <b>10.00</b>	76.81	104.19	122.14	178.56	0.0	0.0	0.0	12.9	200 200	200 200	CIRCULAR	PVC	SDR 35	1.00	33.3	0.00%	1.05	0.00	0.00
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 <b>10.00</b>	76.81	104.19	122.14	178.56	0.0	0.0	0.0	12.1	200 200	200 200	CIRCULAR	PVC	SDR 35	1.00	33.3	0.00%	1.05	0.00	0.00
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 <b>10.18</b>	76.81	104.19	122.14	178.56	0.0	0.0	27.5	18.3	300 300	300 300	CIRCULAR	PVC	SDR 35	5.00	215.0	12.80%	3.05	1.74	0.18
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 <b>10.14</b>	76.81	104.19	122.14	178.56	0.0	0.0	24.3	13.4	300 300	300 300	CIRCULAR	PVC	SDR 35	4.85	211.8	11.48%	3.01	1.64	0.14
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 <b>11.00</b>	76.81	104.19	122.14	178.56	0.0	0.0	76.9	48.2	375 375	375 375	CIRCULAR	PVC	SDR 35	0.25	82.4	93.33%	0.78	0.80	1.00

### C.2 PRE DEVELOPMENT RATIONAL METHOD 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

Sub-catc	hment	Runoff C	oefficient Table Area		Runoff			Overall
Area	1		(ha)	(	Coefficient			Runoff
Catchment Type	ID / Description		"A"		"C"	"A	x C"	Coefficient
Uncontrolled - Tributary	EX-20	Hard	0.003		0.9	0.002		
Official officer of the officer of t	LX-20	Soft	0.187		0.9	0.002		
		Subtotal		0.19			0.0399	0.210
Uncontrolled - Tributary	EX-19	Hard	0.045		0.9	0.041		
Choomeoned Theatary		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	0.000	0.2	0.000	0.0000	0.000
		Subtotal		0.232			0.2088	0.900
Uncontrolled - Tributary	EX-12	Hard	0.232		0.9	0.209		
		Soft	0.000	0.000	0.2	0.000	0.2088	0.000
		Subtotal		0.232			0.2088	0.900
Uncontrolled - Tributary	EX-11	Hard	0.032		0.9	0.029		
		Soft	0.101	0.422	0.2	0.020	0.04004	0.070
		Subtotal		0.133			0.04921	0.370
Uncontrolled - Tributary	EX-10	Hard	0.189		0.9	0.170		
		Soft Subtotal	0.151	0.34	0.2	0.030	0.2006	0.590
		Subtotal		0.54			0.2000	0.550
Uncontrolled - Tributary	EX-9	Hard	0.061		0.9	0.055		
		Soft Subtotal	0.000	0.061	0.2	0.000	0.0549	0.900
		Cubiciai		0.001			0.0040	0.500
Uncontrolled - Tributary	EX-8	Hard	0.511		0.9	0.460		
		Soft Subtotal	0.177	0.688	0.2	0.035	0.49536	0.720
Uncontrolled - Tributary	EX-7	Hard Soft	0.000		0.9 0.2	0.000 0.015		
		Subtotal	0.075	0.0746	0.2	0.015	0.01492	0.200
Uncontrolled - Tributary	EX-6	Hard Soft	0.277		0.9 0.2	0.250 0.029		
		Soft Subtotal	0.145	0.422	0.2	0.029	0.27852	0.660
Uncontrolled - Tributary	EX-5	Hard Soft	0.231 0.000		0.9 0.2	0.208 0.000		
		Subtotal	0.000	0.231	0.2	0.000	0.2079	0.900
Uncontrolled - Tributary	EX-4	Hard Soft	0.510		0.9 0.2	0.459 0.038		
		Subtotal	0.190	0.7	0.2	0.000	0.497	0.710
Uncontrolled - Tributary	EX-3	Hard Soft	0.232 0.000		0.9 0.2	0.209		
		Subtotal	0.000	0.232	5.2	0.000	0.2088	0.900
Harrison T.O. C.	EVO	11	0.050		0.0	0.050		
Uncontrolled - Tributary	EX-2	Hard Soft	0.058 0.211		0.9 0.2	0.052 0.042		
		Subtotal		0.269			0.09415	0.350
Uppentralled T-thut	EV 4	U	0.040		0.0	0.044		
Uncontrolled - Tributary	EX-1	Hard Soft	0.049 0.235		0.9 0.2	0.044 0.047		
		Subtotal		0.284			0.09088	0.320
Total				5.403			3.519	
rerall Runoff Coefficient= C:								0.65

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

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

5 yr Inte		$I = a/(t + b)^{c}$	a =	998.071	t (min)	I (mm/hr)
City of C	Ottawa		b = c =	6.053 0.814	5 10	141.18 104.19
					15	83.56
					20 25	70.25 60.90
					30	53.93
					35	48.52
					40	44.18 40.63
					45 50	37.65
					55	35.12
				L	60	32.94
5 YI Subdrainage Are			rget Release		tion of Sit	е
Area (ha		3	y Area to Outle	<b></b>		
Typical T	ime of Conce	ntration				
tc (min)	I (5 yr) (mm/hr)	Qtarget (L/s)				
10	104.19	1055.18				
5 YEAR	R Modified F	Rational Met	hod for Entir	e Site		
Subdrainage Are	a: EX-20				Uncontroll	ed - Tributary
Area (ha						,
tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored	Ī
(min) 10	(mm/hr) 104.19	(L/s) 11.56	(L/s) 11.56	(L/s)	(m^3)	
20	70.25	7.79	7.79			
30	53.93	5.98	5.98			
40 50	44.18 37.65	4.90 4.18	4.90 4.18			
60	32.94	3.65	3.65			
70	29.37	3.26	3.26			
80 90	26.56 24.29	2.95 2.69	2.95 2.69			
100	22.41	2.49	2.49			
110 120	20.82 19.47	2.31 2.16	2.31 2.16			
Subdrainage Are	a: EX-19				Uncontrol	ed - Tributary
Area (ha					Oncom on	ou modaly
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 30	70.25 53.93	12.09 9.28	12.09 9.28			
40	44.18	7.60	7.60			
50	37.65	6.48	6.48			
60 70	32.94 29.37	5.67 5.06	5.67 5.06			
80	26.56	4.57	4.57			
90 100	24.29 22.41	4.18	4.18 3.86			
110	20.82	3.86 3.58	3.58			
120 Subdrainage Are	19.47 a: EX-18	3.35	3.35		Uncontroll	ed - Tributary
Area (ha					550mii 011	butaly
tc (min)	l (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	
10 20	104.19 70.25	2.84 1.91	2.84 1.91			•
30	53.93	1.91	1.91			
40	44.18	1.20	1.20			
50 60	37.65 32.94	1.03 0.90	1.03 0.90			
70	29.37	0.80	0.80			
80	26.56	0.72	0.72			
90 100	24.29 22.41	0.66 0.61	0.66 0.61			
110 120	20.82	0.57 0.53	0.57 0.53			
Subdrainage Are	a: EX-17	0.00	3.00		Uncontrol	ed - Tributary
Area (ha						,
tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored	Ī
(min)	(mm/hr) 104.19	(L/s)	(L/s)	(L/s)	(m^3)	Į
10 20	104.19 70.25	106.36 71.71	106.36 71.71			
30	53.93	55.05	55.05			
40 50	44.18 37.65	45.10	45.10			
50 60	37.65 32.94	38.44 33.63	38.44 33.63			
70	29.37	29.98	29.98			
80	26.56	27.11	27.11			
90	24.29 22.41	24.79 22.87	24.79 22.87			
100						
100 110	20.82	21.26	21.26			

	100 yr Inte	nsitv	I = a/(t + b)	a =	1735.688	t (min)	I (mm/hr)
	City of Otta		(c · 5)	b =	6.014	5	242.70
			[	c =	0.820	10 15	178.56 142.89
						20	119.95
						25 30	103.85 91.87
						35 40	82.58
						45	75.15 69.05
						50 55	63.95 59.62
						60	55.89
Subdrai			velopment Topment Tributar	-		ortion of S	ite
Ouburui	Area (ha): C:	5.5926	3	y Aica to Gua			
	Estimated 1						
	tc (min)	I (100 yr) (mm/hr)	Q100yr (L/s)				
	10	178.56	2260.38	stheed for Fr	tina Cita		
			I Rational Me	etnoa for En	tire Site		
Subdrai	nage Area: Area (ha): C:	0.19 0.26				Uncontroll	ed - Tributary
	tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	
	10 20	178.56 119.95	24.76 16.63	24.76 16.63	` -/	` -/	
	30	91.87	12.74	12.74			
	40 50	75.15 63.95	10.42 8.87	10.42 8.87			
	60 70	55.89 49.79	7.75 6.90	7.75 6.90			
	80	44.99	6.24	6.24			
	90 100	41.11 37.90	5.70 5.26	5.70 5.26			
	110 120	35.20 32.89	4.88 4.56	4.88 4.56			
Cubal			4.00	4.00		Uneerte."	od Tribut
Supdrai	nage Area: Area (ha): C:	EX-19 0.15 0.51				Uncontroll	ed - Tributary
	tc (min)	l (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	
	10 20	178.56 119.95	38.41 25.81	38.41 25.81			
	30	91.87	19.76	19.76			
	40 50	75.15 63.95	16.17 13.76	16.17 13.76			
	60 70	55.89 49.79	12.03 10.71	12.03 10.71			
	80	44.99	9.68	9.68			
	90 100	41.11 37.90	8.84 8.15	8.84 8.15			
	110 120	35.20 32.89	7.57 7.08	7.57 7.08			
Subdrai	nage Area: Area (ha):	EX-18 0.05				Uncontroll	ed - Tributary
	C:	0.25 I (100 yr)	Qactual	Qrelease	Qstored	Vstored	
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)	
	10 20	178.56 119.95	4.08	4.08			
	30 40	91.87 75.15	3.13 2.56	3.13 2.56			
	50	63.95	2.18	2.18			
	60 70	55.89 49.79	1.90 1.70	1.90 1.70			
	80 90	44.99 41.11	1.53 1.40	1.53 1.40			
	100	37.90	1.29	1.29			
	110 120	35.20 32.89	1.20 1.12	1.20 1.12			
Subdrai	nage Area: Area (ha):	EX-17 0.41				Uncontroll	ed - Tributary
	C:	1.00 I (100 yr)	Qactual	Qrelease	Qstored	Vstored	
	(min) 10	(mm/hr) 178.56	(L/s) 202.53	(L/s) 202.53	(L/s)	(m^3)	
	20 30	119.95 91.87	136.05 104.20	136.05 104.20			
	40	75.15	85.23	85.23			
	50 60	63.95 55.89	72.54 63.40	72.54 63.40			
	70	49.79	56.47	56.47			
	80 90	44.99 41.11	51.03 46.63	51.03 46.63			
	100	37.90	42.99	42.99			
	110	35.20	39.93	39.93			

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

#### EX-16 0.48 0.58 Uncontrolled - Tributary Subdrainage Area: Area (ha): C: I (5 yr) (mm/hr) 104.19 Qstored (L/s) 80.81 54.48 41.82 34.27 (L/s) 80.81 54.48 41.82 34.27 29.20 25.55 22.78 20.60 18.84 17.38 16.15 15.10 (min) 10 20 30 40 50 60 70 80 90 100 110 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 29.20 25.55 25.55 22.78 20.60 18.84 17.38 16.15 15.10 Subdrainage Area: Area (ha): C: EX-15 0.08 0.43 Uncontrolled - Tributary I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 Vstored (m^3) Qactual Qstored (L/s) 9.72 (L/s) 9.72 6.55 5.03 4.12 3.51 3.07 2.74 20 30 40 50 60 70 80 90 100 110 120 6.55 5.03 4.12 3.51 3.07 2.74 2.48 2.26 2.09 1.94 1.82 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 2.48 2.26 2.09 1.94 1.82 EX-14 0.34 0.35 Uncontrolled - Tributary I (5 yr) Qactual Qstored Vstored (m^3) (L/s) 34.17 23.04 17.68 14.49 12.35 10.80 9.63 8.71 7.96 7.35 6.83 6.38 (L/s) 34.17 (L/s) 34.17 23.04 17.68 14.49 12.35 10.80 9.63 8.71 20 30 40 50 60 70 80 90 100 110 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 7.96 7.35 6.83 6.38 Subdrainage Area: Area (ha): C: Uncontrolled - Tributary EX-13 0.23 0.90 Vstored (m^3) (min) 10 (L/s) 60.48 (L/s) (L/s) 60.48 40.78 31.30 20 30 40 50 60 70 80 90 100 110 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 40.78 31.30 31.30 25.65 21.86 19.12 17.05 15.42 14.10 25.65 21.86 19.12 17.05 15.42 14.10 13.01 12.09 13.01 12.09 20.82 Subdrainage Area: Area (ha): C: EX-12 Uncontrolled - Tributary 0.23 Qactual (L/s) 60.48 40.78 31.30 25.65 Qrelease (L/s) 60.48 40.78 31.30 25.65 I (5 yr) (mm/hr) 104.19 70.25 Qstored Vstored (m^3) tc (min) 10 20 30 40 50 60 70 80 90 100 110 (L/s) 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 25.65 21.86 19.12 17.05 15.42 14.10 13.01 12.09 21.86 19.12 17.05 15.42 14.10 13.01 12.09 11.30

Subdraina	ao Aros:	EX-16				Uncontrolled - Tributary
	rea (ha):	0.48				Gricoria olieu - Tribu(ary
	C:	0.73				
	tc (min)	l (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
	10	178.56	173.11	173.11	( -/	
	20 30	119.95 91.87	116.29 89.06	116.29 89.06		
	40 50	75.15 63.95	72.85 62.00	72.85 62.00		
	60	55.89	54.19	54.19		
	70 80	49.79 44.99	48.27	48.27 43.62		
	90	41.11	43.62 39.86	39.86		
	100 110	37.90	36.75	36.75		
	120	35.20 32.89	34.13 31.89	34.13 31.89		
Subdraina	ge Area:	EX-15				Uncontrolled - Tributary
A	rea (ha): C:	0.08 0.54				
	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
L	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10 20	178.56 119.95	20.81 13.98	20.81 13.98		
	30	91.87	10.71	10.71		
	40 50	75.15 63.95	8.76 7.45	8.76 7.45		
	60	55.89	6.51	6.51		
	70 80	49.79 44.99	5.80 5.24	5.80 5.24		
	90	41.11	4.79	4.79		
	100 110	37.90 35.20	4.42 4.10	4.42 4.10		
	120	32.89	3.83	3.83		
Subdraina	ge Area: rea (ha):	EX-14 0.34				Uncontrolled - Tributary
	C:	0.44				
	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
	(min) 10	(mm/hr) 178.56	(L/s) 73.19	(L/s) 73.19	(L/s)	(m^3)
	20 30	119.95 91.87	49.16 37.65	49.16 37.65		
	40	75.15	30.80	30.80		
	50 60	63.95 55.89	26.21 22.91	26.21 22.91		
	70	49.79	20.41	20.41		
	80 90	44.99 41.11	18.44 16.85	18.44 16.85		
	100	37.90	15.54	15.54		
	110 120	35.20 32.89	14.43 13.48	14.43 13.48		
Subdraina	ge Area:	EX-13				Uncontrolled - Tributary
	rea (ha): C:	0.23 1.00				•
-	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10 20	178.56 119.95	115.16 77.36	115.16 77.36		
	30	91.87	59.25	59.25		
	40 50	75.15 63.95	48.47 41.25	48.47 41.25		
	60	55.89	36.05	36.05		
	70 80	49.79 44.99	32.11 29.02	32.11 29.02		
	90	41.11	26.51	26.51		
	100 110	37.90 35.20	24.45 22.70	24.45 22.70		
	120	32.89	21.22	21.22		
Subdraina		EX-12				Uncontrolled - Tributary
А	rea (ha): C:	0.23 1.00				
	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
L	(min) 10	(mm/hr) 178.56	(L/s) 115.16	(L/s) 115.16	(L/s)	(m^3)
	20	119.95	77.36	77.36		
	30 40	91.87 75.15	59.25 48.47	59.25 48.47		
	50	63.95	41.25	41.25		
	60	55.89	36.05	36.05		
	70 80	49.79 44.99	32.11 29.02	32.11 29.02		
	70 80 90	49.79 44.99 41.11	32.11 29.02 26.51	32.11 29.02 26.51		
	70 80	49.79 44.99	32.11 29.02	32.11 29.02		

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

		alculatons			
Subdrainage Area:	EX-11				Uncontrolled - Tributary
Area (ha): C:	0.13 0.37				
-	1 (5)	0	01	0-4	W-td
tc (min)	l (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 40	53.93 44.18	7.38 6.04	7.38 6.04		
50	37.65	5.15	5.15		
60	32.94	4.51	4.51		
70	29.37	4.02	4.02		
80 90	26.56 24.29	3.63 3.32	3.63 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): C:	0.34 0.59				
<b>U</b> .	0.55				
tc	l (5 yr)	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
10 20	104.19 70.25	58.11 39.18	58.11 39.18		
30	53.93	30.07	30.07		
40	44.18	24.64	24.64		
50 60	37.65	21.00	21.00		
60 70	32.94 29.37	18.37 16.38	18.37 16.38		
80	26.56	14.81	14.81		
90	24.29	13.54	13.54		
100 110	22.41 20.82	12.50 11.61	12.50 11.61		
120	19.47	10.86	10.86		
Cubdusia A-	EV ^				Uncentralled Tableton
Subdrainage Area: Area (ha):	EX-9 0.06				Uncontrolled - Tributary
C:	0.90				
tc (min)	l (5 yr) (mm/hr)	Qactual (L/s)	Qrelease	Qstored	Vstored
10	104.19	15.90	(L/s) 15.90	(L/s)	(m^3)
20	70.25	10.72	10.72		
30	53.93	8.23	8.23		
40 50	44.18 37.65	6.74 5.75	6.74 5.75		
60	32.94	5.03	5.03		
70	29.37	4.48	4.48		
80 90	26.56 24.29	4.05 3.71	4.05 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): C:	0.69				
٥.					
	0.72				
tc (min)	I (5 yr)	Qactual	Qrelease	Qstored	Vstored (m^3)
tc (min) 10		Qactual (L/s) 143.48	Qrelease (L/s) 143.48	Qstored (L/s)	Vstored (m^3)
(min) 10 20	I (5 yr) (mm/hr) 104.19 70.25	(L/s) 143.48 96.74	(L/s) 143.48 96.74		
(min) 10 20 30	I (5 yr) (mm/hr) 104.19 70.25 53.93	(L/s) 143.48 96.74 74.26	(L/s) 143.48 96.74 74.26		
(min) 10 20	1 (5 yr) (mm/hr) 104.19 70.25 53.93 44.18	(L/s) 143.48 96.74 74.26 60.85	(L/s) 143.48 96.74 74.26 60.85		
(min) 10 20 30 40 50 60	1 (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37		
(min) 10 20 30 40 50 60 70	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45		
(min) 10 20 30 40 50 60 70 80	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58		
(min) 10 20 30 40 50 60 70	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45		
(min) 10 20 30 40 50 60 70 80 90 100	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67		
(min) 10 20 30 40 50 60 70 80 90 100	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86		
(min) 10 20 30 40 50 60 70 80 90 100 110	1 (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67		
(min) 10 20 30 40 50 60 70 80 90 110 110 120  Subdrainage Area: Area (ha):	1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67		(m^3)
(min) 10 20 30 40 50 60 70 80 90 100 110 120  Subdrainage Area:	1 (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-7	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67		(m^3)
(min) 10 20 30 40 50 60 70 80 90 110 112  Subdrainage Area: Area (ha):	1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-7 0.07 0.20	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67	(L/s)	Uncontrolled - Tributary
(min) 10 20 30 40 50 60 70 80 90 100 110 120  Subdrainage Area: Area (ha): C: (min)	1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-7 0.07 0.20	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67 26.81	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67 26.81		(m^3)
(min) 10 20 30 40 50 60 70 80 90 100 110 120  Subdrainage Area: Area (ha): C:	1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 29.37 26.56 24.29.37 26.56 24.21 20.82 19.47 0.07 0.20	(L/s) 143.48 96.74 74.26 60.85 51.85 40.45 36.58 33.45 30.86 28.67 26.81	(L/s) 143.48 96.74 74.26 60.85 61.85 45.37 40.45 36.58 33.46 28.67 26.81	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 100 110 120  Subdrainage Area: Area (ha): C: tc (min) 10 20	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 24.29 22.41 20.82 19.47 EX-7 0.07 0.20 I (5 yr) (mm/hr) 104.19 70.25	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.46 28.67 26.81  Qactual (L/s) 4.32 2.91	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67 26.81	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 100 110 120  Subdrainage Area: Area (ha): C:	1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 29.37 26.56 24.29.37 26.56 24.21 20.82 19.47 0.07 0.20	(L/s) 143.48 96.74 74.26 60.85 51.85 40.45 36.58 33.45 30.86 28.67 26.81	(L/s) 143.48 96.74 74.26 60.85 61.85 45.37 40.45 36.58 33.46 28.67 26.81	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 110 112 Subdrainage Area: Area (ha): C: tc (min) 10 20 30 40 50	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 24.29 22.41 20.82 19.47 LX-7 0.20 L(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65	(L/s) 143.48 96.74 74.26 60.85 51.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67 26.81	(L/s) 143.48 143.47 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67 26.81	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 100 110 120  Subdrainage Area: Area (ha): C: tc (min) 10 20 30 40 50 60	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47  EX-7 0.07 (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94	(L/s) 143.48 96.74 74.26 60.85 61.85 45.37 40.45 33.45 30.86 28.67 26.81	(L/s) 143.48 96.74 74.26 60.85 51.85 51.85 45.37 40.45 30.86 28.67 26.81  Qrelease (L/s) 4.32 2.91 2.24 1.83 1.566	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 110 120  Subdrainage Area: (ha): C: tc (min) 10 20 30 40 50 60 70	1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 0.07 0.20 11(5 yr) 104.19 70.25 53.93 44.18 37.65 32.94 49.37	(L/s) 143.48 143.48 143.48 143.48 143.45 143.45 143.45 143.45 143.45 143.45 143.45 143.45 143.45 143.45 143.45 143.45 143.45 143.25 143.21 143	(L/s) 143.48 96.74 74.26 60.85 51.85 51.85 45.37 40.45 30.86 28.67 26.81  Qrelease (L/s) 4.32 2.91 1.224 1.83 1.56 1.37 1.22	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 100 110 120  Subdrainage Area: Area (ha): C: tc (min) 10 20 30 40 50 60	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47  EX-7 0.07 (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94	(L/s) 143.48 96.74 74.26 60.85 61.85 45.37 40.45 33.45 30.86 28.67 26.81	(L/s) 143.48 96.74 74.26 60.85 51.85 51.85 45.37 40.45 30.86 28.67 26.81  Qrelease (L/s) 4.32 2.91 2.24 1.83 1.566	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 110 120  Subdrainage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 90 110 110 110 110 110 110 110 110	I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47  EX-7 0.07 0.20  I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37	(L/s) 143.48 96.74 74.26 60.85 51.85 51.85 45.37 40.45 36.58 33.45 30.86 67 26.81	(L/s) 143.48 96.74 74.26 60.85 51.85 45.37 40.45 36.58 33.45 30.86 28.67 26.81	(L/s)	Uncontrolled - Tributary  Vstored
(min) 10 20 30 40 50 60 70 80 90 110 120  Subdrainage Area: (ha): (min) 10 20 30 40 50 60 70 80 90 90 90 90 90 90 90 90 90 90 90 90 90	1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 24.29 22.41 20.82 19.47 EX-7 0.07 0.20 1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29	(L/s) 143.48 143.48 60.85 51.85 51.85 33.45 30.86 28.67 26.81	(L/s) 143.48 96.74 74.26 60.85 51.85 51.85 36.58 33.45 30.86 28.67 26.81	(L/s)	Uncontrolled - Tributary  Vstored

	nage Area:	EX-11				Uncontrolled - Tributary
	Area (ha):	0.13				
	C:	0.46				
1	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10	178.56	30.53	30.53		
	20	119.95	20.51	20.51		
	30 40	91.87 75.15	15.71	15.71 12.85		
	50	63.95	12.85 10.94	12.85		
	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		
Subdrair	1200 Aron:	EV 10				Uncontrolled - Tributary
	nage Area: Area (ha):	EX-10 0.34				Officontrolled - Tributary
	C:	0.74				
	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10	178.56	124.47	124.47		
	20 30	119.95	83.62	83.62		
	30 40	91.87 75.15	64.04 52.38	64.04 52.38		
	50	63.95	52.38 44.58	52.38 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		
Subdreit	nage Area:	EX-9				Uncontrolled - Tributary
	Area (ha):	0.06				oncommunica - moundry
	C:	1.00				
	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
Į	(min) 10	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	20	178.56 119.95	30.28 20.34	30.28 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		
	80 90	44.99 41.11	6.97	6.97		
	80 90 100	44.99 41.11 37.90	6.97 6.43	6.97 6.43		
	80 90	44.99 41.11 37.90 35.20	6.97	6.97		
	80 90 100 110	44.99 41.11 37.90	6.97 6.43 5.97	6.97 6.43 5.97		
	80 90 100 110 120	44.99 41.11 37.90 35.20 32.89	6.97 6.43 5.97	6.97 6.43 5.97		Uncontrolled - Tributary
	80 90 100 110 120 nage Area: Area (ha):	44.99 41.11 37.90 35.20 32.89 EX-8 0.69	6.97 6.43 5.97	6.97 6.43 5.97		Uncontrolled - Tributary
	80 90 100 110 120	44.99 41.11 37.90 35.20 32.89	6.97 6.43 5.97	6.97 6.43 5.97		Uncontrolled - Tributary
	80 90 100 110 120 nage Area: Area (ha):	44.99 41.11 37.90 35.20 32.89 EX-8 0.69 0.90	6.97 6.43 5.97 5.58	6.97 6.43 5.97 5.58	Qstored	
	80 90 100 110 120 nage Area: Area (ha):	44.99 41.11 37.90 35.20 32.89 EX-8 0.69	6.97 6.43 5.97	6.97 6.43 5.97 5.58 Qrelease (L/s)	Qstored (L/s)	Uncontrolled - Tributary  Vstored (m^3)
	80 90 100 110 120 nage Area: Area (ha): C: tc (min)	44.99 41.11 37.90 35.20 32.89 EX-8 0.69 0.90 I (100 yr) (mm/hr) 178.56	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20	44.99 41.11 37.90 35.20 32.89 EX-8 0.69 0.90 I (100 yr) (mm/hr) 178.56 119.95	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30	44.99 41.11 37.90 35.20 32.89 EX-8 0.69 0.90 I (100 yr) (mm/hr) 178.56 119.95 91.87	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40	44.99 41.11 37.90 35.20 32.89 EX-8 0.69 0.90 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35		Vstored
	80 90 100 110 120 nage Area: (ha): C: tc (min) 10 20 30 40 50	44.99 41.11 37.90 35.20 32.89 EX-8 0.69 0.90 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90  I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 70	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09	G.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90  I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71	6.97 6.43 5.97 5.58 <b>Qrelease</b> ( <b>L/s</b> ) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90	44,99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90  I (100 yr) (mm/hr) 178.56 119.95 55.89 49.79 44.99 41.11 37.90	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25		Vstored
	80 90 100 110 120 hage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110	44,99 41.11 37.90 35.20 32.89 0.89 0.90  I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 49.79 44.99 41.11 37.90 35.20	Gactual (L/s) 307.37 206.48 110.09 96.22 85.71 77.45 70.77 65.25 60.60	6.97 6.43 5.97 5.58 <b>Qrelease</b> ( <b>L(s)</b> 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 60.60		Vstored
	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90	44,99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90  I (100 yr) (mm/hr) 178.56 119.95 55.89 49.79 44.99 41.11 37.90	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25		Vstored
	80 90 100 1120 nage Area: Area (ha): C: tc (min) 20 30 40 50 60 70 80 90 110 120	44.99 41.11 37.90 35.20 32.89 EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 44.11 37.90 35.20 32.89	Gactual (L/s) 307.37 206.48 110.09 96.22 85.71 77.45 70.77 65.25 60.60	6.97 6.43 5.97 5.58 <b>Qrelease</b> ( <b>L(s)</b> 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 60.60		Vstored (m*3)
Subdrair	80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110 120	44,99 41,11 37,90 35,20 32,89  EX-8 0,69 0,90  I (100 yr) (mm/hr) 178,56 119,95 91,87 75,15 63,95 95,89 44,79 44,99 41,11 37,90 35,20 32,89	Gactual (L/s) 307.37 206.48 110.09 96.22 85.71 77.45 70.77 65.25 60.60	6.97 6.43 5.97 5.58 <b>Qrelease</b> ( <b>L(s)</b> 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 60.60		Vstored
Subdrair	80 90 100 1120 nage Area: Area (ha): C: tc (min) 20 30 40 50 60 70 80 90 110 120	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 95.89 44.99 41.11 37.90 35.20 32.89  EX-7 0.07	Gactual (L/s) 307.37 206.48 110.09 96.22 85.71 77.45 70.77 65.25 60.60	6.97 6.43 5.97 5.58 <b>Qrelease</b> ( <b>L(s)</b> 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 60.60		Vstored (m*3)
Subdrair	80 90 100 110 120 120 120 120 120 10 20 30 40 50 60 70 80 90 110 120 120 120 120 120 120 120 120 12	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90  I (100 yr) (mm/hr) 178.56 119.95 51.87 75.15 63.95 94.79 44.99 44.11 37.90 35.20 32.89  EX-7 0.07 0.25	Gactual (L/s) 307.37 206.48 110.09 96.22 85.71 77.45 70.77 65.25 60.60	6.97 6.43 5.97 5.58 <b>Qrelease</b> ( <b>L(s)</b> 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 60.60		Vstored (m*3)
Subdrair	80 90 100 110 120 120 120 120 120 10 20 30 40 50 60 70 80 90 110 120 120 120 120 120 120 120 120 12	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 95.89 44.99 41.11 37.90 35.20 32.89  EX-7 0.07	Gactual (L/s) 307.37 206.48 110.09 96.22 85.71 77.45 70.77 65.25 60.60	6.97 6.43 5.97 5.58 <b>Qrelease</b> ( <b>L(s)</b> 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 60.60		Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrair	80 90 100 110 1120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110 120 120 130 140 150 150 150 150 150 150 150 150 150 15	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 63.98 55.89 44.79 44.99 44.11 37.90 32.89  EX-7 0.07 0.25	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62	(L/s)	Vstored (m^3)  Uncontrolled - Tributary
Subdrain	80 90 100 1120 1220 1220 130 40 50 60 70 80 110 120 120 120 120 120 120 120 120 12	44.99 41.11 37.90 35.20 32.89  EX-8 0.89 0.90 1 (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90 32.89  EX-7 0.07 0.25	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 177.74 5.25 60.60 56.62	6.97 6.43 5.97 5.58 <b>Qrelease</b> (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	80 90 100 110 1120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110 120 120 120 120 120 120 120 120 12	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 0.90 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 44.99 44.99 44.19 37.90 35.20 32.89  EX-7 0.07 0.25 1(100 yr) 1(110.95) 1(110.95) 1(110.95) 1(110.95) 1(110.95) 1(110.95)	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 765.25 60.60 56.62	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrair	80 90 100 1120 1220 1220 1320 140 150 160 170 170 170 170 170 170 170 170 170 17	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 119.95 55.89 49.79 44.19 37.90 32.89  EX-7 0.07 0.25  I (100 yr) (mm/hr) 178.56 119.95 91.87	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 17.77,45 70.77 65.25 60.60 56.62 Qactual (L/s) 9.26 6.22 4.76	6.97 6.43 5.97 5.58 <b>Qrelease</b> (L/s) 307.37 206.48 156.14 129.35 110.09 96.22 85.71 77.45 70.76 65.25 60.60 56.62	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	80 90 1000 1110 120 hage Area: Area (ha): C: tc (min) 10 40 120 120 120 120 120 120 120 120 120 12	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 0.90 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 44.99 44.99 44.19 178.56 179.56 179.56 179.56 179.56 179.56 179.56 179.56 179.56 179.56	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.62 Qactual (L/s) 9.22 6.22 4.76 3.39	6.97 6.43 5.97 5.58 Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	80 90 100 1120 1220 1326 Area (ha): C: (min) 10 20 30 120 120 120 120 120 120 120 120 120 12	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 119.95 55.89 49.79 44.99 41.11 37.90 32.89  EX-7 0.25 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.47 65.25 60.60 56.62	6.97 6.43 5.97 5.58 <b>Qrelease</b> (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.745 70.765.25 60.60 56.62	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrair	80 90 100 1120 1220 1320 Area (ha): C: tc (min) 120 120 120 130 Area (ha): C: tc (min) 10 20 30 40 120 120 120 120 120 120 140 150 40 150 60 60 150 60	44.99 41.11 37.90 35.20 9.90 .90 .90 (mm/hr) 178.56 119.95 91.87 75.15 63.95 94.79 44.91 37.90 35.20 32.89  EX-7 0.07 0.25  I(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 208.14 129.35 110.09 96.22 85.71 77.74 60.60 60.60 66.62 Qactual (L/s) 9.22 4.76 3.90 3.32 2.90	6.97 6.43 5.97 6.58  Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62  Qrelease (L/s) 9.26 6.22 4.76 3.39 3.32 2.90	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrair	80 90 100 1120 1220 1326 Area (ha): C: (min) 10 20 30 120 120 120 120 120 120 120 120 120 12	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 1(100 yr) (mm/hr) 178.56 119.95 55.89 44.79 44.99 41.11 37.90 35.20 32.89  EX-7 0.07 0.25 1(100 yr) 178.56 119.95 56.89 49.79	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77.45 70.77.45 60.60 56.62 Qactual (L/s) 9.26 6.22 4.76 3.30 3.32 2.98	6.97 6.43 5.97 6.58  Qrelease (Lts) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62  Qrelease (Lts) 9.26 6.22 4.76 3.90 3.32 2.90	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	80 90 1000 1110 120 120 120 120 120 120 120	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 0.90 1(100 yr) (mm/hr) 178.56 119.95 55.89 44.79 44.99 35.20 32.89  EX-7 0.07 0.25 1(100 yr) (mm/hr) 178.56 119.95 55.89 49.79 44.99 41.11	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62 Qactual (L/s) 9.26 6.22 4.76 3.39 2.58 2.33 2.58 2.33 2.33	6.97 6.43 5.97 6.58  Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 45.71 77.45 70.77 65.25 60.60 56.62  Qrelease (L/s) 9.26 6.22 4.76 3.90 3.92 2.98 2.33 2.13	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	80 90 100 1120 1220 130 40 100 110 120 120 130 40 100 100 100 100 100 100 100 100 100	44.99 41.11 37.90 35.20 32.89  EX-8 0.89 0.90 1 (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90 178.56 119.95 91.87 75.15 63.95 55.89 49.79	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62 Qactual (L/s) 6.22 4.76 6.22 4.76 3.39 2.33 2.13 2.13 1.97	6.97 6.43 5.97 5.58   Qrelease (L/s) 307.37 206.48 118.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62   Qrelease (L/s) 3.90 3.32 2.90 2.88 2.33 2.13 1.97	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	80 90 1000 1110 120 120 120 120 120 120 120	44.99 41.11 37.90 35.20 32.89  EX-8 0.69 0.90 0.90 1(100 yr) (mm/hr) 178.56 119.95 55.89 44.79 44.99 35.20 32.89  EX-7 0.07 0.25 1(100 yr) (mm/hr) 178.56 119.95 55.89 49.79 44.99 41.11	6.97 6.43 5.97 5.58 Qactual (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 85.71 77.45 70.77 65.25 60.60 56.62 Qactual (L/s) 9.26 6.22 4.76 3.39 2.58 2.33 2.58 2.33 2.33	6.97 6.43 5.97 6.58  Qrelease (L/s) 307.37 206.48 158.14 129.35 110.09 96.22 45.71 77.45 70.77 65.25 60.60 56.62  Qrelease (L/s) 9.26 6.22 4.76 3.90 3.92 2.98 2.33 2.13	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored

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

#### EX-6 0.42 0.66 Uncontrolled - Tributary Subdrainage Area: Area (ha): C: Qactual (L/s) 80.68 54.39 41.76 34.21 29.15 25.51 I (5 yr) (mm/hr) 104.19 Qstored (L/s) 80.68 54.39 41.76 34.21 29.15 25.51 22.74 20.57 18.81 17.35 16.12 15.07 (min) 10 20 30 40 50 60 70 80 90 100 110 (L/s) 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 25.51 22.74 20.57 18.81 17.35 16.12 15.07 Subdrainage Area: Area (ha): C: Uncontrolled - Tributary I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 Vstored (m^3) Qactua Qrelease Qstored (L/s) 40.60 31.17 25.54 21.76 19.04 16.98 15.35 14.04 12.95 12.03 11.25 20 30 40 50 60 70 80 90 100 110 120 40.60 31.17 25.54 21.76 19.04 16.98 15.35 14.04 12.95 12.03 11.25 32.94 29.37 26.56 24.29 22.41 20.82 19.47 Uncontrolled - Tributary I (5 yr) Qactual Qstored (m^3) (L/s) 143.96 (L/s) 143.96 (L/s) 20 30 40 50 60 70 80 90 100 110 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 97.06 74.51 61.05 52.02 45.52 40.58 36.70 33.56 30.96 28.77 26.90 97.06 74.51 61.05 52.02 45.52 40.58 36.70 33.56 30.96 28.77 26.90 Subdrainage Area: Area (ha): C: Uncontrolled - Tributary EX-3 0.23 Vstored (m^3) (min) 10 20 30 40 50 60 70 80 90 100 110 (L/s) 60.48 (L/s) (L/s) 60.48 40.78 31.30 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 40.78 31.30 31.30 25.65 21.86 19.12 17.05 15.42 14.10 13.01 12.09 25.65 21.86 19.12 17.05 15.42 14.10 13.01 12.09 Subdrainage Area: Area (ha): C: EX-2 0.27 0.35 Uncontrolled - Tributary I (5 yr) (mm/hr) 104.19 70.25 Qreleas Qstored Vstored (m^3) tc (min) 10 20 30 40 50 60 70 80 90 100 110 Qactual (L/s) 27.27 18.39 14.11 11.56 9.86 8.62 7.69 6.95 6.36 5.86 5.45 (L/s) 27.27 18.39 14.11 11.56 (L/s) 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 9.86 8.62 7.69 6.95 6.36 5.86 5.45 5.10

Subdrair	nage Area:	EX-6				Uncontrolled - Tributary
	Area (ha):	0.42				*
	C:	0.83				
	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
Į	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10 20	178.56 119.95	172.82 116.09	172.82 116.09		
	30	91.87	88.92	88.92		
	40	75.15	72.73	72.73		
	50	63.95	61.90	61.90		
	60 70	55.89	54.10	54.10		
	70 80	49.79 44.99	48.19 43.54	48.19 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		
Subdrair	nage Area:	EX-5				Uncontrolled - Tributary
	Area (ha):	0.23				•
	C:	1.00				
1	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
ı	10	178.56	114.67	114.67		<del></del> -
	20	119.95	77.03	77.03		
	30 40	91.87 75.15	59.00 48.26	59.00 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		
	90 100	41.11 37.90	26.40 24.34	26.40 24.34		
	110	35.20	22.61	22.61		
	120	32.89	21.12	21.12		
Cultural						Uncentralist Table
	nage Area: Area (ha):	EX-4 0.70				Uncontrolled - Tributary
	C:	0.70				
,						
	tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (I/e)	Vstored (m^3)
l	10	178.56	308.38	308.38	(L/s)	(···· 0)
	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 70	55.89 49.79	96.53 85.99	96.53 85.99		
	60 70 80	55.89 49.79 44.99	96.53 85.99 77.70	96.53 85.99 77.70		
	60 70 80 90	55.89 49.79 44.99 41.11	96.53 85.99 77.70 71.00	96.53 85.99 77.70 71.00		
	60 70 80 90 100	55.89 49.79 44.99 41.11 37.90	96.53 85.99 77.70 71.00 65.46	96.53 85.99 77.70 71.00 65.46		
	60 70 80 90	55.89 49.79 44.99 41.11	96.53 85.99 77.70 71.00	96.53 85.99 77.70 71.00		
	60 70 80 90 100 110 120	55.89 49.79 44.99 41.11 37.90 35.20 32.89	96.53 85.99 77.70 71.00 65.46 60.80	96.53 85.99 77.70 71.00 65.46 60.80		
	60 70 80 90 100 110 120	55.89 49.79 44.99 41.11 37.90 35.20 32.89	96.53 85.99 77.70 71.00 65.46 60.80	96.53 85.99 77.70 71.00 65.46 60.80		Uncontrolled - Tributary
	60 70 80 90 100 110 120	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23	96.53 85.99 77.70 71.00 65.46 60.80	96.53 85.99 77.70 71.00 65.46 60.80		Uncontrolled - Tributary
	60 70 80 90 100 110 120 nage Area: Area (ha):	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23 1.00	96.53 85.99 77.70 71.00 65.46 60.80 56.81	96.53 85.99 77.70 71.00 65.46 60.80 56.81		
	60 70 80 90 100 110 120 mage Area: Area (ha): C:	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23 1.00	96.53 85.99 77.70 71.00 65.46 60.80 56.81	96.53 85.99 77.70 71.00 65.46 60.80 56.81	Qstored	Vstored
	60 70 80 90 100 110 120 nage Area: Area (ha): C:	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23 1.00 I (100 yr) (mm/hr)	96.53 85.99 77.70 71.00 65.46 60.80 56.81	96.53 85.99 77.70 71.00 65.46 60.80 56.81	Qstored (L/s)	
	60 70 80 90 100 110 120 mage Area: Area (ha): C:	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23 1.00	96.53 85.99 77.70 71.00 65.46 60.80 56.81	96.53 85.99 77.70 71.00 65.46 60.80 56.81		Vstored
	60 70 80 90 100 110 120 Area (ha): C: tc (min) 10 20 30	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  I (100 yr) (mm/hr) 178.56 119.95 91.87	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25		Vstored
	60 70 80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47		Vstored
	60 70 80 90 100 110 120  mage Area: Area (ha): c: tc (min) 10 20 30 40 50	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  I (100 yr) (mm/hr) 178.56 91.87 75.15 63.95	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25		Vstored
	60 70 80 90 100 110 120 mage Area: (ha): C: tc (min) 10 20 30 40 50 60	55.89 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00 I(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.05		Vstored
	60 70 80 90 100 110 120  mage Area: Area (ha): c: tc (min) 10 20 30 40 50	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  I (100 yr) (mm/hr) 178.56 91.87 75.15 63.95	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25		Vstored
	60 70 80 90 100 110 120 nage Area: Area (ha): C: tc (min) 10 20 40 50 60 70 80 90	55.89 49.79 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 73.25 48.47 41.25 36.05 32.11 29.02 26.51		Vstored
	60 70 80 90 1100 1110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 100	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23 1.00 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45	96.53 85.99 77.70 71.00 65.46 60.80 66.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45		Vstored
	60 70 80 90 1100 1110 120 nage Area (ha): c: tc (min) 10 20 30 40 50 60 70 80 90 1110	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23 1.00 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.96 49.79 44.99 41.11 37.90 35.20	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.21 129.02 26.51 24.55 22.70		Vstored
	60 70 80 90 1100 1110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 100	55.89 49.79 44.99 41.11 37.90 35.20 32.89 EX-3 0.23 1.00 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45	96.53 85.99 77.70 71.00 65.46 60.80 66.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45		Vstored
Subdrain	60 70 80 90 1000 1110 20 1100 1100 1100 1100 11	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 95.89 44.99 41.11 37.90 35.20 32.89	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.21 129.02 26.51 24.55 22.70		Vstored
Subdrain	60 70 80 90 100 1120 nage Area: Area (ha): C: (min) 10 20 30 40 50 60 70 80 90 110 110 110 110 Area (ha): Area (ha): Area (ha): Area (ha):	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  [(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 95.89 49.79 44.11 37.90 35.20 32.89  EX-2 0.27	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.21 129.02 26.51 24.55 22.70		Vstored (m²3)
Subdrain	60 70 80 90 1000 1110 20 1100 1100 1100 1100 11	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 95.89 44.99 41.11 37.90 35.20 32.89	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.21 129.02 26.51 24.55 22.70		Vstored (m²3)
Subdrain	60 70 80 90 100 1120 nage Area: Area (ha): C: (min) 10 20 30 40 50 60 70 80 90 110 110 110 110 Area (ha): Area (ha): Area (ha): Area (ha):	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  [(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 95.89 49.79 44.11 37.90 35.20 32.89  EX-2 0.27	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qactual (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.21 129.02 26.51 24.55 22.70		Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 1100 1120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110 120 nage Area: Area (ha): C: tc (min)	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  I(100 yr) (mm/hr) 178.56 51.87 55.89 49.79 44.11 37.90 35.20 32.89  EX-2 0.27 0.44	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 77.36 59.25 48.47 41.25 32.11 29.02 26.51 24.45 22.70 21.22	96.53 85.99 77.70 71.00 65.46 60.80 66.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 32.11 29.02 26.51 24.45 22.70 21.22	(L/s)	Vstored (m^3)  Uncontrolled - Tributary
Subdrain	60 70 80 90 100 1120  nage Area: Area (ha): c: tc (min) 10 20 30 40 50 60 70 80 90 110 120  nage Area: Area (ha): c: tc (min) 110 120  120  120  120  120  100 110 120  100 110 120  110 110	55.89 49.79 44.99 41.11 37.90 35.20  EX-3 0.23 1.00 178.56 119.95 91.87 75.15 63.95 944.99 44.99 44.191 37.90 35.20 32.89  EX-2 0.27 0.44  I (100 yr) (mm/hr) 178.56	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22	96.53 85.99 77.70 71.00 65.46 60.80 56.81 <b>Qrelease</b> ( <b>L/s</b> ) 115.16 77.36 59.25 48.47 41.25 32.11 29.02 26.51 24.45 22.70 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 1100 1110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 1100 1101 120 ange Area: Area (ha): C: tc (min) 10 20 30 30 30 30 30 30 30 30 30 30 30 30 30	55.89 49.79 44.99 41.11 37.90 35.29  EX-3 0.23 1.00  I(100 yr) (mm/hr) 178.56 49.79 44.99 41.11 37.90 35.20 35.20 35.20 35.20 35.20 35.20 36.27 0.44  I(100 yr) (mm/hr) 178.56 119.95	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 77.36 59.25 48.47 41.25 48.47 41.25 22.70 21.22	96.53 85.99 77.70 71.00 65.46 60.80 66.81 115.16 77.36 59.25 48.47 41.25 32.11 29.02 26.51 24.45 22.70 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 100 1120  nage Area: Area (ha): c: tc (min) 10 20 30 40 50 60 70 80 90 110 120  nage Area: Area (ha): c: tc (min) 110 20 30 40 50 60 70 80 60 70 80 90 110 120 60 70 80 90 110 120 30 30 40 30 30	55.89 49.79 44.99 41.11 37.90 35.20 1.00 EX-3 0.23 1.00 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90 32.89 EX-2 0.27 0.44 I (100 yr) (mm/hr) 178.56 119.95 91.87	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qactual (L's)	96.53 85.99 77.70 71.00 65.46 60.80 56.81 15.16 77.36 59.25 48.47 41.25 32.11 29.02 226.51 24.50 21.22 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 1100 1110 120 nage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 1100 1101 120 ange Area: Area (ha): C: tc (min) 10 20 30 30 30 30 30 30 30 30 30 30 30 30 30	55.89 49.79 44.99 41.11 37.90 35.29  EX-3 0.23 1.00  I(100 yr) (mm/hr) 178.56 49.79 44.99 41.11 37.90 35.20 35.20 35.20 35.20 35.20 35.20 36.27 0.44  I(100 yr) (mm/hr) 178.56 119.95	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 77.36 59.25 48.47 41.25 48.47 41.25 22.70 21.22	96.53 85.99 77.70 71.00 65.46 60.80 66.81 115.16 77.36 59.25 48.47 41.25 32.11 29.02 26.51 24.45 22.70 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 100 1100 1120  mage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 1100 1120  mage Area: Area (ha): C: tc (min) 10 20 30 40 40 40	55.89 49.79 44.99 41.11 37.90 35.20  EX-3 0.23 1.00  I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 94.99 44.11 37.90 35.20 32.89  EX-2 0.27 0.44 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qactual (L/s) 68.80 59.25 48.47 21.22 Qactual (L/s) 69.25 48.47 21.22 21.22	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Qrelease (L/s) 115.16 77.36 59.25 48.47 41.25 36.01 29.02 26.51 24.45 22.70 21.22 Qrelease (L/s) 32.11 29.02 26.51 24.45 22.70 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 100 1100 1120  nage Area: Area (ha): C: (min) 10 20 30 40 50 60 70 hage Area: C: (min) 10 20 30 40 50 60 70 10 20 10 30 40 50 60 70 70 70 70 80 80 90 100 110 100 100 110 100 100 100 100	55.89 49.79 44.99 41.11 37.90 35.20  EX-3 0.23 1.00  I(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 44.79 44.11 37.90 32.89  EX-2 0.27 0.44  I(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 177.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qactual (L/s) 58.42 39.24 39.24 58.42 39.26 39.26 59.26	96.53 85.99 77.70 71.00 65.46 60.80 66.81 115.16 77.36 59.25 48.47 41.25 20.22 26.51 24.45 22.70 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 100 1120 1220 100 110 120 100 110 120 100 110 120 100 110 120 100 10	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 94.79 44.99 44.11 37.90 35.20 32.89  EX-2 0.27 0.44  I(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 44.99	96.53 85.99 77.70 71.00 65.46 60.80 56.81 (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qactual (L/s) Qactual (L/s) 9.25 48.47 21.22 20.51 24.45 22.70 21.22	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Sec. 10 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qrelease (L/s) Qrelease (L/s) Qrelease (L/s) 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 1100 1120 nage Area: Area (ha): C: (min) 10 20 30 40 1100 1100 1100 1100 1100 1100 11	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00  I(100 yr) (mm/hr) 178.56 119.95 55.89 44.79 44.99 41.11 37.90 35.20 32.89  EX-2 0.44  I(100 yr) I	96.53 85.99 77.70 71.00 65.46 60.80 56.81 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qactual (L's) 58.42 39.24 40.06 24.59 24.50 26.51 24.65 22.70 21.22	96.53 85.99 77.70 71.00 65.46 60.80 66.81 115.16 77.36 59.25 48.47 41.25 22.70 21.22 26.51 24.45 22.70 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored
Subdrain	60 70 80 90 100 1120 1220 100 110 120 100 110 120 100 110 120 100 110 120 100 10	55.89 49.79 44.99 41.11 37.90 35.20 32.89  EX-3 0.23 1.00 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 94.79 44.99 44.11 37.90 35.20 32.89  EX-2 0.27 0.44  I(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 44.99	96.53 85.99 77.70 71.00 65.46 60.80 56.81 (L/s) 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qactual (L/s) Qactual (L/s) 9.25 48.47 21.22 20.51 24.45 22.70 21.22	96.53 85.99 77.70 71.00 65.46 60.80 56.81 Sec. 10 115.16 77.36 59.25 48.47 41.25 36.05 32.11 29.02 26.51 24.45 22.70 21.22 Qrelease (L/s) Qrelease (L/s) Qrelease (L/s) 21.22	(L/s)	Vstored (m^3) Uncontrolled - Tributary Vstored

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

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

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

| Total Roof Areas | 0.332 ha | 5.256 ha | Total Tributary Surface Areas (Controlled and Uncontrolled) | 5.558 ha | Total Uncontrolled Areas (Non-Tributary) | 0.000 ha | Total Site | 5.588 ha | Total Site | Total Site | 5.588 ha | Total Site | Total Site

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

City of Ottawa b = 6.033 5 c = 0.814 10 15 20 25 30 35 40 45	141.18 104.19 83.56
15 20 25 30 35 40	
20 25 30 35 40	83.56
25 30 35 40	
30 35 40	70.25
35 40	60.90
40	53.93
	48.52
AE	44.18
45	40.63
50	37.65
55	35.12
60	32.94

Typical Time of Concentration

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

#### 5 YEAR Modified Rational Method for Entire Site

 
 Subdrainage Area:
 L103B

 Area (ha):
 0.06

 C:
 0.61
 Controlled - Tributary

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	10.47	2.4	0.7	0.0	0.0

Storage: e Above CE

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

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

Subdrainage Area:	L103A	Controlled - Iributary
Area (ha):	0.13	

tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(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

Orifice	e Equation: 0	CdA(2gh)^0.5		Where C =	0.61
Orifice	Diameter:	83.00	mm		

	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 + t	o) a=	1735.688	t (min)	I (mm/hr)
City of Ottawa	b =	6.014	5	242.70
	c =	0.820	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 Predevelopm	nent Release	from Red	eveloped	Portions of

Typical Time of Concentration

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

#### 100 YEAR Modified Rational Method for Entire Site

Controlled - Tributary

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

Surface Storage Above CB

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

	Stage	Head	Discharge	Vreq	Vavail	Volume
		(m)	(L/s)	(cu. m)	(cu. m)	Check
100-year Water Level	77.20	1.63	10.2	8.3	16.0	OK
					7.00	

Controlled - Tributary

tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(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

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

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

Subdra	inage Area:	L102A 0.12				Controlle	ed - Tributary	
	Area (ha): C:	0.70						
	tc (min)	l (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)		
	10 20	104.19 70.25	23.5 15.9	7.1 7.1	16.4 8.8	9.9 <b>10.5</b>		
	30	53.93	12.2	7.1	5.1	9.1		
	40 50	44.18 37.65	10.0 8.5	7.1 7.1	2.9 1.4	6.9 4.2		
	60	32.94	7.4	7.1	0.3	1.2		
	70 80	29.37 26.56	6.6 6.0	7.1 7.1	0.0	0.0		
	90 100	24.29 22.41	5.5 5.1	7.1 7.1	0.0	0.0		
	110	20.82	4.7	7.1	0.0	0.0		
Storage:	120 e Above CE	19.47	4.4	7.1	0.0	0.0		
Orifi	ce Diameter:	LMF 80						
Inv	rert Elevation /G Elevation	75.44 76.82	m m					
	onding Depth	0.16	m					
Dow	nstream 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	
Subdra	inage Area: Area (ha):	F100A 0.11			_	Uncontrolle	ed - Tributary	
	C:	0.49 I (5 yr)	Qactual	Qrelease	Qstored	Vstored		
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)		
	10 20	104.19 70.25	15.6 10.5	15.6 10.5				
	30	53.93	8.1	8.1				
	40 50	44.18 37.65	6.6 5.6	6.6 5.6				
	60	32.94	4.9	4.9				
	70 80	29.37 26.56	4.4 4.0	4.4 4.0				
	90 100	24.29 22.41	3.6 3.4	3.6 3.4				
	110	20.82	3.1	3.1				
	120	19.47	2.9	2.9				
Subdra	inage Area: Area (ha): C:	0.12 0.90		N	Maximum Sto	orage Depth:	Roof 150 m	nm
	tc (min)	l (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.
	20 30	70.25 53.93	20.2 15.5	6.4 6.4	13.8 9.1	16.5 16.3	105.6 105.2	0.
	40	44.18	12.7	6.4	6.3	15.2	103.0	0.
	50 60	37.65 32.94	10.8 9.5	6.3 6.2	4.5 3.3	13.6 11.9	99.9 94.5	0.
	70	29.37	8.5	6.0	2.4	10.2	89.0	0.
	80 90	26.56 24.29	7.6 7.0	5.9 5.8	1.8	8.4	83.4	0.
					12			
	100	22.41	6.4	5.6	1.2 0.9	6.7 5.2	77.9 71.4	0.
	110	20.82	6.4 6.0	5.6 5.4	0.9 0.6	6.7 5.2 3.9	77.9 71.4 63.8	0.
Storage:		20.82 19.47	6.4	5.6	0.9	6.7 5.2	77.9 71.4	0.
Storage:	110 120	20.82 19.47 je	6.4 6.0 5.6	5.6 5.4 5.2	0.9 0.6 0.4	6.7 5.2 3.9 2.8	77.9 71.4 63.8 56.7	0.
	110 120	20.82 19.47	6.4 6.0	5.6 5.4	0.9 0.6	6.7 5.2 3.9	77.9 71.4 63.8	0.
5-year	110 120 Roof Storag	20.82 19.47 le Depth (mm)	6.4 6.0 5.6 Head (m)	5.6 5.4 5.2 Discharge (L/s)	0.9 0.6 0.4 Vreq (cu. m)	6.7 5.2 3.9 2.8 Vavail (cu. m)	77.9 71.4 63.8 56.7 Discharge Check	0.
5-year	110 120 Roof Storag	20.82 19.47 Telescope Depth (mm) 105.56 BLDGC 0.12 0.90	6.4 6.0 5.6 Head (m)	5.6 5.4 5.2 Discharge (L/s) 6.4	0.9 0.6 0.4 Vreq (cu. m)	6.7 5.2 3.9 2.8 Vavail (cu. m)	77.9 71.4 63.8 56.7 Discharge Check 0.00	0.0 0.0 0.0
5-year	Roof Storag Water Leve inage Area: Area (ha): C: tc (min)	20.82 19.47 le Depth (mm) 105.56 BLDGC 0.12 0.90	6.4 6.0 5.6 Head (m) 0.11	5.6 5.4 5.2 Discharge (L/s) 6.4	0.9 0.6 0.4  Vreq (cu. m) 16.5  Aaximum Sto	6.7 5.2 3.9 2.8  Vavail (cu. m) 46.0  Vstored (m*3)	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m	0. 0. 0.
5-year	110 120 Roof Storag Water Leve inage Area: Area (ha): C: tc (min) 10 20	20.82 19.47 Teles Depth (mm) 105.56 BLDGC 0.12 0.90 I (5 yr) (mm/hr) 104.19 70.25	6.4 6.0 5.6 Head (m) 0.11 Qactual (L/s) 30.0 20.2	5.6 5.4 5.2 Discharge (L/s) 6.4	0.9 0.6 0.4 Vreq (cu. m) 16.5	6.7 5.2 3.9 2.8  Vavail (cu. m) 46.0  Vstored (m*3) 14.2 16.5	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m	0.0 0.0 0.0
5-year	110 120  Roof Storage Water Leve inage Area: Area (ha): C: tc (min) 10 20 30	20.82 19.47 le Depth (mm) 105.56 BLDGC 0.12 0.90 I (5 yr) (mm/hr) 104.19 70.25 53.93	6.4 6.0 5.6 Head (m) 0.11 Qactual (L/s) 30.0 20.2 15.5	5.6 5.4 5.2 Discharge (L/s) 6.4	0.9 0.6 0.4  Vreq (cu. m) 16.5  Aaximum Sto (L/s) 23.6 13.8 9.1	6.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.2 16.5 16.3	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m  Depth (mm) 101.1 105.6	0. 0. 0. 0.
5-year	Table 10 120 Roof Storage Area:  Water Leve inage Area (ha): C: tc (min) 10 20 30 40 50	20.82 19.47 le Depth (mm) 105.56 BLDGC 0.12 0.90 I(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65	Gactual (L/s) 30.0 20.2 15.5 12.7 10.8	5.6 5.4 5.2 Discharge (L/s) 6.4	0.9 0.6 0.4  Vreq (cu. m) 16.5  faximum Stc  Qstored (L/s) 23.6 13.8 9.1 6.3 4.5	6.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.2 16.5 16.3 15.2 13.6	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m  Depth (mm) 101.1 105.6 105.2 103.0 99.9	0. 0. 0.
5-year	110 120 Roof Storag  Water Leve inage Area: Area (ha): C: tc (min) 20 30 40 50 60	20.82 19.47 le  Depth (mm) 105.56  BLDGC 0.12 0.90  I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94	Gactual (L/s) 30.0 20.2 15.5 12.7 10.8 9.5	5.6 5.4 5.2 Discharge (L/s) 6.4	0.9 0.6 0.4  Vreq (cu.m) 16.5  Aaximum Sto  Qstored (L/s) 23.6 13.8 9.1 6.3 4.5 3.3	6.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.5 16.5 16.3 15.2 13.6 11.9	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m  Depth (mm) 101.1 105.6 105.2 103.0 99.9 94.5	0. 0. 0.
5-year	Table 10 120 Roof Storage Area:  Water Leve inage Area (ha): C: tc (min) 10 20 30 40 50	20.82 19.47 le Depth (mm) 105.56 BLDGC 0.12 0.90 I(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65	6.4 6.0 5.6 Head (m) 0.11 Qactual (L/s) 30.0 20.2 15.5 12.7 10.8 9.5 8.5 7.6	5.6 5.4 5.2 Discharge ((L/s)) 6.4 Qrelease ((L/s)) 6.3 6.4 6.4 6.4 6.4	0.9 0.6 0.4  Vreq (cu. m) 16.5  faximum Stc  Qstored (L/s) 23.6 13.8 9.1 6.3 4.5	6.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.2 16.5 16.3 15.2 13.6	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m  Depth (mm) 101.1 105.6 105.2 103.0 99.9	0. 0. 0. 0. 0. 0. 0. 0.
5-year	110 120 Roof Storag Water Leve inage Area: Area (ha): tc (min) 10 20 30 40 50 60 70 80 90	20.82 19.47 le  Depth (mm) 105.56  BLDGC 0.12 0.90 1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29	Gactual (L/s) 30.0 20.2 15.5 12.7 10.8 9.5 7.6 7.0	5.6 5.4 5.2 Discharge (L/s) 6.4 Qrelease (L/s) 6.3 6.4 6.4 6.3 6.2 6.0 5.9 5.8	0.9 0.6 0.4  Vreq (cu. m) 16.5  Aaximum Sto (L/s) 23.6 13.8 9.1 6.3 4.5 3.3 4.5 1.8 1.2	6.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.2 16.5 16.3 15.2 13.6 11.9 10.2 8.4 6.7	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m 101.1 105.6 105.2 103.0 99.9 94.5 89.0 83.4 77.9	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0
5-year	110 120 Roof Storag Water Leve inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 100 110	20.82 19.47 le Depth (mm) 105.56 BLDGC 0.12 0.90 I (5 yr) (mm/hr) 104.19 104.19 37.65 32.94 429.37 26.56 24.29 22.41 20.82	Gactual (L/s) 30.0 20.2 15.5 12.7 10.8 9.5 7.6 6.4 6.0	5.6 5.4 5.2 Discharge (L/s) 6.4 Qrelease (L/s) 6.3 6.4 6.4 6.3 6.2 6.0 5.9 5.8 5.6	0.9 0.6 0.4  Vreq (cu. m) 16.5  Aaximum Sto  Qstored (L/s) 23.6 13.8 9.1 6.3 4.5 3.3 4.5 1.2 0.9 0.6	0.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.2 16.5 16.3 15.2 13.6 11.9 10.2 8.4 6.7 5.2 3.9	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m 101.1 105.6 105.2 103.0 99.9 94.5 89.0 83.4 77.9 71.4 63.8	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0
5-year	110 120 Roof Storag Water Leve inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110 120	20.82 19.47 le Depth (mm) 105.56 BLDGC 0.12 0.90 I (5 yr) (mm/hr) 104.19 70.25 53.93 32.94 44.18 37.65 29.37	Gactual (L/s) 0.11  Qactual (L/s) 0.20.2 15.5 8.5 8.5 7.6 7.0 6.4	5.6 5.4 5.2 Discharge (L/s) 6.4 6.4 6.4 6.3 6.2 6.0 5.9 5.6	0.9 0.6 0.4  Vreq (cu. m) 16.5  Maximum Stc (L/s) 23.6 13.8 9.1 6.3 4.5 3.3 2.4 1.8 1.2 0.9	6.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 varage Depth: Vstored (m*3) 14.2 16.5 16.3 15.2 13.6 11.9 10.2 10.2 10.2 10.2 10.2 10.2 10.2 10.2	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m 101.1 105.6 105.2 103.0 99.9 94.5 89.0 83.4 77.9 71.4	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0
5-year	110 120 Roof Storag Water Leve inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 100 110	20.82 19.47 le Depth (mm) 105.56 BLDGC 0.12 0.90 I (5 yr) (mm/hr) 104.19 70.25 53.93 32.94 44.18 37.65 29.37	Gactual (L/s) 30.0 20.2 15.5 12.7 10.8 9.5 7.6 6.4 6.0	5.6 5.4 5.2 Discharge (L/s) 6.4 Qrelease (L/s) 6.3 6.4 6.4 6.3 6.2 6.0 5.9 5.8 5.6	0.9 0.6 0.4  Vreq (cu. m) 16.5  Aaximum Sto  Qstored (L/s) 23.6 13.8 9.1 6.3 4.5 3.3 4.5 1.2 0.9 0.6	0.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.2 16.5 16.3 15.2 13.6 11.9 10.2 8.4 6.7 5.2 3.9	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m 101.1 105.6 105.2 103.0 99.9 94.5 89.0 83.4 77.9 71.4 63.8	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0
5-year	110 120 Roof Storag Water Leve inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110 120	20.82 19.47 lee  Depth (mm) 105.56  BLDGC 0.12 0.90  1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 lee  Depth	6.4 6.0 5.6 Head (m) 0.11 Qactual (L/s) 30.0 20.2 15.5 12.7 10.8 9.5 8.6 7.0 6.4 6.0 5.6	5.6 5.4 5.2  Discharge (L/s) 6.4  6.3 6.4 6.4 6.3 6.2 6.0 5.9 5.6 5.4 5.4 Discharge	0.9 0.6 0.4  Vreq (cu m) 16.5  Asximum Ste (L/s) 23.6 13.8 9.1 6.3 4.5 3.3 2.4 1.8 1.2 0.9 0.6 0.4	6.7 5.2 3.9 2.8 Vavail (cu. m) 46.0 Vstored (m*3) 14.2 16.5 16.3 15.2 13.6 11.9 10.2 8.4 6.7 5.2 3.9 2.8	77.9 71.4 63.8 56.7  Discharge Check 0.00  Roof 150 m  Depth (mm) 101.1 105.6 105.2 103.0 99.9 94.5 89.0 83.4 77.9 71.4 63.8 56.7	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0
5-year Subdra	110 120 Roof Storag Water Leve inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 110 120	20.82 19.47 lel Depth (mm) 105.56 BLDGC 0.12 0.90 11 (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	6.4 6.0 5.6 Head (m) 0.11 Qactual (L/s) 30.0 20.2 15.5 12.7 10.8 9.5 7.6 6.4 6.0 5.6	5.6 5.4 5.2 Discharge (L/s) 6.4 A A Qrelease (L/s) 6.3 6.4 6.4 6.4 6.3 6.2 6.0 5.9 5.8 5.6 5.4 5.2	Vreq (ou. m) 16.5  Aaximum Sto (L/s) 23.6 13.8 4.5 3.3 4.5 3.2 4.1 1.2 0.9 0.6 0.4	6.7 5.2 3.9 2.8  Vavail (cu. m) 46.0  vstored (m*3) 14.2 16.5 16.3 15.2 13.6 11.9 10.2 8.4 6.7 5.2 3.9 2.8	77.9 71.4 63.8 56.7 Discharge Check 0.00  Roof 150 m  Depth (mm) 101.1 105.6 105.0 105.0 99.9 99.9 99.7 71.4 63.8 56.7	0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0. 0

Subdra	inage Area: Area (ha):	L102A 0.12				Control	led - Tributary	
	C:	0.88					1	
	tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)		
	10 20	178.56 119.95	50.4 33.8	7.4 7.4	43.0 26.5	25.8 31.8		
	30	91.87	25.9	7.4	18.6	33.4		
	40 50	75.15 63.95	21.2 18.0	7.4 7.4	13.8 10.7	33.2 32.0		
	60	55.89	15.8	7.4	8.4	30.3		
	70 80	49.79 44.99	14.0 12.7	7.4 7.4	6.7 5.3	28.1 25.6		
	90 100	41.11 37.90	11.6 10.7	7.4 7.4	4.2 3.3	22.9 20.0		
	110 120	35.20 32.89	9.9	7.4 7.4	2.6 1.9	17.0 13.8		
Storage:	Surface Sto	orage Above	СВ					
	ce Diameter:			CB Storage:	0.71	m3		
	rert Elevation G Elevation							
Max Po	onding Depth nstream W/L		m					
		Stage	Head (m)	Discharge (L/s)	Vreq	Vavail (cu. m)	Volume Check	
100-year	Water Leve	77.10	(m) 1.66	7.4	(cu. m) 33.4	(cu. m) 53.9 20.50	OK	
Subdra	inage Area:	F100A					led - Tributary	
	Area (ha): C:	0.11 0.61						
	tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)		
	10 20	178.56 119.95	33.4 22.5	33.4 22.5				
	30	91.87	17.2	17.2				
	40 50	75.15 63.95	14.1 12.0	14.1 12.0				
	60 70	55.89 49.79	10.5 9.3	10.5 9.3				
	80	44.99	8.4	8.4				
	90 100	41.11 37.90	7.7 7.1	7.7 7.1				
	110 120	35.20 32.89	6.6	6.6 6.2				
Subdra	inage Area: Area (ha):	BLDGA 0.12		N	laximum Str	orage Depth	Roof : 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 20	178.56 119.95	57.1 38.3	7.1 7.3	50.0 31.1	30.0 37.3	129.4 138.7	0. 0.
	30	91.87	29.4	7.4	22.0	39.6	141.8	0.
	40 50	75.15 63.95	24.0 20.4	7.4 7.4	16.6 13.1	<b>40.0</b> 39.3	142.2 141.3	0.
	60	55.89	17.9	7.3	10.6	38.0	139.7	0.
	70 80	49.79 44.99	15.9 14.4	7.3 7.2	8.7 7.2	36.4 34.5	137.6 135.2	0.
	90	41.11	13.1	7.1	6.0	32.5	132.5	0.
	100 110	37.90 35.20	12.1 11.3	7.1 7.0	5.1 4.3	30.3 28.1	129.8 127.0	0. 0.
_	120	32.89	10.5	6.9	3.6	26.0	123.8	0.
Storage:	Roof Storag	ge Depth	Head	Discharge	Vreq	Vavail	Discharge	
100-year	Water Leve	(mm) 142.21	(m) 0.14	(L/s) 7.4	(cu. m) 40.0	(cu. m) 46.0	Check 0.00	
Subdra	inage Area:	BLDGC					Roof	
	Area (ha): C:	0.12 1.00		M	laximum Sto	orage Depth	: 150	mm
	tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
	10 20	178.56 119.95	57.1 38.3	7.1 7.3	50.0 31.1	30.0 37.3	129.4 138.7	O. O.
	30	91.87	29.4	7.4	22.0	39.6	141.8	0.
	40 50	75.15 63.95	24.0 20.4	7.4 7.4	16.6 13.1	<b>40.0</b> 39.3	142.2 141.3	0. 0.
	60	55.89	17.9	7.3	10.6	38.0	139.7	0.
	70 80	49.79 44.99	15.9 14.4	7.3 7.2	8.7 7.2	36.4 34.5	137.6 135.2	O. O.
	90	41.11	13.1	7.1	6.0	32.5	132.5	0.
	100 110	37.90 35.20	12.1 11.3	7.1 7.0	5.1 4.3	30.3 28.1	129.8 127.0	O. O.
	120	32.89	10.5	6.9	3.6	26.0	123.8	0.
Storage:	Roof Storag							
		Depth (mm)	Head (m)	Discharge (L/s)	Vreq (cu. m)	Vavail (cu. m)	Discharge Check	
				7.4				

Modified Ra	tional Method	Calculatons	for Storage

Subdra	inage Area: Area (ha):	BLDGB 0.10		Λ.	Maximum Str	orage Depth:	Roof 150	mm
	C:	0.90			ilaxiiiidiii Oti	ладе Бериі.	150	
	tc (min)	l (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
	10 20	104.19 70.25	26.6 17.9	6.3 6.4	20.3 11.5	12.2 13.8	100.2 103.8	
	30 40	53.93 44.18	13.8 11.3	6.4 6.3	7.4 5.0	13.3 12.0	102.6 99.5	
	50	37.65	9.6	6.2	3.5	10.4	93.8	
	60 70	32.94 29.37	8.4 7.5	6.0 5.8	2.4 1.7	8.7 6.9	87.8 81.6	
	80 90	26.56 24.29	6.8 6.2	5.7 5.5	1.1 0.7	5.2 3.9	75.5 66.8	
	100 110	22.41 20.82	5.7 5.3	5.3 5.1	0.5	2.7 1.6	58.5 50.8	
	120	19.47	5.0	4.8	0.2	1.4	47.3	
torage:	Roof Storag	e						
5-year	Water Leve	Depth (mm) 103.78	Head (m) 0.10	Discharge (L/s) 6.4	Vreq (cu. m) 13.8	Vavail (cu. m) 40.8	Discharge Check 0.00	
Subdra	inage Area:	L301A				Controll	ed - Tributary	
	Area (ha): C:	0.14 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 30	70.25 53.93	23.6 18.1	40.2 40.2	0.0	0.0 0.0		
	40 50	44.18 37.65	14.9 12.7	40.2 40.2	0.0	0.0		
	60	32.94	11.1	40.2	0.0	0.0		
	70 80	29.37 26.56	9.9 8.9	40.2 40.2	0.0	0.0 0.0		
	90	24.29	8.2	40.2	0.0	0.0		
	100 110	22.41 20.82	7.5 7.0	40.2 40.2	0.0	0.0 0.0		
	120	19.47	6.5	40.2	0.0	0.0		
torage:	e Above CE ce Equation:	CdA(2abW	15	Where C =	0.61			
Orific	ce Equation: ce Diameter: vert Elevation	127.00 77.99	mm m	Mining C =	0.01			
T	/G Elevation	79.37	m					
Dow	onding Depth nstream W/L	0.00 75.30	m 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	
Subdra	inage Area: Area (ha): C:	L300A 0.14 0.87				Controll	ed - Tributary	
	tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored		
	(min) 10	(mm/hr) 104.19	(L/s) 34.5	(L/s) 40.2	(L/s) 0.0	(m^3) 0.0		
	20 30	70.25 53.93	23.3 17.9	40.2 40.2	0.0	0.0 0.0		
	40	44.18	14.6	40.2	0.0	0.0		
	50 60	37.65 32.94	12.5 10.9	40.2 40.2	0.0	0.0		
	70	29.37	9.7	40.2	0.0	0.0		
	80 90	26.56 24.29	8.8	40.2 40.2	0.0	0.0 0.0		
	100	22.41	7.4	40.2	0.0	0.0		
	110 120	20.82 19.47	6.9 6.5	40.2 40.2	0.0 0.0	0.0 0.0		
Storage:	e Above CE							
Orific	ce Equation: ce Diameter:	127.00	mm	Where C =	0.61			
Inv	ert Elevation /G Elevation	77.89 79.27	m m					
Max Po	onding Depth	0.00	m					
Dowr	nstream W/L	75.30 Stage	m Head	Dienha	\/ra-	Vavail	Volume	
5-year	Water Leve	79.27	(m) 1.38	Discharge (L/s) 40.2	Vreq (cu. m) 0.0	(cu. m) 18.7	Check	
Subdra	inage Area: Area (ha):	L101B 0.25				Controll	ed - Tributary	
	C:	0.49 I (5 yr)	Qactual	Qrelease	Qstored	Vstored		
	(min) 10	(mm/hr) 104.19	(L/s) 35.9	(L/s)	(L/s) 24.8	(m^3) 14.9		
	20	70.25	24.2	11.1	13.1	15.8		
	30 40	53.93 44.18	18.6 15.2	11.1 11.1	7.5 4.2	13.5 10.0		
	50 60	37.65 32.94	13.0 11.4	11.1 11.1	1.9 0.3	5.7 1.0		
	70	29.37	10.1	11.1	0.0	0.0		
	80 90	26.56 24.29	9.2 8.4	11.1 11.1	0.0	0.0		
	100	22.41	7.7	11.1	0.0	0.0		
	110 120	20.82 19.47	7.2 6.7	11.1 11.1	0.0	0.0		
Storage:	e Above CE		0.,		0.0	5.0		
Orifie	ce Diameter:	102.00						
Inv	rert Elevation	75.63 76.75	m					
	onding Depth	76.75 0.16 75.23	m m m					
Down	nstream W/L	75.23	1111					
Down	nstream W/L	Stage	Head	Discharge	Vreq	Vavail	Volume	
Dowr	nstream W/L Water Leve			Discharge (L/s) 11.1	Vreq (cu. m) 15.8	Vavail (cu. m) 31.9	Volume Check OK	

Subdrain		BLDGB			4	D#b:	Roof	
,	Area (ha): C:	0.10 1.00		N	naximum Sto	rage Depth:	150	mm
	tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)	Depth (mm)	
	10	178.56 119.95	50.6 34.0	7.0	43.6 26.8	26.2 32.1	128.7	
	30	91.87	26.1	7.3	18.7	33.7	139.7	
	40 50	75.15 63.95	21.3 18.1	7.3 7.3	14.0 10.9	33.6 32.6	139.5 138.1	
	60	55.89	15.8	7.2	8.6	31.1	135.9	
	70 80	49.79 44.99	14.1 12.8	7.1 7.1	7.0 5.7	29.3 27.3	133.2 130.3	
	90 100	41.11 37.90	11.7 10.7	7.0 6.9	4.7 3.8	25.2 23.0	127.3 123.8	
	110	35.20	10.0	6.8	3.2	21.0	119.4	
	120	32.89	9.3	6.7	2.6	19.0	115.0	
torage: F	Roof Storag							
100-year W	/ater Leve	Depth (mm) 139.72	(m) 0.14	Discharge (L/s) 7.3	Vreq (cu. m) 33.7	Vavail (cu. m) 40.8	Discharge Check 0.00	
Out design		12044				0411-	d Television	
Subdrain	age Area: Area (ha): C:	L301A 0.14 1.00				Controlle	ed - Tributary	
Γ	tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)		
Ŀ	10	178.56	69.0	42.8	26.2	15.7		
	20 30	119.95 91.87	46.4 35.5	42.8 42.8	3.6 0.0	4.3 0.0		
	40 50	75.15 63.95	29.0 24.7	42.8 42.8	0.0	0.0		
	60	55.89	21.6	42.8	0.0	0.0		
	70 80	49.79 44.99	19.2 17.4	42.8 42.8	0.0	0.0		
	90	41.11	15.9	42.8	0.0	0.0		
	100 110	37.90 35.20	14.6 13.6	42.8 42.8	0.0	0.0		
	120	32.89	12.7	42.8	0.0	0.0		
		rage Above Q = CdA(2g		Where C =	0.61			
Orifice	Diameter:	127.00 i	mm	CB Storage:	0.71	m3		
	t Elevation Elevation	77.99 i 79.37 i						
Max Pond	ding Depth	0.18 i 75.30 i	m					
Downst	tream W/L	75.30 i Stage	n Head	Discharge	Vreq	Vavail	Volume	
100-year W	/ater Level	79.55	(m) 1.56	(L/s) 42.8	(cu. m) 15.7	(cu. m) 16.8	Check	
					_	1.06		
Subdrain	age Area: Area (ha): C:	L300A 0.14 1.00				Controlle	ed - Tributary	
Г	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored		
L	(min) 10	(mm/hr) 178.56	(L/s) 68.0	(L/s) 42.8	(L/s) 25.3	(m^3) 15.2		
	20	119.95	45.7	42.8	2.9	3.5		
	30 40	91.87 75.15	35.0 28.6	42.8 42.8	0.0	0.0		
	50	63.95 55.89	24.4	42.8	0.0	0.0		
	60 70	49.79	21.3 19.0	42.8 42.8	0.0	0.0		
	80 90	44.99	17.1 15.7	42.8 42.8	0.0	0.0		
	100	41.11 37.90	14.4	42.8	0.0	0.0		
	110 120	35.20 32.89	13.4 12.5	42.8 42.8	0.0	0.0		
orage: S	Surface Sto	rage Above	СВ					
Orifice	Diameter:	Q = CdA(2g 127.00 i	mm	Where C = CB Storage:	0.61 0.71	m3		
Inver	t Elevation	77.89 i	m m	-				
Max Pond	ding Depth tream W/L	0.18 i						
Downst	ueam vv/L	Stage	n Head	Discharge	Vreq	Vavail	Volume	
100-year W	/ater Leve	79.45	(m) 1.56	(L/s) 42.8	(cu. m) 15.2	(cu. m) 18.7	Check OK	
						3.56 Controlle	ed - Tributary	
Subdrain		L101B						
	age Area: Area (ha): C:	0.25 0.61						
	Area (ha): C: tc (min)	0.25 0.61 I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)		
	tc (min)	0.25 0.61 I (100 yr) (mm/hr)	(L/s) 76.9	(L/s) 25.4	(L/s) 51.6	(m^3) 30.9		
	tc (min) 10 20 30	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87	76.9 51.7 39.6	(L/s) 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2	(m^3) 30.9 31.6 25.6		
	tc (min) 10 20 30 40	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15	76.9 51.7 39.6 32.4	(L/s) 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0	30.9 31.6 25.6 16.8		
	tc (min) 10 20 30 40 50 60	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89	76.9 51.7 39.6 32.4 27.6 24.1	25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0		
	tc (min) 10 20 30 40 50 60 70 80	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99	76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	51.6 26.3 14.2 7.0 2.2 0.0 0.0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0		
	tc (min) 10 20 30 40 50 60 70 80 90	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0		
	Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 100 110	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90 35.20	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0 0.0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0 0.0		
[	tc (min) 10 20 30 40 50 60 70 80 90 100 110 120	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 44.11 37.90 35.20 32.89	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2 14.2	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0		
[	tc (min) 10 20 30 40 60 70 80 90 110 120 Surface Sto	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90 35.20 32.89	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2 14.2	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0 0.0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0 0.0		
torage: S Orifice Orifice	tc (min) 10 20 30 40 50 60 70 80 90 110 120 Surface Sto	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.91 37.90 35.20 32.89 rage Above Q = CdA(2g	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2 14.2 CB	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0 0.0 0.0 0.0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0 0.0		
torage: \$ Orifice Orifice	tc (min) 10 20 30 40 50 60 70 80 90 100 110 120 Surface Sto	0.25 0.61 I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 44.99 41.11 37.90 35.20 32.89 rage Above Q = CdA(2g	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2 14.2 CB h)\^0.5 mm	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0 0.0 0.0 0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0 0.0		
torage: \$ Orifice Inver	Area (ha): C:  tc (min) 10 20 30 40 50 60 70 80 100 1120 Surface Sto Equation: Diameter: t Elevation Iding Depth	0.25 0.61 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99 41.11 37.90 35.20 32.89 arage Above Q = CdA(2g 102.00 75.63 76.75 102.00	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2 14.2 CB	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0 0.0 0.0 0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0 0.0		
torage: \$ Orifice Inver	Area (ha):	0.25 0.61 1(100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 44.99 44.99 44.11 37.90 42.20 32.89 rage Above Q = CdA(2g 102.00 t 75.63 t 76.75	(L/s) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2 14.2 CB	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(L/s) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0 0.0 0.0 0	(m^3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0 0.0	Volume	
torage: \$ Orifice Orifice Inver	Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 1100 1120 Surface Sto Equation: Diameter: t Elevation ding Depth	0.25 0.61 1 (100 yr) (mm/hr) 178.56 119.95 55.89 49.79 44.99 41.11 37.90 35.20 37.90 35.20 37.90 36.395 40.79 4	(Us) 76.9 51.7 39.6 32.4 27.6 24.1 21.4 19.4 17.7 16.3 15.2 14.2 CB h)^0.5 mm n	(L/s) 25.4 25.4 25.4 25.4 25.4 25.4 25.4 25.4	(Us) 51.6 26.3 14.2 7.0 2.2 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0	(m*3) 30.9 31.6 25.6 16.8 6.6 0.0 0.0 0.0 0.0 0.0 0.0 m3	Volume Check OK	

### Project #160401483, Norberry Residences Modified Rational Method Calculators for S

				for Storag	je	
Subdrai	inage Area:	F101A				Uncontrolled - Tributary
	Area (ha): C:	0.11 0.76				
	tc (min)	l (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
	10	104.19	24.2	24.2	, ,	
	20 30	70.25 53.93	16.3 12.5	16.3 12.5		
	40	44.18	10.3	10.3		
	50 60	37.65 32.94	8.8 7.7	8.8 7.7		
	70	29.37	6.8	6.8		
	80 90	26.56 24.29	6.2 5.6	6.2 5.6		
	100	22.41	5.2	5.2		
	110 120	20.82 19.47	4.8 4.5	4.8 4.5		
Subdrai	inage Area:	UNC-2				Uncontrolled - Tributary
Juburan	Area (ha):	0.05				Oncombined - Indutary
	C:	0.30				
	tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored
	(min) 10	(mm/hr) 104.19	(L/s) 4.6	(L/s) 4.6	(L/s)	(m^3)
	20	70.25	3.1	3.1		
	30 40	53.93 44.18	2.4	2.4		
	50	37.65	1.7	1.7		
	60 70	32.94 29.37	1.5 1.3	1.5 1.3		
	80	26.56	1.2	1.2		
1	90 100	24.29 22.41	1.1 1.0	1.1 1.0		
1	110	20.82	0.9	0.9		
<b>-</b>	120	19.47	0.9	0.9		
Subdrai	inage Area:	EX-19				Uncontrolled - Tributary
	Area (ha): C:	0.15 0.48				
			Onet	Orol	Ontre	Votored
	tc (min)	l (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
	10 20	104.19 70.25	20.3 13.7	20.3 13.7		
	30	53.93	10.5	10.5		
	40 50	44.18 37.65	8.6 7.3	8.6 7.3		
	60	32.94	6.4	6.4		
	70 80	29.37 26.56	5.7 5.2	5.7 5.2		
	90	24.29	4.7	4.7		
	100 110	22.41 20.82	4.4 4.1	4.4 4.1		
	120	19.47	3.8	3.8		
Quibale-	inage Area:	EX-18				Uncontrolled - Tributary
Subdrai	Area (ha):	0.06				Oncontrolled - Inbutary
	C:	0.31				
	tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored
	(min)	(mm/hr)	(L/s) 5.7	(L/s) 5.7	(L/s)	(m^3)
	10	104 19				
	10 20	104.19 70.25	3.9	3.9		
	20 30	70.25 53.93	3.9 3.0	3.0		
	20 30 40 50	70.25 53.93 44.18 37.65	3.9 3.0 2.4 2.1	3.0 2.4 2.1		
	20 30 40	70.25 53.93 44.18	3.9 3.0 2.4	3.0 2.4		
	20 30 40 50 60 70 80	70.25 53.93 44.18 37.65 32.94 29.37 26.56	3.9 3.0 2.4 2.1 1.8 1.6 1.5	3.0 2.4 2.1 1.8 1.6 1.5		
	20 30 40 50 60 70	70.25 53.93 44.18 37.65 32.94 29.37	3.9 3.0 2.4 2.1 1.8 1.6	3.0 2.4 2.1 1.8 1.6		
	20 30 40 50 60 70 80 90 100	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2		
	20 30 40 50 60 70 80 90	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3	3.0 2.4 2.1 1.8 1.6 1.5 1.3		
Subdrai	20 30 40 50 60 70 80 90 100 110 120	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2		Uncontrolled - Tributary
Subdrai	20 30 40 50 60 70 80 90 100 110	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2		Uncontrolled - Tributary
Subdrai	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha):	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1	Ontrace	
Subdrai	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha): C:	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1	Qstored (L/s)	Uncontrolled - Tributary  Vstored (m*3)
Subdrai	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha): C:	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1  Qactual (L/s) 9.7	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1		Vstored
Subdrai	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha): C: tc (min) 10 20 30	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 I(5 yr) (mm/hr) 104.19 70.25 53.93	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1  Qactual (L/s) 9.7 6.6 5.0	3.0 2.4 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1		Vstored
Subdrai	20 30 40 50 60 70 80 100 110 120 inage Area: Area (ha): C: tc (min) 10 20 30 40	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 1 (5 yr) (mm/hr) 104.19 70.25 53.93 44.18	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 0 Crelease (L/s) 9.7 6.6 5.0 4.1		Vstored
Subdrai	20 30 40 50 60 70 80 90 100 110 120 inage Area: C: tc (min) 10 20 30 40 50 60 60 70 80 90 100 110 120 110 120 60 70 60 70 100 110 110 120 60 70 60 70 70 70 70 70 70 70 70 70 70 70 70 70	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 21.47 EX-15 0.08 0.43 I (5 yr) (mm/hr) 70.25 53.93 44.18 37.65	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1   Cactual (L/s) 9.7 6.6 5.0 4.1 3.5 3.1	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 9.7 6.6 5.0 4.1 3.5		Vstored
Subdrai	20 30 40 50 60 70 80 90 110 120 inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 100 110 120	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.7	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 2.7		Vstored
Subdrai	20 30 40 50 60 70 80 90 1100 1110 120 inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 70 80 90 90 100 110 110 120 100 110 90 90 90 90 90 90 90 90 90 90 90 90 90	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 I(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 32.94 29.37 26.56 29.37 20.56 29.37 20.56 20.57 20.57	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 2.7 2.5 3.1 2.7 2.5 2.3	3.0 2.4 2.1 1.8 1.6 1.3 1.2 1.1 1.1 1.1 2.7 6.6 5.0 4.1 3.5 3.1 2.7 2.7 2.3		Vstored
Subdrai	20 30 40 50 60 70 80 90 110 110 110 20 40 50 60 70 80 90 100 110 20 30 40 60 70 80 90 100 110 100 110 100 100 100 100 100	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 104.19 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 20.82 19.47	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.7 6.6 5.0 4.1 3.5 3.1 2.7 6.6	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.7 6.6 5.0 4.1 3.5 3.1 2.7 2.5		Vstored
Subdrai	20 30 40 50 60 70 80 90 1100 1110 120 inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 70 80 90 90 100 110 110 120 100 110 90 90 90 90 90 90 90 90 90 90 90 90 90	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 I(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 32.94 29.37 26.56 29.37 20.56 29.37 20.56 20.57 20.57	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 2.7 6.6 5.0 4.1 3.5 3.1 2.7 2.5 3.1 2.7 2.5 2.1	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.7 6.6 5.0 4.1 3.5 2.5 2.3 2.1		Vstored
	20 30 40 50 60 70 80 110 120 120 100 110 120 100 110 120 100 110 100 10	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 1 (5 yr) (mm/lhr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.7 2.3 2.1 1.9 2.7 2.3 2.1 1.9	3.0 2.4 2.1 1.8 1.6 1.3 1.2 1.1 1.1 1.1 2.7 6.6 5.0 4.1 3.5 3.1 2.7 2.7 2.3 2.1		Vstored (m^3)
	20 30 40 50 60 70 80 90 110 20 20 30 40 50 60 70 80 90 90 90 90 90 90 90 90 110 20 80 80 80 80 80 80 80 80 80 80 80 80 80	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 120.82 19.47  EX-15 0.08 0.43 1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47  EX-14 0.33	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.7 2.3 2.1 1.9 2.7 2.3 2.1 1.9	3.0 2.4 2.1 1.8 1.6 1.3 1.2 1.1 1.1 1.1 2.7 6.6 5.0 4.1 3.5 3.1 2.7 2.7 2.3 2.1		Vstored
	20 30 40 50 60 70 80 80 90 120 120 100 80 90 90 90 90 90 90 90 90 90 90 90 90 90	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-15 0.08 0.43 1(5 ty) 104.19 70.25 32.94 29.37 26.56 24.29 22.41 20.82	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.7 2.3 2.1 1.9 2.7 2.3 2.1 1.9	3.0 2.4 2.1 1.8 1.6 1.3 1.2 1.1 1.1 1.1 2.7 6.6 5.0 4.1 3.5 3.1 2.7 2.7 2.3 2.1		Vstored (m^3)
	20 30 40 50 60 70 80 90 110 20 20 30 40 50 60 70 80 90 110 110 120 10 10 10 10 10 10 10 10 10 10 10 10 10	70.25 53.93 44.18 53.93 44.18 53.93 44.18 52.94 52.93 7.65 56 64.29 52.94 7.02 65 66 64.29 64.29 7.02 65 66 64.29 64.29 7.02 65 64.29 64.18 64.29 64.29 64.18 64.29 64.2	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.6 5.0 4.1 3.5 3.1 2.7 2.5 2.3 1.1 1.9 1.8	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.1 2.1 2.1 2.1 2.1 2.1	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored
	20 30 40 50 60 70 80 90 110 120 120 120 110 120 12	70.25 53.93 44.18 73.765 53.93 44.18 72.94 72.85.56 72.94 72.85.56 72.94 72.85	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.6 5.0 4.1 3.5 2.7 2.5 2.1 1.8	3.0 2.4 2.1 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2release (_/s) 9.7 6.6 5.0 4.1 3.5 3.1 2.7 2.5 3.1 1.8	(L/s)	Vstored (m^3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 110 120 100 110 120 100 110 120 100 110 120 100 110 120 100 110 120 100 110 100 110 100 10	70.25 53.93 44.18 75.393 44.18 76.53.93 77.65 76.50 76	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.8 6.0 4.1 3.5 2.7 2.5 2.1 1.8  Qactual (L/s) 3.8 1.2 2.7 2.8 2.9 1.8	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored
	20 30 40 50 60 70 80 90 110 20 30 40 50 60 70 80 90 110 120 20 30 80 90 110 120 120 120 120 120 120 120 120 12	70.25 53.93 44.18 72.65 53.93 44.18 72.65	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.6 5.0 4.1 3.5 2.7 2.7 2.7 1.9 1.8	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qrelease (L/s) 4.1 2.7 2.3 2.1 1.9 1.8  Qrelease (L/s) 3.8.1 2.7 2.5 3.8.1 2.7 2.5 3.8.1 2.7 2.7 2.5 3.8.1 2.7 2.7 2.8 3.8.1 3.8.1	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored
	20 30 40 50 60 70 80 90 110 20 30 40 50 60 70 80 90 110 120 10 20 80 100 110 120 10 120 10 120 10 120 10 120 10 120 10 120 10 120 10 120 10 120 10 120 10 10 10 10 10 10 10 10 10 10 10 10 10	70.25 53.93 44.18 76.53.93 44.18 77.65 32.94 42.92 93.7 65.56 0.43 11(5 yr) 104.19 70.25 53.93 12.94 12.95 12.95 1	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.5 0 4.1 3.5 2.7 2.7 2.1 1.9 1.8	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 2.1 2.1 2.1 2.1 2.1 3.5 3.1 2.7 3.5 3.1 2.7 3.5 3.1 3.1 3.5 3.1 3.1 3.5 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored
	20 30 40 50 60 70 80 90 110 120  tc (min) 10 20 30 40 40 50 100 110 120  tc (min) 10 20 30 40 40 50 60 60	70.25 53.93 44.18 32.94 20.82 21.947 26.56 0.08 0.08 0.43 116.97) (mm/hr) 104.19 70.20 22.41 104.21 22.53 23.24 22.24 22.42 23.24 24.29 25.39 26.30 26	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1 1.1  Qactual (L/s) 9.7 6.5 5.0 4.1 3.5 2.3 2.1 1.9 1.8  Qactual (L/s) 3.1 2.7 2.5 2.3 2.1 1.9 1.8  Qactual (L/s) 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1 3.1	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1   Qrelease (_/s) 9.7 6.6 5.0 4.1 3.5 3.1 2.7 2.5 3.1 1.8  Qrelease (_/s) 1.8  Qrelease (_/s) 1.8  1.9 1.9 1.8  1.9 1.9 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.8 1.9 1.9 1.8 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.9 1.8 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored
	20 30 40 50 60 70 80 110 120 100 110 120 100 110 120 100 110 120 100 10	70.25 53.93 44.18 32.94 22.41 16.97 10.97 10.97 10.97 10.97 10.19	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.5 5.0 4.1 3.5 2.1 1.9 1.8  Qactual (L/s) 1.9 1.8  Qactual (L/s) 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1   Qrelease (_/s) 9.7 6.6 5.0 4.1 3.5 3.1 2.7 2.5 3.1 1.8  Qrelease (_/s) 1.8  Qrelease (_/s) 1.8  Qrelease (_/s) 1.8  Qrelease (_/s) 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored
	20 30 40 50 60 70 80 90 110 120 12	70.25 53.93 44.18 72.65.62 72.65.62 70.25 70.25 70.25 70.25 70.25 70.26	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.6 5.0 4.1 3.5 2.7 2.7 2.5 2.3 1.1 1.9 1.8	Qrelease (L/s) Qrelease (L/s) 1.8 Qrelease (L/s) 1.1 1.1 2.7 6.6 5.0 4.1 2.7 6.6 5.0 4.1 1.9 1.8 Qrelease (L/s) 1.8 1.9 1.9 1.8 1.9 1.8 1.9 1.8 1.9 1.8 1.9 1.8 1.9 1.9 1.8 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored
	20 30 40 50 60 70 80 110 120 100 110 120 100 110 120 100 110 120 100 10	70.25 53.93 44.18 32.94 22.41 16.97 10.97 10.97 10.97 10.97 10.19	3.9 3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1  Qactual (L/s) 9.7 6.5 5.0 4.1 3.5 2.1 1.9 1.8  Qactual (L/s) 1.9 1.8  Qactual (L/s) 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	3.0 2.4 2.1 1.8 1.6 1.5 1.3 1.2 1.1 1.1 1.1   Qrelease (_/s) 9.7 6.6 5.0 4.1 3.5 3.1 2.7 2.5 3.1 1.8  Qrelease (_/s) 1.8  Qrelease (_/s) 1.8  Qrelease (_/s) 1.8  Qrelease (_/s) 1.8 1.9 1.9 1.8 1.9 1.9 1.8 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9 1.9	(L/s)	Vstored (m^3)  Uncontrolled - Tributary  Vstored

	Rational M					· · · · · · · · · · · · · · · · · · ·
	nage Area: Area (ha): C:	F101A 0.11 0.95				Uncontrolled - Tributary
1	tc tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
l	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10 20	178.56 119.95	51.9 34.8	51.9 34.8		
	30	91.87	26.7	26.7		
	40 50	75.15 63.95	21.8 18.6	21.8 18.6		
	60	55.89	16.2	16.2		
	70 80	49.79 44.99	14.5 13.1	14.5 13.1		
	90	41.11	11.9	11.9		
	100 110	37.90 35.20	11.0 10.2	11.0 10.2		
	120	32.89	9.6	9.6		
	nage Area:					Uncontrolled - Tributary
	Area (ha): C:	0.05 0.38				
r						
	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		(11. 0)
	20 30	119.95 91.87	6.7 5.1	6.7 5.1		
	40	75.15	4.2	4.2		
	50 60	63.95 55.89	3.6 3.1	3.6 3.1		
	70	49.79	2.8	2.8		
	80 90	44.99 41.11	2.5 2.3	2.5 2.3		
	100	37.90	2.1	2.1		
	110 120	35.20 32.89	2.0 1.8	2.0 1.8		
2bdrair	nage Area:	EX-19				Uncontrolled - Tributary
ծնսա	Area (ha): C:	0.15 0.60				Uncontrolled - Hibutary
[	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
l	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10 20	119.95	43.5 29.2	43.5 29.2		
	30	91.87	22.4	22.4		
	40 50	75.15 63.95	18.3 15.6	18.3 15.6		
	60	55.89 49.79	13.6	13.6		
	70 80	44.99	12.1 11.0	12.1 11.0		
	90 100	41.11 37.90	10.0 9.2	10.0 9.2		
	110	35.20	8.6	8.6		
	120	32.89	8.0	8.0		
Subdrair	nage Area: Area (ha):	EX-18 0.06				Uncontrolled - Tributary
,	C:	0.39				
	tc (min)	l (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
	10	178.56	12.2	12.2		
	20 30	119.95 91.87	8.2 6.3	8.2 6.3		
	40 50	75.15	5.1	5.1 4.4		
	60	63.95 55.89	4.4 3.8	3.8		
	70 80	49.79 44.99	3.4	3.4 3.1		
	90	41.11	2.8	2.8		
	100	37.90 35.20	2.6	2.6 2.4		
	110 120	35.20 32.89	2.4	2.4		
	nage Area:	EX-15	_			Uncontrolled - Tributary
	Area (ha): C:	0.08 0.54				
	tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
l	(min) 10	(mm/hr) 178.56	(L/s) 20.8	(L/s) 20.8	(L/s)	(m^3)
	20	119.95	14.0	14.0		
	30 40	91.87 75.15	10.7 8.8	10.7 8.8		
	50	63.95	7.5	7.5		
	00	55.89	6.5	6.5 5.8		
	60 70	40.70	5 R			
	70 80	49.79 44.99	5.8 5.2	5.2		
	70 80 90	44.99 41.11	5.2 4.8	5.2 4.8		
	70 80	44.99	5.2	5.2		

tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(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		

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

Subdrainage Area   EX.13				s for Storaç		
C: 0.90						Uncontrolled - Tributary
	0.	0.90				
10		I (5 yr)				
20	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
Subdrainage Area: EX-11						
Subdrainage Area: Ex-11		53.93	31.3	31.3		
Subdrainage Area: Ex-1   Subdrainage Area: Ex-1   Subdrainage Area: Ex-1   Subdrainage Area: Ex-1   Subdrainage Area: Ex-2   Subdrainage Area: Ex-3   Subdrainage Area: E		44.18				
Subdrainage Area:						
Subdrainage Area:   Ex-12   Uncontrolled - Tributary   Uncontrolled - Tributary			17.0			
Subdrainage Area (National Common C						
110						
Subdrainage Area:   EX-12						
C			11.3	11.3		
C						
Cc         I (5 yr)         Qactual (mambr) (Us)         Qrelease (Qstored (m²s))         Vestored (m²s)           100         170         40.8 <td< td=""><td>Subdrainage Area:</td><td></td><td></td><td></td><td></td><td>Uncontrolled - Tributary</td></td<>	Subdrainage Area:					Uncontrolled - Tributary
Texas	C:	0.23				
(min)   (mm/hr)   (Us)   (Us)   (Us)   (Us)   (m*3)						
10						
20				60.5	(L/S)	(m^3)
40						
Sol						
60   32.94   19.1   19.1   70   29.37   77.0   17.0   80   26.56   15.4   15.4   15.4   90   24.29   14.1   14.1   100   22.41   13.0		44.18 37.65				
80						
90	70	29.37	17.0	17.0		
100						
110						
Subdrainage Area: EX-11	110	20.82	12.1	12.1		
Area (ha): 0.13	120	19.47		11.3		
Area (ha): 0.13	Subdrainage Area:	EX.11				Uncontrolled - Tributary
C:         0.42         Credit (mm) (mm/hr) (L/s) (Mm/s)         Ostored (m/s)         Vistored (m/s)           10         104.19         16.2         16.2         20         70.25         10.9         10.9         30         53.33         8.4         8.4         40         44.18         6.9         6.9         9         50         37.65         5.8         5.8         5.8         5.8         5.8         5.0         5.1         5.1         70         29.37         4.6         4.6         4.6         4.6         80         28.25         4.1         4.1         90         24.29         3.8         3.8         100         22.41         3.5         3.5         110         20.92         3.2						Oncontrolled - Inibulary
min		0.42				
min		1/5	Onet	Oreit	Onto	Votovod
10			Qactual (L/s)	(L/s)		vstored (m^3)
20	10	104.19	16.2	16.2	,=-v,	. 7
140						
Subdrainage Area:   EX-9						
Total						
80						
90						
110						
Subdrainage Area: EX-10						
Subdrainage Area: EX-10						
Area (ha): 0.38   C						
C:         0.69           tc (min)         (Isyr)         Qactual (Us)         Crolease (Us)         Qstored (m³3)           10         104.19         75.1         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         35.9         38.9         38.9           50         37.65         27.2         27.2         60         32.94         23.8         23.8         27.2         21.2	Subdrainage Area:					Uncontrolled - Tributary
Text						
mim	U:	0.09				
10						
20	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
30						
50 37.65 27.2 27.2 8.6   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 17.5 17.5 100 22.41 16.2 16.2 110 20.82 15.0 15.0 15.0 120 19.47 14.0 14.0    Subdrainage Area: EX-9						
60 32.94 23.8 23.8 7 21.2 21.2 80 26.56 19.2 19.2 19.2 19.2 19.0 24.29 17.5 17.5 10.0 22.41 16.2 16.2 11.0 20.82 15.0 15.0 15.0 12.0 19.47 14.0 14.0 14.0 14.0 14.0 14.0 14.0 14.0						
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  Area (ha): 0.06 C: 0.90     tc (min) temm/hr) temm/hr) temm. (L/s) (						
90	70	29.37	21.2	21.2		
100						
120		22.41				
Subdrainage Area: EX-9	110	20.82	15.0	15.0		
Area (ha): 0.06	120	19.47	14.0	14.0		
Area (ha): 0.06	Subdrainage Area:	EX-9				Uncontrolled - Tributary
Text	Area (ha):	0.06				
(min)         (mm/hr)         (L/s)         (L/s)         (L/s)         (M*3)           1         104 19         15.8         15.8         (m*3)           20         70.25         10.7         10.7           30         53.93         8.2         8.2           40         44.18         6.7         6.7           50         37.68         5.7         5.7           60         32.94         5.0         5.0           70         29.37         4.5         4.5           80         26.56         3.7         3.7           100         22.49         3.7         3.7           110         20.02         3.2         3.2           120         19.47         3.0         3.0           Subdrainage Area:         EX.8         Uncontrolled - Tributary           Area (ha):         0.71         C.         0.6           (min)         (mm/hr)         (mm/hr)         (L/s)         (L/s)         (Vstored (m*3)           10         104.19         134.4         34.4         4           20         70.25         90.6         90.6           30         53.93         80.	C:	0.90				
(min)         (mm/hr)         (L/s)         (L/s)         (L/s)         (m^3)           1         10.4 19         15.8         15.8         (m^3)           20         70.25         10.7         10.7         30.7         10.7         40.7         4.8         4.8         4.8         4.8         4.8         4.8         4.7         6.7         5.7         5.0         5.0         5.0         5.0         5.0         7.0         7.2         2.9.3         4.5         4.5         8.0         26.56         4.0         4.0         4.0         9.0         24.29         3.7         3.7         3.0         3.0         3.2         3.2         3.2         3.2         3.2         3.2         3.2         3.2         3.2         3.2         3.2         3.2         3.2         3.0 <td< td=""><td>tc</td><td>I (5 yr)</td><td>Qactual</td><td>Qrelease</td><td>Qstored</td><td>Vstored</td></td<>	tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored
20 70.25 10.7 10.7 3 3 3 53.93 8.2 8.2 8.2 40 44.18 6.7 6.7 5.7 5.0 37.65 5.7 5.7 5.60 32.94 5.0 5.0 5.0 70 29.37 4.5 4.5 4.5 80 26.56 4.0 4.0 90 24.29 3.7 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 \$\$\$\$\$\$ Uncontrolled - Tributary \$\$\$\$\$\$\$\$ Ltc   I (5 yr)   Cactual (min)   Cactual (Lis)   Cactual (min)   Cactual (Lis)   Cactual (L	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
30 53.93 8.2 8.2 8.2 4.4 44.18 6.7 6.7 5.7 5.7 6.0 32.94 4.2 5.0 4.6 4.0 4.18 57.0 5.0 5.0 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6 4.6						
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 Area (ha): 0.71  t t (min) (mm)hrly (Lis) (Lis) (Lis) (Lis) (Lis) (M-3) 10 104.19 134.4 134.4 20 70.25 90.6 90.6 30 53.93 69.6 90.6 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						
60   32.94   50   50   50   70   29.37   4.5   4.5   4.5   80   26.56   4.0   4.0   90   24.29   3.7   3.7   3.7   100   22.41   3.4   3.4   3.4   110   20.82   3.2   3.2   120   19.47   3.0   3.0        Subdrainage Area:   EX-8	40	44.18	6.7	6.7		
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 Area (ha): 0.71 C: 0.65  t						
80 26.56 4.0 4.0 99 24.29 3.7 3.7 3.7 100 22.41 3.4 3.4 110 20.82 3.2 3.2 3.2 120 19.47 3.0 3.0  Subdrainage Area: EX-8 Area (ha): 0.71				4.5		
100   22.41   3.4   3.4   3.4   110   20.82   3.2   3.2   3.2   120   19.47   3.0   3.0	80	26.56	4.0	4.0		
110   20.82   3.2   3.2   3.0						
120						
Aroa (ha): 0.71 C: 0.65  tc (min) (mm/hr) (L/s) (L/s) (L/s) (L/s) (M*3)  10 104.19 134.4 134.4 20 70.25 90.6 90.6 30 53.93 69.6 90.6 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 24.29 31.3 31.3		19.47	3.0	3.0		
Aroa (ha): 0.71 C: 0.65  tc (min) (mm/hr) (L/s) (L/s) (L/s) (L/s) (M*3)  10 104.19 134.4 134.4 20 70.25 90.6 90.6 30 53.93 69.6 90.6 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 24.29 31.3 31.3	Subdrainas *	EV c				Uncontrolled - Tributes
C: 0.65  tc (min)   (Lyr)   Qactual (Lus)   Qrolease Qstored (Lus)   (Lus) (markin)   10 104.19 134.4 134.4 20 70.25 90.6 90.6 30 53.93 69.6 99.6 40 44.18 57.0 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						Oncontrolled - Indutary
tc (min)         I (6 yr)         Cactual (L/s)         Crolease (L/s)         Qstored (L/s)         Vstored (m^3)           10         104.19         134.4	Area man					
(min)         (mm/hr)         (L/s)         (L/s)         (L/s)         (m^3)           10         104.19         134.4         134			0	0	0-4	Votered
10 104.19 134.4 134.4 20 70.25 90.6 90.6 30 53.93 60.6 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	C:	1.75.	<b>Qactual</b>			
20 70.25 90.6 90.6 30 53.93 60.6 60.6 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	C:		(L/e)		(=/0)	···
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	tc (min)	(mm/hr)	(L/s) 134.4	134.4		
50 37.65 48.6 48.6 60 32.94 42.5 70 29.37 37.9 37.9 80 26.56 34.3 34.3 90 24.29 31.3 31.3	tc (min) 10 20	(mm/hr) 104.19 70.25	134.4 90.6	134.4 90.6		
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	tc (min) 10 20 30	(mm/hr) 104.19 70.25 53.93	134.4 90.6 69.6	134.4 90.6 69.6		
70 29.37 37.9 37.9 80 26.56 34.3 34.3 90 24.29 31.3 31.3	tc (min) 10 20 30 40	(mm/hr) 104.19 70.25 53.93 44.18	134.4 90.6 69.6 57.0	134.4 90.6 69.6 57.0		
90 24.29 31.3 31.3	tc (min) 10 20 30 40 50 60	(mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94	134.4 90.6 69.6 57.0 48.6 42.5	134.4 90.6 69.6 57.0 48.6 42.5		
	C: tc (min) 10 20 30 40 50 60 70	(mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37	134.4 90.6 69.6 57.0 48.6 42.5 37.9	134.4 90.6 69.6 57.0 48.6 42.5 37.9		
	tc (min) 10 20 30 40 50 60 70 80	(mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56	134.4 90.6 69.6 57.0 48.6 42.5 37.9 34.3	134.4 90.6 69.6 57.0 48.6 42.5 37.9 34.3		
110 20.82 26.9 26.9	tc (min) 10 20 30 40 50 60 70 80 90	(mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41	134.4 90.6 69.6 57.0 48.6 42.5 37.9 34.3 31.3 28.9	134.4 90.6 69.6 57.0 48.6 42.5 37.9 34.3 31.3 28.9		
120 19.47 25.1 25.1	tc (min) 10 20 30 40 50 60 70 80 90 100	(mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82	134.4 90.6 69.6 57.0 48.6 42.5 37.9 34.3 31.3 28.9 26.9	134.4 90.6 69.6 57.0 48.6 42.5 37.9 34.3 31.3 28.9 26.9		

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

Subdrainage Area:	EX-13				Uncontrolled - Tributary
					Uncontrolled - Iributary
Area (ha):					
C:	1.00				
tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
10	178.56	115.2	115.2		<del></del>
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:					Uncontrolled - Tributary
Area (ha):	0.23				
C:	1.00				

Subdrainage A		EX-12				Uncontrolle	a - Tributary
Area		0.23					
	C:	1.00					
_		1					
to		I (100 yr)	Qactual	Qrelease	Qstored	Vstored	
(mi	in)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)	
10	0	178.56	115.2	115.2			
20	0	119.95	77.4	77.4			
30	0	91.87	59.3	59.3			
40	0	75.15	48.5	48.5			
50	0	63.95	41.2	41.2			
60	0	55.89	36.0	36.0			
70	0	49.79	32.1	32.1			
80	0	44.99	29.0	29.0			
90	0	41.11	26.5	26.5			
10	10	37.90	24.4	24.4			
11	0	35.20	22.7	22.7			
12	20	32.89	21.2	21.2			

Uncontrolled - Tributary tc | 1(100 yr) (mm/hr) | 10 | 178.56 | 20 | 119.95 | 30 | 91.87 | 40 | 75.15 | 50 | 63.95 | 60 | 55.89 | 70 | 49.79 | 80 | 44.99 | 90 | 41.11 | 100 | 37.90 | 110 | 35.20 | 120 | 32.89 Qrelea: (L/s) 34.7 23.3 17.8 14.6 12.4 10.8 9.7 8.7 8.7 8.0 7.4 6.8 6.4 Qstored Vstored (L/s) (m^3) Qactual (L/s) 34.7 23.3 17.8 14.6 12.4 10.8 9.7 8.7 8.0 7.4 6.8

Uncontrolled - Tributary

tc	I (100 yr) (mm/hr)	Qactual	Qrelease	Qstored	Vstored
(min)		(L/s)	(L/s)	(L/s)	(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 Area (ha): 0.06 C: 1.00 Uncontrolled - Tributary

tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(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	22.00	E C	E 6		

Subdrainage Area: Area (ha): C: Uncontrolled - Tributary

tc	I (100 yr)	Qactual	Qrelease	Qstored	Vstored
(min	) (mm/hr)	(L/s)	(L/s)	(L/s)	(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		

Subdra				for Storag		
	inage Area:	EX-7				Uncontrolled - Tributary
	Area (ha): C:	0.07				
	C:	0.20				
	tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored
	(min) 10	(mm/hr) 104.19	(L/s) 4.3	(L/s) 4.3	(L/s)	(m^3)
	20	70.25	2.9	2.9		
	30	53.93	2.2	2.2		
	40	44.18	1.8	1.8		
	50 60	37.65 32.94	1.6 1.4	1.6 1.4		
	70	29.37	1.2	1.2		
	80	26.56	1.1	1.1		
	90 100	24.29 22.41	1.0 0.9	1.0 0.9		
	110	20.82	0.9	0.9		
	120	19.47	0.8	0.8		
		EV =				
Subdra	inage Area: Area (ha):	EX-5 0.23				Uncontrolled - Tributary
	C:	0.90				
	tc (min)	l (5 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
	10	104.19	60.2	60.2	(1.0)	(111 3)
	20	70.25	40.6	40.6		
	30 40	53.93 44.18	31.2 25.5	31.2 25.5		
	50	37.65	21.8	21.8		
	60	32.94	19.0	19.0		
	70 80	29.37 26.56	17.0 15.4	17.0 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		
Subdra	inage Area:	EX-4				Uncontrolled - Tributary
	Area (ha):	0.69				•
	C:	0.63				
	tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
	10 20	104.19 70.25	125.2 84.4	125.2 84.4		
	30	70.25 53.93	84.4 64.8	64.8		
	40	44.18	53.1	53.1		
	50	37.65	45.2	45.2 39.6		
	60 70	32.94 29.37	39.6 35.3	35.3		
	80	26.56	31.9	31.9		
	90	24.29	29.2	29.2		
	100 110	22.41 20.82	26.9 25.0	26.9 25.0		
	120	19.47	23.4	23.4		
		EV 0				
Subdra	inage Area: Area (ha):	EX-3 0.23				Uncontrolled - Tributary
	C:	0.90				
	tc	I (5 yr)	Qactual	Qrelease	Qstored	Vstored
	(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	
	10	404.40				
		104.19	60.2	60.2	(/	(m^3)
	20 30	70.25 53.93	60.2 40.6 31.2	40.6 31.2	(/	(111-3)
	20 30 40	70.25 53.93 44.18	40.6 31.2 25.5	40.6 31.2 25.5		(III-3)
	20 30 40 50	70.25 53.93 44.18 37.65	40.6 31.2 25.5 21.8	40.6 31.2 25.5 21.8		(iii-a)
	20 30 40 50 60	70.25 53.93 44.18 37.65 32.94	40.6 31.2 25.5 21.8 19.0	40.6 31.2 25.5 21.8 19.0	<u> </u>	(11-3)
	20 30 40 50 60 70 80	70.25 53.93 44.18 37.65 32.94 29.37 26.56	40.6 31.2 25.5 21.8 19.0 17.0 15.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4	ν=-γ	(III 3)
	20 30 40 50 60 70 80 90	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0	<u>, , </u>	ur s)
	20 30 40 50 60 70 80	70.25 53.93 44.18 37.65 32.94 29.37 26.56	40.6 31.2 25.5 21.8 19.0 17.0 15.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4	ν=-/	un a)
	20 30 40 50 60 70 80 90	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0	ζ= -7	(III 3)
-	20 30 40 50 60 70 80 90 100 110	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0	,= J/	
Subdra	20 30 40 50 60 70 80 90 100 110 120	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0	ν= - γ	Uncontrolled - Tributary
Subdra	20 30 40 50 60 70 80 90 100 110	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0	ν=5/	
Subdra	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha):	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3		Uncontrolled - Tributary
Subdra	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha): C:	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3	Qstored	Uncontrolled - Tributary Vstored
Subdra	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha): C:	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 I (5 yr) (mm/hr) 104.19	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 11.3	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3		Uncontrolled - Tributary
Subdra	20 30 40 50 60 70 80 90 100 110 120 inage Area: (ha): C: tc (min) 10 20	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 I(5 yr) (mm/hr) 104.19 70.25	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 11.3 Qactual (L/s) 28.8 19.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3	Qstored	Uncontrolled - Tributary Vstored
Subdra	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha): C:	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 I (5 yr) (mm/hr) 104.19	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 11.3	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3	Qstored	Uncontrolled - Tributary  Vstored
Subdra	20 30 40 50 60 70 80 90 100 120 inage Area: Area (ha): C: tc (min) 10 20 30 40 50	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 I(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 Qactual (L/s) 28.8 19.4 14.9 12.2	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 Qrelease (L/s) 28.8 19.4 14.9 12.2	Qstored	Uncontrolled - Tributary  Vstored
Subdra	20 30 40 50 60 70 80 90 100 110 120 inage Area: Area (ha): C: tc (min) 10 20 30 40 40 50 60 70 80 90 100 100 100 100 100 100 100 100 100	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 21.47 0.37 EX-2 0.27 0.37 I (5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 Qactual (L/s) 28.8 19.4 14.9 12.2 10.4 9.1	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 Qrelease (L/s) 28.8 19.4 14.9 12.2 10.4 9.1	Qstored	Uncontrolled - Tributary  Vstored
Subdra	20 30 40 50 60 70 80 90 100 120 inage Area: Area (ha): C: tc (min) 10 20 30 40 50	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 I(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 Qactual (L/s) 28.8 19.4 14.9 12.2	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 Qrelease (L/s) 28.8 19.4 14.9 12.2	Qstored	Uncontrolled - Tributary  Vstored
Subdra	20 30 40 50 60 70 80 90 110 120 inage Area: Area (ha): C: (min) 10 20 30 40 50 60 70 80 90 10 10 10 10 10 10 10 10 10 10 10 10 10	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 27.20	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 12.2 10.4 9.1 7.3 6.7	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 12.0 11.3 28.8 19.1 28.8 19.1 14.9 12.9 10.4 9.1 8.1 7.3 6.7	Qstored	Uncontrolled - Tributary Vstored
Subdra	20 30 40 50 60 70 80 90 1100 1120 inage Area: Area (ha): C: tc (min) 10 20 30 40 50 60 70 80 90 100 1120	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 I (5 yr) (mu/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 29.37 20.57	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 28.8 19.4 14.9 12.2 10.4 9.1 8.1 9.1 8.1 9.1 8.1 9.1 8.1 9.1 9.1 8.1 9.1 8.1 9.1 9.1 9.1 9.1 9.1 9.1 9.1 9.1 9.1 9	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3 28.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7	Qstored	Uncontrolled - Tributary Vstored
Subdra	20 30 40 50 60 70 80 90 110 120 inage Area: Area (ha): C: (min) 10 20 30 40 50 60 70 80 90 10 10 10 10 10 10 10 10 10 10 10 10 10	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 27.20	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 12.2 10.4 9.1 7.3 6.7	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 12.0 11.3 28.8 19.1 28.8 19.1 14.9 12.9 10.4 9.1 8.1 7.3 6.7	Qstored	Uncontrolled - Tributary Vstored
	20 30 40 50 60 70 80 90 100 1120 Inage Area: Area (ha): tc (min) 10 20 30 40 50 60 70 100 110 120 110 120 110 120 110 100 110 11	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 12.41 20.82 19.47  EX-2 0.27 0.37 1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 12.2 10.4 9.1 7.3 6.7 6.2 5.8	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 11.3 <b>Qrelease</b> (L/s) 12.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8	Qstored	Uncontrolled - Tributary  Vstored (m^3)
	20 30 40 50 60 70 80 90 100 1120 inage Area: Area (ha): C: tc (min) 10 0 50 60 70 80 90 100 1100 1100 1100 1100 1100 110	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 1(5 yr) (mm/hr) 104.19 104.19 37.65 32.94 29.37 26.56 24.29 26.56 27.27 28.57 29.37	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 12.2 10.4 9.1 7.3 6.7 6.2 5.8	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 11.3 <b>Qrelease</b> (L/s) 12.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8	Qstored	Uncontrolled - Tributary Vstored
	20 30 40 50 60 70 80 90 100 1120 Inage Area: Area (ha): tc (min) 10 20 30 40 50 60 70 100 110 120 110 120 110 120 110 100 110 11	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 12.41 20.82 19.47  EX-2 0.27 0.37 1(5 yr) (mm/hr) 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 12.2 10.4 9.1 7.3 6.7 6.2 5.8	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 12.0 11.3 <b>Qrelease</b> (L/s) 12.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8	Qstored	Uncontrolled - Tributary  Vstored (m^3)
	20 30 40 50 60 70 80 90 110 20 100 80 90 100 110 120 100 1120 100 1120 100 1120 100 170 170 170 170 170 170 170 170 17	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47  EX-2 0.27 1(5 yr) (murhr) 104.19 70.25 32.94 29.37 26.56 22.94 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 20.33	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.4 14.0 13.0 12.0 11.3   Qactual (L/s) 12.8 19.4 14.9 12.2 10.4 9.1 7.3 6.7 6.2 5.8 5.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3   Qrelease (L/s) 22.8 19.4 14.9 20.8 19.4 14.9 20.8 19.4 14.9 20.8 5.8 5.4	Qstored (L/s)	Uncontrolled - Tributary  Vstored (m^3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 110 20 30 40 50 60 70 80 90 110 120 10 10 20 30 40 50 60 70 80 90 110 120 12	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 104.19 70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47 EX-2 0.27 0.37 104.19 70.25 53.93 44.18 37.65 24.29 29.37 26.56 24.29 29.47 EX-2 10.82	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L(s) 28.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8 5.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrelease (L/s) 28.8 19.1 14.9 12.2 10.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8 5.4	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 110 110 110 110 110 10 20 30 40 40 60 70 80 90 100 110 120 11age Area: Area (ha): C: tc (min) 10 20 20 20 20 20 20 20 20 20 20 20 20 20	70.25 53.93 44.18 37.65 32.94 29.37 26.56 24.29 22.41 20.82 19.47  EX-2 0.27 1(5 yr) (murhr) 104.19 70.25 32.94 29.37 26.56 22.94 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 26.56 29.37 20.33	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 9.1 8.1 7.3 6.2 6.8 5.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrelease (L/s) 22.8 19.4 14.9 25.8 5.4	Qstored (L/s)	Uncontrolled - Tributary  Vstored (m^3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 110 20 120 102 10 120 10 120 10 10 10 10 10 10 10 10 10 10 10 10 10	70.25 5.393 44.18   44.18   53.93 44.18   71.65 7.393 7.65 5.003 7.65 5.003 7.003 7.003 7.003 7.003 7.003 7.003 7.003 7.003 7.003 7.003 7.003 7	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.6 19.4 14.9 12.2 19.4 14.9 5.8 5.4  Qactual (L/s) 27.1 8.1 8.1 9.1 8.1 8.1 8.1 8.1 8.1 8.1 8.1 8.1 8.1 8	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrelease (L/s) 28.8 19.4 14.9 21.2 26.8 19.4 14.9 27.3 67 67 67 62 5.8 5.4	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 110 20 30 40 50 60 70 80 90 110 120 10 20 80 100 110 20 100 10	70.25 53.93 44.18 77.65 53.93 44.18 78.65 79.67 70.27 70.37 71.65 71.70 70.25 70.37 70.37	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L(s) 28.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8 5.4  Qactual (L(s) 18.3 14.1	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrolease (L/s) 28.8 19.1 8.1 7.3 6.7 6.2 5.8 5.4	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 110 20 120 100 110 120 100 100 110 120 100 10	70.25 53.93 44.18 75.393 44.18 76.53.93 77.65 76.593 77.65 76.593 77.65	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 12.2 13.8 14.7 67 67 67 6.2 5.8 5.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrelease (L/s) 22.8 19.4 14.9 25.8 19.4 14.9 26.8 19.4 14.9 27.1 27.1 27.1 27.1 27.1 27.1 27.1 27.1	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 110 20 30 40 50 60 70 80 90 110 120 10 20 80 100 110 20 100 10	70.25 53.93 44.18 77.65 53.93 44.18 78.65 79.67 70.27 70.37 71.65 71.70 70.25 70.37 70.37	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L(s) 28.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8 5.4  Qactual (L(s) 18.3 14.1	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrolease (L/s) 28.8 19.1 8.1 7.3 6.7 6.2 5.8 5.4	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 110 20 100 120 110 20 100 120 110 20 100 120 100 120 100 120 100 120 100 120 100 120 100 120 100 120 100 10	70.25 53.93 44.18 7.65 53.93 44.18 7.65 53.93 7.65 50 7.65 7.65 7.65 7.65 7.65 7.65 7.65 7.65	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L(s)) 28.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8 5.4  Qactual (L(s)) 28.8 1.1 1.1 1.5 9.8 8.6 7.7	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrolease (L/s) 28.8 19.1 2.2 10.4 14.9 12.2 10.4 14.9 12.2 5.8 5.4  Qrolease (L/s) 12.5 8.6 7.7	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 80 90 110 120 102 102 102 102 102 102 102 10	70.25 53.93 44.18 32.94 22.41 16.97 10.37 10.41	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 12.2 10.4 8.1 14.7 6.2 5.8 5.4  Qactual (L/s) 27.1 18.3 14.1 11.5 9.8 8.6 7.7 6.9	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrelease (L/s) 22.8 19.4 14.9 1.1 8.1 17.3 6.7 6.2 5.8 5.4  Qrelease (L/s) 11.5 9.8 8.6 7.7 6.9	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 110 20 100 120 110 20 100 120 110 20 100 120 100 120 100 120 100 120 100 120 100 120 100 120 100 120 100 10	70.25 53.93 44.18 7.65 53.93 44.18 7.65 53.93 7.65 50 7.65 7.65 7.65 7.65 7.65 7.65 7.65 7.65	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L(s)) 28.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8 5.4  Qactual (L(s)) 28.8 1.1 1.1 1.5 9.8 8.6 7.7	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrolease (L/s) 28.8 19.1 2.2 10.4 14.9 12.2 10.4 14.9 12.2 5.8 5.4  Qrolease (L/s) 12.5 8.6 7.7	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 100 120 110 120 10 80 80 90 100 120 120 10 80 80 90 100 60 60 70 80 80 90 100 100 100 100 100 100 100 100 100	70.25 53.93 44.18 72.65 53.93 44.18 72.65 72.65 72.65 72.65 72.75 72.65 73.76 73.76 74.19 75.76 75.76 75.76 75.76 76.76 76.76 76.77 76.76 76.77 76.76 76.77	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3   Qactual (L(s)) 28.8 19.4 14.9 12.2 10.4 9.1 8.1 7.3 6.7 6.2 5.8 5.4   Qactual (L(s)) 28.8 5.4	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3   Qrelease (L/s) 28.8 19.1 2.2 10.4 14.9 12.2 10.4 14.9 12.2 10.4 14.9 11.8 1.7 3.6 5.8 5.4   Qrelease (L/s) 2.8 6.7 6.2 6.8 6.7 6.9 6.3 5.8 5.4	Qstored (L's)	Uncontrolled - Tributary  Vistored (m*-3)  Uncontrolled - Tributary
	20 30 40 50 60 70 80 90 100 20 20 30 40 50 60 70 80 90 90 100 100 100 100 100 100 100 100	70.25 53.93 44.18 32.94 22.41 1(5 yr) 104.19 105.19 105.19 105.19 106.19 107.19	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qactual (L/s) 28.8 19.4 14.9 21.2 21.8 21.8 21.8 21.8 21.8 21.8 21.8	40.6 31.2 25.5 21.8 19.0 17.0 15.4 14.0 13.0 12.0 11.3  Qrelease (L/s) 22.8 19.4 14.9 21.2 10.4 14.9 21.2 10.4 14.9 11.5 8.6 7.7 6.2 5.8 8.6 7.7 6.9 6.3 5.8	Qstored (L's)	Uncontrolled - Tributary  Vistored (m²-3)  Uncontrolled - Tributary  Vistored

ainage Area					Uncontrolled - Tributary
Area (ha): C:	0.07				
tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10 20	178.56 119.95	9.3	9.3 6.2	(23)	( 0)
30	91.87	4.8	4.8		
40 50	75.15 63.95	3.9 3.3	3.9 3.3		
60 70	55.89 49.79	2.9 2.6	2.9 2.6		
80 90	44.99 41.11	2.3 2.1	2.3 2.1		
100 110	37.90 35.20	2.0 1.8	2.0 1.8		
120 drainage Area	32.89 : EX-5	1.7	1.7		Uncontrolled - Tributary
Area (ha):	0.23				Oncombolica Tributary
tc (min)	I (100 yr) (mm/hr)	Qactual (L/s)	Qrelease (L/s)	Qstored (L/s)	Vstored (m^3)
10 20	178.56 119.95	114.7 77.0	114.7 77.0		
30 40	91.87 75.15	59.0 48.3	59.0 48.3		
50	63.95	41.1	41.1		
60 70	55.89 49.79	35.9 32.0	35.9 32.0		
80 90	44.99 41.11	28.9 26.4	28.9 26.4		
100	37.90	24.3	24.3		
110 120	35.20 32.89	22.6 21.1	22.6 21.1		
ıbdrainage Area Area (ha):	0.69				Uncontrolled - Tributary
tc tc	0.79	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s) 268.2	(L/s) 268.2	(L/s)	(m^3)
20	119.95	180.1	180.1		
30 40	91.87 75.15	138.0 112.9	138.0 112.9		
50 60	63.95 55.89	96.0 83.9	96.0 83.9		
70	49.79	74.8	74.8		
80 90	44.99 41.11	67.6 61.7	67.6 61.7		
100 110	37.90 35.20	56.9 52.9	56.9 52.9		
120	32.89	49.4	49.4		
ibdrainage Area Area (ha): C:	0.23				Uncontrolled - Tributary
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	(L/5)	(111-3)
20 30	119.95 91.87	77.0 59.0	77.0 59.0		
40 50	75.15 63.95	48.3 41.1	48.3 41.1		
60	55.89	35.9	35.9		
70 80	49.79 44.99	32.0 28.9	32.0 28.9		
90 100	41.11 37.90	26.4 24.3	26.4 24.3		
110 120	35.20 32.89	22.6 21.1	22.6 21.1		
ıbdrainage Area Area (ha):	0.27				Uncontrolled - Tributary
tc tc	0.46	Qactual	Qrelease	Qstored	Vstored
(min)	(mm/hr)	(L/s)	(L/s)	(L/s)	(m^3)
20	119.95	41.5	41.5		
30 40	91.87 75.15	31.8 26.0	31.8 26.0		
50 60	63.95 55.89	22.1 19.3	22.1 19.3		
70	49.79	17.2	17.2		
80 90	44.99 41.11	15.6 14.2	15.6 14.2		
100 110	37.90 35.20	13.1 12.2	13.1 12.2		
120	32.89	11.4	11.4		
	0.28				Uncontrolled - Tributary
ubdrainage Area Area (ha): C:			Qrelease	Qstored	Vstored
Area (ha):	I (100 yr)	Qactual (L/s)	(L/s)	(L/s)	(m^3)
Area (ha): C: tc (min)	I (100 yr) (mm/hr) 178.56	(L/s) 58.2	(L/s) 58.2	(L/s)	(m^3)
Area (ha): C: tc (min) 10 20 30	I (100 yr) (mm/hr) 178.56 119.95 91.87	(L/s) 58.2 39.1 29.9	(L/s) 58.2 39.1 29.9	(L/s)	(m^3)
tc (min) 10 20 30 40 50	1 (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95	(L/s) 58.2 39.1 29.9 24.5 20.8	(L/s) 58.2 39.1 29.9 24.5 20.8	(L/s)	(m^3)
Area (ha): C: tc (min) 10 20 30 40 50 60	I (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89	(L/s) 58.2 39.1 29.9 24.5 20.8 18.2	(L/s) 58.2 39.1 29.9 24.5 20.8 18.2	(L/s)	(m^3)
Area (ha): C: tc (min) 10 20 30 40 50 60 70 80	1 (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79 44.99	(L/s) 58.2 39.1 29.9 24.5 20.8 18.2 16.2 14.7	(L/s) 58.2 39.1 29.9 24.5 20.8 18.2 16.2 14.7	(L/s)	(m^3)
tc (min) 10 20 30 40 50 60 70	1 (100 yr) (mm/hr) 178.56 119.95 91.87 75.15 63.95 55.89 49.79	58.2 39.1 29.9 24.5 20.8 18.2 16.2	(L/s) 58.2 39.1 29.9 24.5 20.8 18.2 16.2	(L/s)	(m^3)

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

YEAR SUMMARY TO OUTLET	AR 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							
Torret	202 2 1 /2							

#### 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

	Rati	ng Curve	Volume Estimation					
Elevation	Discharge Rate	Outlet Discharge	Storage	Elevation	Area	Volume	(cu. m)	Water Depth
(m)	(cu.m/s)	(cu.m/s)	(cu. m)	(m)	(sq. m)	Increment	Accumulated	(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

	Drawdowr	<b>Estimate</b>	
Total	Total		
Volume	Time	Vol	Detention
(cu.m) (sec)		(cu.m)	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	115
Number of Roof Notches*		8	
Max. Allowable Depth of Roof Ponding (m)		0.15	* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).
Max. Allowable Storage (cu.m)		46	
Estimated 100 Year Drawdown Time (h)		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	

<sup>\*</sup> 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	

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

	Rating	Curve		Volume Estimation				
Elevation	Discharge Rate	Outlet Discharge	Storage	Elevation	Area	Volume	(cu. m)	Water Depth
(m)	(cu.m/s)	(cu.m/s)	(cu. m)	(m)	(sq. m)	Increment	Accumulated	(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	Total								
Volume	Time	Vol	Detention						
(cu.m)	(sec)	(cu.m)	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			<del>_</del>						
				From Wat	ts Drain C	atalogue			
Total Building Area (sq.m)		1020		Head (m)	L/s				
Assume Available Roof Area (sq.	80%	816			Open	75%	50%	25%	Closed
Roof Imperviousness		0.99		0.025	0.3155	0.3155	0.3155	0.3155	0.3155
Roof Drain Requirement (sq.m/Notch)		232		0.050	0.6309	0.6309	0.6309	0.6309	0.3155
Number of Roof Notches*		8		0.075	0.9464	0.8675	0.7886	0.7098	0.3155
Max. Allowable Depth of Roof Ponding (m)		0.15	* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).	0.100	1.2618	1.1041	0.9464	0.7886	0.3155
Max. Allowable Storage (cu.m)		41		0.125	1.5773	1.3407	1.1041	0.8675	0.3155
Estimated 100 Year Drawdown Time (h)		1.4		0.150	1.8927	1.5773	1.2618	0.9464	0.3155

<sup>\*</sup> 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								
Elevation	Discharge Rate	Outlet Discharge	Storage	Elevation	Area	Volume	(cu. m)	Water Depth
(m)	(cu.m/s)	(cu.m/s)	(cu. m)	(m)	(sq. m)	Increment	Accumulated	(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	Total				
Volume	Time	Vol	Detention		
(cu.m)	(sec)	(cu.m)	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			_						
				From Watts Drain Catalogue					
Total Building Area (sq.m)		1150		Head (m)	L/s				
Assume Available Roof Area (sq.	80%	920			Open	75%	50%	25%	Closed
Roof Imperviousness		0.99		0.025	0.3155	0.3155	0.3155	0.3155	0.3155
Roof Drain Requirement (sq.m/Notch)		232		0.050	0.6309	0.6309	0.6309	0.6309	0.3155
Number of Roof Notches*		8		0.075	0.9464	0.8675	0.7886	0.7098	0.3155
Max. Allowable Depth of Roof Ponding (m)		0.15	* As per Ontario Building Code section OBC 7.4.10.4.(2)(c).	0.100	1.2618	1.1041	0.9464	0.7886	0.3155
Max. Allowable Storage (cu.m)		46		0.125	1.5773	1.3407	1.1041	0.8675	0.3155
Estimated 100 Year Drawdown Time (h)		1.6		0.150	1.8927	1.5773	1.2618	0.9464	0.3155

<sup>\*</sup> 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	



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:  $[5 \text{ gpm}(\text{per inch of head}) \times 2 \text{ inches of head}] + 2-1/2 \text{ gpm}(\text{for the third inch of head}) = 12-1/2 \text{ gpm}.$ 

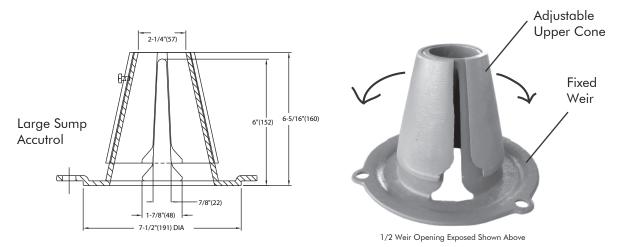


TABLE 1. Adjustable Accutrol Flow Rate Settings

	Head of Water						
Weir Opening	1"	2"	3"	4"	5"	6"	
Exposed	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 reserves the right to modify or change product design or construction without prior notice and without incurring any obligation to make similar changes and modifications to products previously or subsequently sold. See your WATTS Drainage representative for any clarification. Dimensions are subject to manufacturing tolerances.



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

# SERVICING AND STORMWATER MANAGEMENT REPORT - NORBERRY RESIDENCES - 740 SPRINGLAND DRIVE

# 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	<b>Date</b> 7/10/2019		
Designer Information		EOR Information (optional)		
Name	Cameron Odam	Name		
Company	Stantec Consulting Ltd. Company			
Phone #	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	State/Province Ontario Total Number of Rainfall Events 4093			
Rainfall Station Name	OTTAWA MACDONALD- CARTIER INT'L A	I Otal Raintall (mm)		
Station ID #	6000	Average Annual Rainfall (mm)		
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)		

0.003	0.077			
Up Stream Flow Diversion				
Max. Flow to Stormceptor (cms)				
Design Details				
Stormceptor Inlet Inve	rt Elev (m)			
Stormceptor Outlet Inve				
Stormceptor Rim E				
Normal Water Level Ele				
Pipe Diameter (r	375			
Pipe Materia	PVC - plastic			
Multiple Inlets (	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		Infiltration Parameters		
Total Area (ha) 0.364 Horton's ed		Horton's equation is used to estimate infiltration		
Imperviousness %	53.1	Max. Infiltration Rate (mm/hr) 61.98		
Surface Characteristics		Min. Infiltration Rate (mm/hr) 10.16		
Width (m)	121.00	<b>Decay Rate (1/sec)</b> 0.0005		
Slope %	2	Regeneration Rate (1/sec) 0.01		
Impervious Depression Storage (mm)	0.508	Evaporation		
Pervious Depression Storage (mm)	5.08	Daily Evaporation Rate (mm/day) 2.54		
Impervious Manning's n 0.015		Dry Weather Flow		
Pervious Manning's n	0.25	Dry Weather Flow (lps) 0		
Maintenance Frequency		Winter Months		
Maintenance Frequency (months) > 12		Winter Infiltration 0		
	TSS Loadin	ng Parameters		
TSS Loading Function				
Buildup/Wash-off Parameters		TSS Availability Parameters		
Target Event Mean Conc. (EMC) mg/L		Availability Constant A		
Exponential Buildup Power		Availability Factor B		
Exponential Washoff Exponent		Availability Exponent C		
		Min. Particle Size Affected by Availability (micron)		





Cumulative Runoff Volume by Runoff Rate				
Runoff Rate (L/s)	Runoff Rate (L/s) Runoff Volume (m³) Volume Over (m³)		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 Cumulative Runoff Volume (%) 32 Flow (L/s)

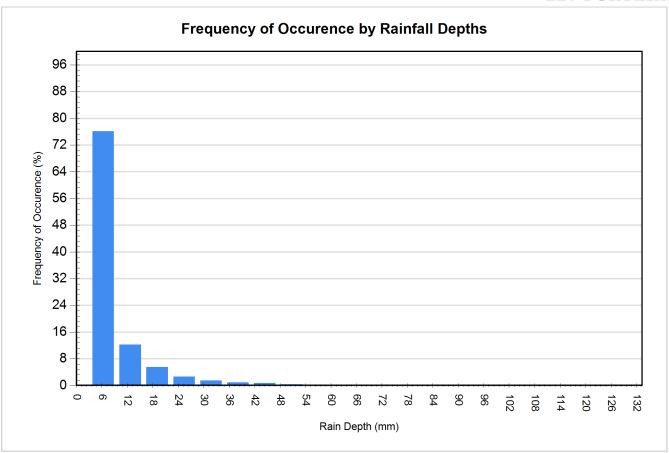




Rainfall Event Analysis					
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)	
6.35	3113	76.1	5230	24.9	
12.70	501	12.2	4497	21.4	
19.05	225	5.5	3469	16.5	
25.40	105	2.6	2317	11.0	
31.75	62	1.5	1765	8.4	
38.10	35	0.9	1206	5.8	
44.45	28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





Discharge (cms)

Drainage Area		
Total Area (ha)	0.12	
Imperviousness %	71.4	
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)		

2100111		.ge (ee)	
0.000 0.000		.000	
Up Stream	Flow Diversi	on	
Max. Flow to Stormce	otor (cms)		
Design Details			
Stormceptor Inlet Inve	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	

**Up Stream Storage** 

Storage (ha-m)

## **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		



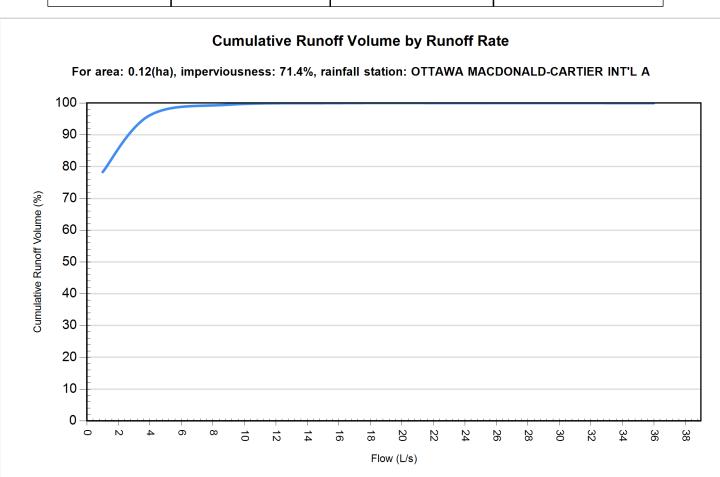


Site Name		Norberry 102		
Site Details				
Drainage Area		Infiltration Parameters		
Total Area (ha)	0.12	Horton's equation is used to estimate infiltration		
Imperviousness %	71.4	Max. Infiltration Rate (mm/hr) 61.98		
Surface Characteristics	S	Min. Infiltration Rate (mm/hr) 10.16		
Width (m)	69.00	<b>Decay Rate (1/sec)</b> 0.00055		
Slope %	2	Regeneration Rate (1/sec) 0.01		
Impervious Depression Storage (mm)	0.508	Evaporation		
Pervious Depression Storage (mm)	5.08	Daily Evaporation Rate (mm/day) 2.54		
Impervious Manning's n	0.015	Dry Weather Flow		
Pervious Manning's n	0.25	Dry Weather Flow (lps) 0		
Maintenance Frequency		Winter Months		
Maintenance Frequency (months) >	12	Winter Infiltration 0		
	TSS Loading	ng Parameters		
TSS Loading Function				
Buildup/Wash-off Parame	eters	TSS Availability Parameters		
Target Event Mean Conc. (EMC) mg/L		Availability Constant A		
Exponential Buildup Power		Availability Factor B		
Exponential Washoff Exponent		Availability Exponent C		
		Min. Particle Size Affected by Availability (micron)		





Cumulative Runoff Volume by Runoff Rate				
Runoff Rate (L/s)	Runoff Volume (m³)	Volume Over (m³)	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	



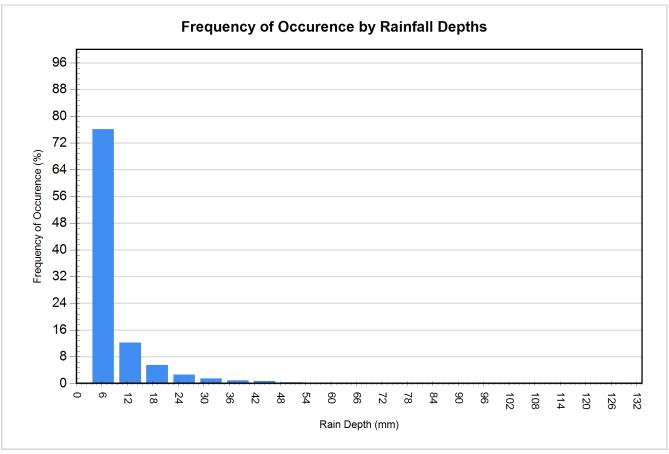




Rainfall Event Analysis				
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)
6.35	3113	76.1	5230	24.9
12.70	501	12.2	4497	21.4
19.05	225	5.5	3469	16.5
25.40	105	2.6	2317	11.0
31.75	62	1.5	1765	8.4
38.10	35	0.9	1206	5.8
44.45	28	0.7	1163	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	t Name Norberry Crescent Project Number 160401483		160401483
City	Ottawa	State/ Province	Ontario
Country	Canada	<b>Date</b> 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.





Discharge (cms)

Drainage Area					
Total Area (ha) 0.198					
Imperviousness %	42.9				
Water Quality Objective	e				
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)					

Storage (in in)				
0.000 0.000				
Up Stream	Flow Diversi	on		
Max. Flow to Stormce	Max. Flow to Stormceptor (cms)			
Desi	gn Details			
Stormceptor Inlet Inve	rt Elev (m)	75.42		
Stormceptor Outlet Inve	75.37			
Stormceptor Rim E	77.23			
Normal Water Level Ele	74.52			
Pipe Diameter (r	300			
Pipe Materia	PVC - plastic			
Multiple Inlets (	Yes			
Grate Inlet (Y/I	N)	No		

**Up Stream Storage** 

Storage (ha-m)

## **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		Infiltration Parameters		
Total Area (ha)	0.198	Horton's equation is used to estimate	infiltration	
Imperviousness %	42.9	Max. Infiltration Rate (mm/hr)	61.98	
Surface Characteristics	5	Min. Infiltration Rate (mm/hr)	10.16	
Width (m)	89.00	Decay Rate (1/sec)	0.00055	
Slope %	2	Regeneration Rate (1/sec)	0.01	
Impervious Depression Storage (mm)	0.508	Evaporation		
Pervious Depression Storage (mm)	5.08	Daily Evaporation Rate (mm/day)		
Impervious Manning's n	0.015	Dry Weather Flow		
Pervious Manning's n 0.25		Dry Weather Flow (lps)		
Maintenance Frequency	y	Winter Months		
Maintenance Frequency (months) >	12	Winter Infiltration	0	
	TSS Loading	) Parameters		
TSS Loading Function				
Buildup/Wash-off Parame	eters	TSS Availability Paramete	ers	
Target Event Mean Conc. (EMC) mg/L		Availability Constant A		
Exponential Buildup Power		Availability Factor B		
Exponential Washoff Exponent		Availability Exponent C		
		Min. Particle Size Affected by Availability (micron)		





Cumulative Runoff Volume by Runoff Rate						
Runoff Rate (L/s)	Runoff Volume (m³)	Volume Over (m³)	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 Cumulative Runoff Volume (%)

Flow (L/s)

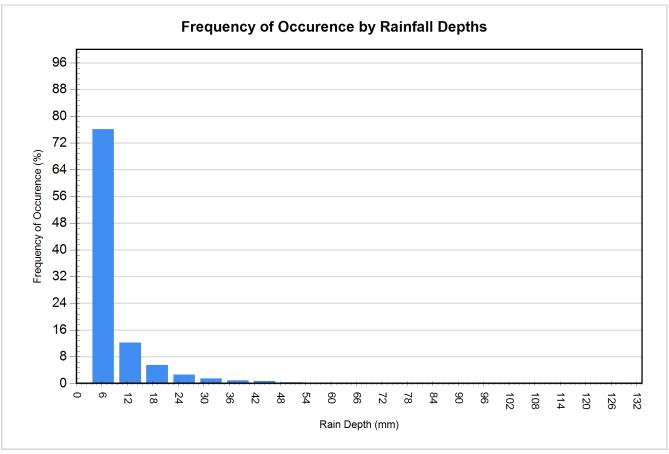




Rainfall Event Analysis						
Rainfall Depth (mm)	No. of Events	Percentage of Total Events (%)	Total Volume (mm)	Percentage of Annual Volume (%)		
6.35	3113	76.1	5230	24.9		
12.70	501	12.2	4497	21.4		
19.05	225	5.5	3469	16.5		
25.40	105	2.6	2317	11.0		
31.75	62	1.5	1765	8.4		
38.10	35	0.9	1206	5.8		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

# SERVICING AND STORMWATER MANAGEMENT REPORT - NORBERRY RESIDENCES - 740 SPRINGLAND DRIVE

# Appendix D GEOTECHNICAL INVESTIGATION



Geotechnical Engineering

Environmental Engineering

**Hydrogeology** 

Geological Engineering

**Materials Testing** 

**Building Science** 

**Archaeological Services** 

# patersongroup

# **Geotechnical Investigation**

Proposed Multi-Storey Buildings Norberry Crescent Ottawa, Ontario

**Prepared For** 

Greatwise Developments

# 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 March 27, 2019

Report PG4834-1



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# **Appendices**

**Appendix 1** Soil Profile and Test Data Sheets

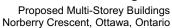
Symbols and Terms

**Analytical Testing Results** 

Atterberg Limit Testing Results

**Appendix 2** Figure 1 - Key Plan

Drawing PG4834-1 - Test Hole Location Plan





## 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 - Atterl	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	СН	
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 - Groundw	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.



Proposed Multi-Storey Buildings Norberry Crescent, Ottawa, Ontario

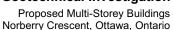
### 5.6 Pavement Structure

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.

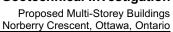
#### **Foundation Backfill**

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.

Report: PG4834-1 March 26, 2019



#### 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

**Geotechnical Investigation** 

**Proposed Multi-Storey Buildings - Norberry Crescent** Ottawa, Ontario

**SOIL PROFILE AND TEST DATA** 

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

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

FILE NO. **PG4834** 

HOLE NO.

**REMARKS** 

DATUM

BH<sub>1</sub> BORINGS BY CME 55 Power Auger DATE February 25, 2019 **SAMPLE** Pen. Resist. Blows/0.3m STRATA PLOT **DEPTH** ELEV. Piezometer Construction **SOIL DESCRIPTION** 50 mm Dia. Cone (m) (m) RECOVERY N VALUE or RQD NUMBER Water Content % 80 **GROUND SURFACE** 20 0+100.13Asphaltic concrete 0.08 1 **FILL:** Brown silty sand with gravel SS 2 56 50 +1 + 99.131.37 Stiff, brown SILTY CLAY 2 SS 88 5 2+98.13- firm and grey by 2.1m depth 3.05 3+97.13GLACIAL TILL: Loose, grey silty SS 3 54 8 sand with clay and gravel 3.66 End of Borehole (GWL @ 2.04m - March 5, 2019) 40 60 80 100 Shear Strength (kPa) ▲ Undisturbed △ Remoulded

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

FILE NO. **PG4834** 

**REMARKS** HOLE NO. **BH 2 BORINGS BY** CME 55 Power Auger DATE February 25, 2019

BORINGS BY CME 55 Power Auger					DATE	ebruary	25, 2019	)	D112		
SOIL DESCRIPTION	PLOT	SAMPLE				DEPTH		Pen. Resist. Blows/0.3m  • 50 mm Dia. Cone			
	STRATA 1	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(m)	(m)	0 V	Vater Content %	Piezometer Construction	
GROUND SURFACE			ı	2	Z	0-	99.99	20	40 60 80	<u>a</u> C	
Asphaltic concrete 0.08  FILL: Brown silty sand with gravel 0.76		AU	1				33.33				
Compact, brown <b>SANDY SILT,</b> trace clay		ss	2		11	1-	-98.99			<u>_</u>	
Very stiff, brown <b>SILTY CLAY</b>		_				2-	-97.99		12		
- grey by 2.1m depth		_				3-	-96.99	Δ	12		
GLACIAL TILL: Loose, grey silt with clay, gravel, cobbles and boulders		ss	3	67	3	4-	-95.99				
5 46		ss × ss	4	79	6	5-	-94.99				
End of Borehole  Practical refusal to augering at 5.46m		<u> </u>	J								
depth (GWL @ 1.31m - March 5, 2019)											
								20 Shea ▲ Undist	40 60 80 100 ar Strength (kPa) turbed △ Remoulded	D	

**Geotechnical Investigation** 

**Proposed Multi-Storey Buildings - Norberry Crescent** Ottawa, Ontario

**SOIL PROFILE AND TEST DATA** 

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

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

FILE NO. **PG4834** 

HOLE NO.

**DATUM** 

**REMARKS** 

RH 3

BORINGS BY CME 55 Power Auger		DATE February 25, 2019 BH 3								
SOIL DESCRIPTION	SAMPLE				DEPTH ELEV.		Pen. Resist. Blows/0.3m  ■ 50 mm Dia. Cone			
GROUND SURFACE	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(m)	(m)		er Content %	Piezometer Construction
Asphaltic concrete 0.08  FILL: Brown silty sand with gravel and crushed stone 0.60		AU	1			0-	100.05			
Stiff, brown SILTY CLAY		ss	2	75	11	1-	-99.05			
<u>1.98</u>		-				2-	-98.05	Δ	<b>A</b>	
		ss	3	54	13	3-	-97.05			
<b>GLACIAL TILL:</b> Loose to compact, grey sandy silt with gravel, cobbles and boulders		ss	4	33	8	4-	-96.05			
		∑ ss ∑ ss	5 6	46	50+	7	90.03			
		∑ SS	7	100	50+	5-	-95.05			
Practical refusal to augering at 5.46m depth										
(Piezometer blocked at 0.50m depth - March 5, 2019)										
								20 40 Shear S ▲ Undisturbe	trength (kPa)	00

**SOIL PROFILE AND TEST DATA** 

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

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

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

FILE NO. **PG4834** 

**REMARKS** 

**DATUM** 

BORINGS BY CME 55 Power Auger				0	DATE	February	25, 2019		HOL	E NO.	BH 4	
SOIL DESCRIPTION	PLOT		SAN	/IPLE	ı	DEPTH	ELEV.			. Blow n Dia. (	/s/0.3m Cone	_
	STRATA 1	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(m)	(m)	0 V	Vater	Conte	ent %	Piezometer
GROUND SURFACE	ß		z	꿆	z º		00.50	20	40	60	80	<u>۾</u>
	15	AU	1			0-	99.56					
FILL: Brown silty sand with gravel		ss	2	72	50+	1-	-98.56					
Compact to loose, brown <b>SILTY SAND,</b> with gravel, trace clay	52 44	ss	3		11	2-	-97.56					
Stiff, grey <b>SILTY CLAY</b>		SS	4	71	4	3-	-96.56	4		<u></u>		
<u>4</u> .	47	_				4-	-95.56					
		ss	5		3	5-	-94.56					
<b>GLACIAL TILL:</b> Very loose, grey clayey silt with sand and gravel		∭ ss	6		Р	6-	-93.56					
Dynamic Cone Penetration Test 6. commenced at 6.70m depth.	70 \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	ss Â	7		3		_					
End of Borehole  Practical DCPT refusal at 6.91m depth												
(GWL @ 3.33m - March 5, 2019)								20 Shea		60 ength △ R	80 (kPa) emoulded	100

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

**PG4834** 

**REMARKS** 

HOLE NO.

FILE NO.

RH 5

BORINGS BY CME 55 Power Auger				D	ATE	February	25, 2019	9 BH 5			
SOIL DESCRIPTION	PLOT		SAMPLE			DEPTH	ELEV.	Pen. Resist. Blows/0.3m  ■ 50 mm Dia. Cone			
GROUND SURFACE	STRATA E	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(m)	(m)	• 50 mm Dia. Cone  O Water Content %  20 40 60 80			
Asphaltic concrete 0.08		<b>*</b>				0-	100.30	20 40 00 80 2			
FILL: Brown silty sand with gravel		AU AU	1								
1.07		ss	2	46	8	1 -	99.30				
Very stiff to stiff, brown <b>SILTY CLAY</b> with sand		ss	3	67	10	2-	-98.30				
grey by 2.1m depth		ss	4	50	10						
<u>3.35</u>		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-	6-94.30				
6.81		ss	9	71	12						
End of Borehole											
Practical refusal to augering at 6.81m depth											
Piezometer blocked - March 5, 2019)											
								20 40 60 80 100  Shear Strength (kPa)  ▲ Undisturbed △ Remoulded			

**Geotechnical Investigation Proposed Multi-Storey Buildings - Norberry Crescent** 

**SOIL PROFILE AND TEST DATA** 

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

Ottawa, Ontario TBM - Top of catchbasin cover located within the eastern parking area, adjacent

**PG4834** 

FILE NO.

to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the **REMARKS** 

**DATUM** 

BORINGS BY CME 55 Power Auger				D	ATE	February	25. 2019	)	HOLE N	o. <b>BH 6</b>				
SOIL DESCRIPTION	PLOT	SAMPLE				DEPTH (m)	ELEV.	Pen. R	Pen. Resist. Blows/0.3m		J.			
	STRATA	TYPE	TYPE	TYPE	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(111)	(111)	0 V	Vater Co	ntent %	Piezometer
GROUND SURFACE	Ø		N	RE	z °	0-	100.20	20	40	60 80	ä			
Asphaltic concrete 0.08  FILL: Brown silty sand with gravel		AU	1				100.20							
Firm to stiff, brown <b>SILTY CLAY</b>		ss	2	62	11	1-	-99.20							
grey by 1.4m depth		_						Δ						
			2		98.20	<b>ф</b>			-					
		_				3-	97.20			110	<b>0</b> 6			
3.35 End of Borehole	2004	-						Δ.						
(Piezometer blocked at 1.15m depth - March 5, 2019)														
								20 Shea	ar Streng	60 80 10 10 10 10 10 10 10 10 10 10 10 10 10	00			

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

FILE NO. **PG4834** 

to 840 Springland Drive. An arbitrary elevation of 100.00m was assigned to the

**REMARKS** HOLE NO. **BH7** BORINGS BY CME 55 Power Auger DATE February 25 2019

BORINGS BY CME 55 Power Auger		DATE February 25, 2019						) ВН /	
SOIL DESCRIPTION	PLOT	SAMPLE			DEPTH		Pen. Resist. Blows/0.3m  ■ 50 mm Dia. Cone		
	STRATA E	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(m)	(m)	<ul> <li>50 mm Dia. Cone</li> <li>Water Content %</li> <li>40 60 80</li> </ul>	
GROUND SURFACE	ω		N	Æ	z °		100 10	20 40 60 80	
Asphaltic concrete 0.08  FILL: Brown silty sand with gravel		AU	1			0-	100.12		
1.37		ss	2	67	58	1-	-99.12		
Grey <b>SILTY CLAY</b>		ss	3	83	3	2-	-98.12		
GLACIAL TILL: Loose, grey silty clay with sand, gravel, cobbles and boulders		ss	4	75	7				
3 66		ss	5	29	10	3-	97.12		
End of Borehole	^ ^								
(GWL @ 1.69m - March 5, 2019)									
								20 40 60 80 100  Shear Strength (kPa)  ▲ Undisturbed △ Remoulded	

**SOIL PROFILE AND TEST DATA** 

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

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

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

**PG4834** 

FILE NO.

**DATUM** 

**REMARKS** 

BORINGS BY CME 55 Power Auger				D	ATE	February	25, 2019	HOLE NO. BH 8
SOIL DESCRIPTION				DEPTH (m)	ELEV. (m)	Pen. Resist. Blows/0.3m  ■ 50 mm Dia. Cone		
	STRATA PLOT	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(,,,,	(111)	● 50 mm Dia. Cone  ○ Water Content %  20 40 60 80
GROUND SURFACE		2	ų –	88	z °	0-	-100.64	20 40 60 80 🗓
Asphaltic concrete 0.08  FILL: Brown silty sand with gravel		& AU	1			0	100.01	
1.37		∑ss -	2	50	50+	1-	-99.64	
		ss	3	33	9	2-	-98.64	
		ss	4	46	9	3-	-97.64	
GLACIAL TILL: Loose to compact, brown silty clay with sand and gravel		ss	5	75	8			
		ss	6	50	11	4-	-96.64	
		ss	7	33	5	5-	-95.64	
		ss 7	8	29	13	6-	-94.64	
6.70 End of Borehole		ss	9	83	2			
(GWL @ 1.75m - March 5, 2019)								
								20 40 60 80 100  Shear Strength (kPa)  ▲ Undisturbed △ Remoulded

SOIL PROFILE AND TEST DATA

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

154 Colonnade Road South, Ottawa, Ontario K2E 7J5

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

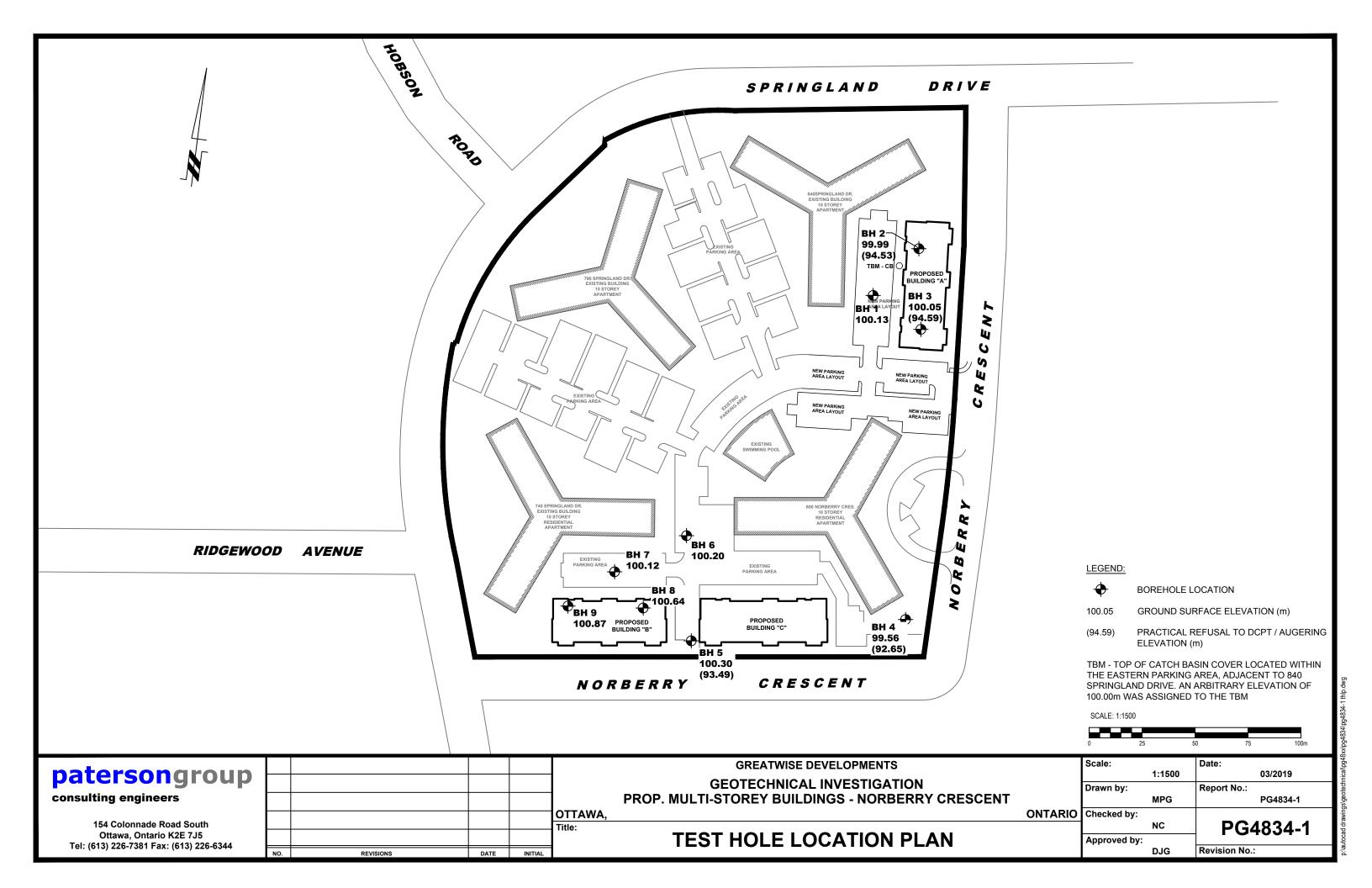
FILE NO. PG4834

HOLE NO.

**DATUM** 

**REMARKS** 

BORINGS BY CME 55 Power Auger					DATE	February	25, 2019	HOLE NO. BH 9	)
SOIL DESCRIPTION	PLOT		SAN	/IPLE		DEPTH ELEV.		Pen. Resist. Blows/0.3	
GROUND SURFACE	STRATA P	TYPE	NUMBER	% RECOVERY	N VALUE or RQD	(m)	(m)	O Water Content %	<u>6</u>
Asphaltic concrete 0.0	2 ******	<b>×</b>		-		0-	-100.87	20 40 60 80	
FILL: Brown silty sand with gravel		AU	1						
<u>1.3</u>	7	X ss	2		50+	1-	-99.87		<u> </u>
		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				
		ss	6	33	6	4-	-96.87		
		ss	7	50	7	5-	-95.87		
	\^^^^	ss	8	21	3	6-	-94.87		
6. <u>7</u> End of Borehole	) ,^,^,^, , ,^,^,^,	ss	9	50	7				
(GWL @ 1.30m - March 5, 2019)									
								20 40 60 80 Shear Strength (kPa)  ▲ Undisturbed △ Remould	



### SERVICING AND STORMWATER MANAGEMENT REPORT - NORBERRY RESIDENCES - 740 SPRINGLAND DRIVE

### Appendix E DRAWINGS

