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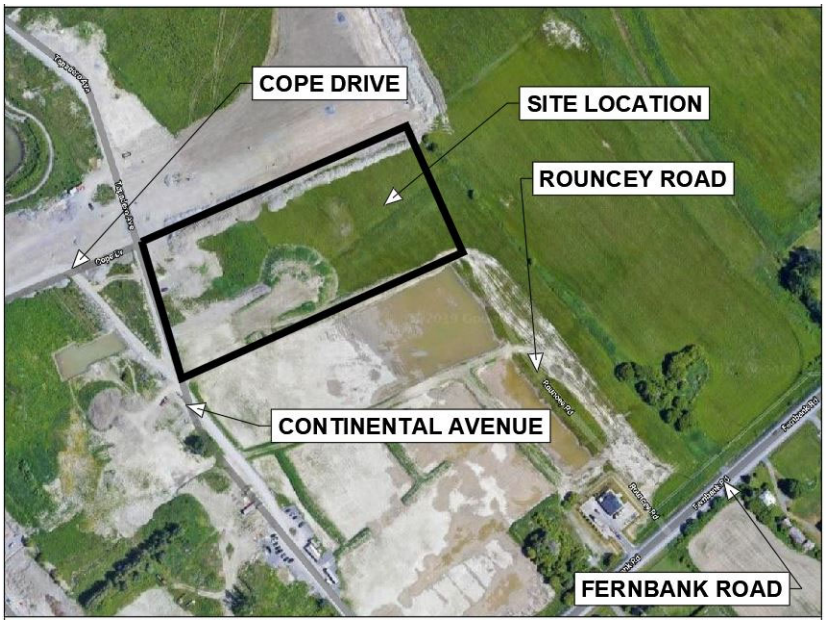
Project No. 19-5070A

Stormwater Management Report

Fernbank Elementary School

480 Cope Drive, Ottawa, Ontario



Revision 1

Prepared for

City of Ottawa
Infrastructure Services and Community Sustainability
110 Laurier Ave. West, 4th floor, Mail Code 01-14
Ottawa, Ontario, K1P 1J1

February 18, 2020

Table of Contents

1 Introduction

Jp2g Consultants Inc. was retained by N45 Architecture Inc. to complete a Stormwater Management Report suitable for City of Ottawa Site Plan Control Application, for the Ottawa Carleton District School Board's proposed Elementary School and Daycare Addition at Cope Drive and Rouncey Road, in the City of Ottawa. The total site area is approximately 2.84 ha and the proposed site development area includes the construction of a 360 m^2 one-storey day-care building, associated parking areas, play area, and landscaped areas. A pre-Consultation meeting was held with City of Ottawa staff on August 23, 2019, to determine the project constraints and requirements. The following report details the stormwater management calculations used for water quantity and quality control in accordance with the City of Ottawa's requirements.

Reference Drawings: SD1 – Stormwater Management Sub-Drainage Areas, C02 – Servicing Tables, C03 - Site Servicing Plan (November 28, 2019), and C04 - Site Grading and Drainage, Erosion and Sediment Control Plan (November 28, 2019).

2 Objective

The objective of the stormwater management plan is to control post-development peak flows to pre-determined levels, and detain onsite, stormwater up to and including the 100-year storm event without affecting adjacent lands. Stormwater quality control will be provided by the downstream pond 6, no onsite quality control is required.

3 Design Parameters

Stormwater management criteria for this site, in terms of quantity control, is based on the following approved reports:

- Servicing and Stormwater Management Report – Blackstone Community Phase 4-8 by Stantec, April 11, 2019.

The maximum allowable release rate for this site shall not exceed the criteria set in the approved servicing report. Flows in excess of the allowable release rate up to and including the 100-year event will be detained onsite.

The Modified Rational Method (Q = 2.78CiA) was chosen to calculate the post-development release rates, and onsite storage requirements for this development. Detailed stormwater management calculations are included in **Appendix B**. All proposed storm sewers were assigned a Manning's coefficient of roughness of 0.013 corresponding to smooth wall pipes. In accordance with City of Ottawa Sewer Design Guidelines (Section 5.4.5.2.1), the coefficients used for calculating the post-development release rate were C = 0.25 for grassed areas and C = 0.90 for hard surfaced areas including rooftops. The rainfall intensities used in this analysis are based on the IDF curves and equations, as per City of Ottawa Sewer Design Guidelines (Section 5.4.2).

4 Water Quantity Controls

4.1 Pre-Development Conditions

The existing site is an undeveloped parcel with a generally flat site topography that is sloped toward the east side of the property with an approximate elevation difference of 0.5 meter over approximately a 220-meter length. The proposed day-care facility will be constructed at the same time as the main school building. Services have been installed along Rouncey Road, as part of the development of the Blackstone Community Phase 4-8.

4.2 Allowable Release Rate

The stormwater management design criteria for this site is based on the subdivision servicing report as noted above. According to the Stantec study, the school site has an allowable release rate up to the 5 year-event of **575.7 L/s**. Refer to **Appendix A** – Background excerpts – Storm Water Management. Minimum storage requirement was set to **50 m3 / ha** per the Subdivision study.

4.3 Post-Development Conditions

Proposed site grading and drainage of the overall site was designed such that stormwater runoff will be collected by the roof and a new storm water collection system which will be connected to the existing 1200mm diameter municipal storm sewer on Rouncey Road and discharged to Pond 6 of the subdivision.

The storm sewer system consists of manholes, catchbasins, storm sewers, perforated subdrain system in landscaped area of the sportsfield. Predominantly, drainage areas are piped to the storm system except for areas fronting onto Cope Drive, the bus layby and a portion of the paved basketball court area. This last area is uncontrolled to permit the unrestricted flow from the building storm sewer and prevent backup to the building.

No surface ponding will occur during the 5-year event. Flows exceeding the allowable release rate up to the 100-year event are to be detained on site.

The overall site development area is approximately **2.84 ha** and has a post-development average weighted runoff coefficient of **C=0.59**, and **C=0.64** for the maximum and 100-year events, respectively. Overall onsite storage requirement was calculated to be **190 m^3** for the 100-year event, which exceeds the minimum storage requirement of 50m^3/ha.

4.4 Onsite Stormwater Detention

Stormwater detention is proposed on the school roof, in the proposed parking area, in the paved school yard as well as along the sportsfield swale.

Flows from the roof area, parking area and grassed areas will be controlled individually in order to provide less restricted flow path. The maximum allowable ponding depth will be limited to 250mm for paved areas and 300mm in grassed areas during 100-year events. Flow control is proposed at manholes CBMH5 and CBMH7.

Flow at CBMH5 serving the parking and paved areas will be limited to 300 L/s. The maximum ponding elevation in the parking area is 100.85 which is below the building finished floor elevation of 101.25. The flows from the parking areas will be restricted at CBMH5 by installing an orifice plate with a discharge rate of **300.0 L/s** at an estimated head of **2.05 m**. The orifice plate is shown on Drawing C006. The maximum head of water is dictated by the overland overflow elevation of 103.46m. The invert of the outlet pipe is 98.64.

The orifice plate was sized using the orifice equation:

$Q = 0.61 \times A \times (2 \times g \times H)^{\wedge 0.5}$, where Q is the discharge rate in m^3/s
Orifice coefficient = 0.61
G= gravitational constant = 9.81 m^2/s
H = head of water (m) above the centre of the orifice = (100.85 – 98.64) – (0.5 x orifice diameter)

The orifice of 314mm provides the required flow

$Q= 0.61 \times A \times (2 \times g \times H)^{0.5} = 0.61 \times (\pi \times (0.314/2)^2) \times (2 \times 9.81 \times (2.21 – (0.5 \times 0.314))^{0.5} = 0.300\ m^3/s$

Flow from the sportsfield and grassed areas will be restricted at CBMH7 by installing an orifice plate with a discharge rate corresponding to the 5-year event of **60 L/s by** at an estimated head of **1.93 m**. The orifice plate is shown on Drawing C006. The maximum head of water is dictated by the overland overflow elevation of 100.76m. The invert of the outlet pipe is 98.90.

The orifice plate was sized using the orifice equation:

$Q = 0.61 \times A \times (2 \times g \times H)^{\wedge 0.5}$, where Q is the discharge rate in m^3/s
Orifice coefficient = 0.61
G= gravitational constant = 9.81 m^2/s
H = head of water (m) above the centre of the orifice = (100.76 – 98.90) – (0.5 x orifice diameter)

The orifice of 145mm provides the required flow

$Q= 0.61 \times A \times (2 \times g \times H)^{0.5} = 0.61 \times (\pi \times (0.145/2)^2) \times (2 \times 9.81 \times (1.86 – (0.5 \times 0.145))^{0.5} = 0.060 m^3/s$

Flow from the combined school and daycare roof will also be detained on the roof by installing parabolic weirs, (Watts Drainage Adjustable Flow Control for Roof Drains, or equivalent approved products), at the 29 proposed roof drains limiting the flow from the roof to **18.3 L/s**. The resulting required storage is **153 m^3** for the 100-year event. Based on a maximum ponding depth of 150mm on the roof, the total available storage is approximately **194 m^3**, which is sufficient to accommodate the 100-year event. Each flow control roof drain, complete with a single slot parabolic weir, will restrict flow at 5 GPM (0.32 L/s) per inch (25.4mm) of head to a maximum of 10 GPM (0.63 L/s). The restricted flow will outlet to the school's 300mm diameter storm sewer service at 4.0% slope downstream of any flow restriction.

The following table summarizes on-site requirements during the 100-year event:

Total Area	Controlled / Uncontrolled	Run-off Coefficient		Outlet Location	Total Storage Provided (m^3)	Flow (L/s)	Required Storage (cu.m.)
		5 year	100 year			100-year event	
2.364	Controlled	0.59	0.64		343	378.3	190
0.480		0.54	0.58	Cope Drive & Rouncey Road ROW		138.6	
2.844					343	516.9	190

Note that storage within the subdrain clearstone trench was not included within the available storage volume. There is sufficient available ponding to accommodate the 100-year event.

The maximum ponding limits are indicated on **SD1**. In the event of a rainfall exceeding the 100-year event, runoff will remain on-site until ponding reaches the overspill elevation. In such event, the school yard and sport field major overland flow route will overflow towards Rouncey Drive and the parking area will overflow to Continental Avenue. The grade elevation at the overflow point is **0.30 m** below the school's finished floor elevation.

4.5 Proposed Release Rates

The proposed release rate for this site during the 100-year event, including uncontrolled flows (**138.6 L/s**) and controlled flows into the minor system of **378.3 L/s**. Therefore, proposed release rates are within the allowable release rate for this site, determined to be **575.7 L/s** in Section 4.2.

5 Erosion and Sediment Control

In accordance with City of Ottawa requirements, best management practices are to be implemented by the Contractor to provide protection of the area drainage system and the receiving water course, during construction activities. This includes limiting the amount of exposed soil, using filter bag inserts under the grates of catch basins and manholes, installing silt fences and other effective sediment traps, and installing and maintaining mud mats for outgoing construction traffic during construction activities.

6 Conclusion

The proposed site development includes a new school building with an attached daycare, a bus lay-by, asphalt parking, hard surface walkways and play areas, landscaped areas, a sports field and an area for portables. Roof drainage and surface runoff will be collected by a new storm sewer system which will be connected to the existing 1200mm diameter municipal storm sewer located on Rouncey Road. Post-development peak flows will be detained on the roof, in the parking area, in the school yard and in the bus lay-by in order to limit the post-development release rate to allowable levels. There is sufficient onsite storage to accommodate the 100-year event.

Summary of report

ID	Description	Value/result
01	Allowable release rate	$Q_{allowable}$ = 575.7 L/s
02	Proposed release rate	$Q_{100\text{-yr post}}$ = 516.9 L/s
03	Post-development runoff coefficient	$C_{5\text{-yr post}}$ = 0.58, $C_{100\text{-yr post}}$ = 0.63
04	Post-development onsite storage requirement	190 m^3
05	Proposed onsite storage	Parking lot and school yard: 190 m^3, Roof: 153m^3, Sportsfield: 6 m^3
06	Discharge outlet location	1200mmϕ storm sewer on Rouncey Road to Pond 6
07	Emergency runoff overflow locations	West side – curb cut in parking area towards Continental Avenue East side – from school yard to layby towards Rouncey Road

END OF REPORT

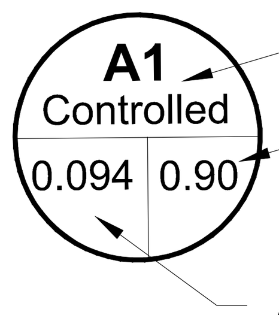
Prepared by:

Barbra Kimmerle, P.Eng.
Civil Engineer

PONDING TABLE

POND NO.	LOCATION	POND ELEV. (m)	TOP OF CB ELEV. (m)	POND DEPTH (m)	POND VOL. (m^3)
P1	CB1	100.85	100.60	0.25	37.93
P2	CB2	100.85	100.67	0.18	15.42
P3	CBMH1	100.85	100.70	0.15	13.81
P4	CBMH2	100.85	100.72	0.13	24.81
P5	CBMH3	100.85	100.65	0.20	15.98
P6	RYCB1	100.85	100.59	0.26	3.44
P7	CBMH4	100.85	100.62	0.18	30.60
P8	CBMH5	100.85	100.60	0.25	41.66
P9	TCB12	100.76	100.71	0.06	0.38
P10	TCB13	100.76	100.76	0.10	1.00
P11	CBMH7	100.76	100.61	0.15	4.58
P12	ROOF			0.12	153.01
				Total=	342.62

NOTE: PONDING VOLUME CALCULATED BY MULTIPLYING THE PONDING AREA BY THE MAXIMUM PONDING DEPTH AND DIVIDING BY 3 FOR A CONICAL POND



AREA ID

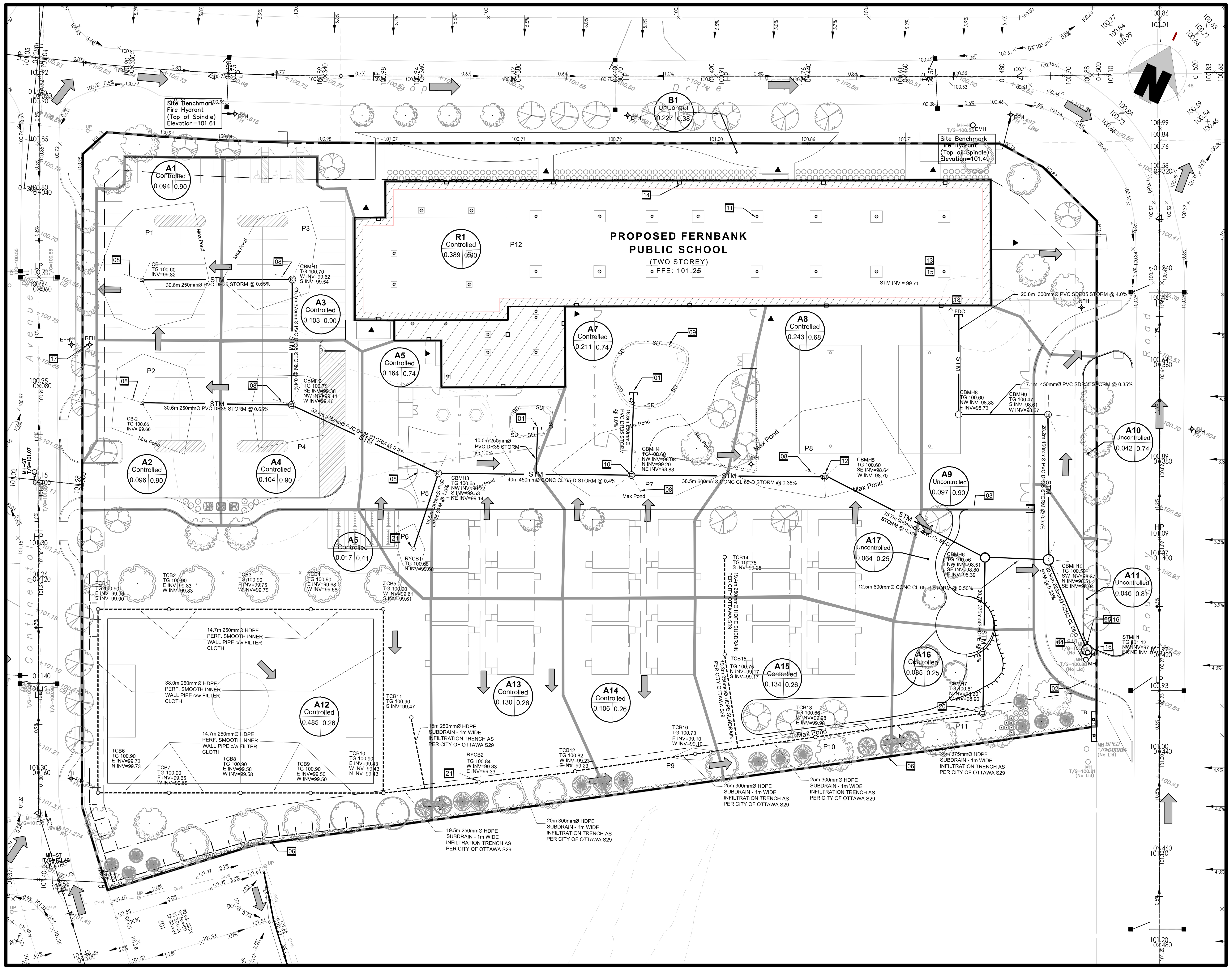
RUNOFF COEFFICIENT

AREA (ha)

PROPOSED DRAINAGE AREA BOUNDARY

PROPOSED BUILDING

MAJOR OVERLAND FLOW ROUTE



OTTAWA-CARLETON DISTRICT SCHOOL BOARD

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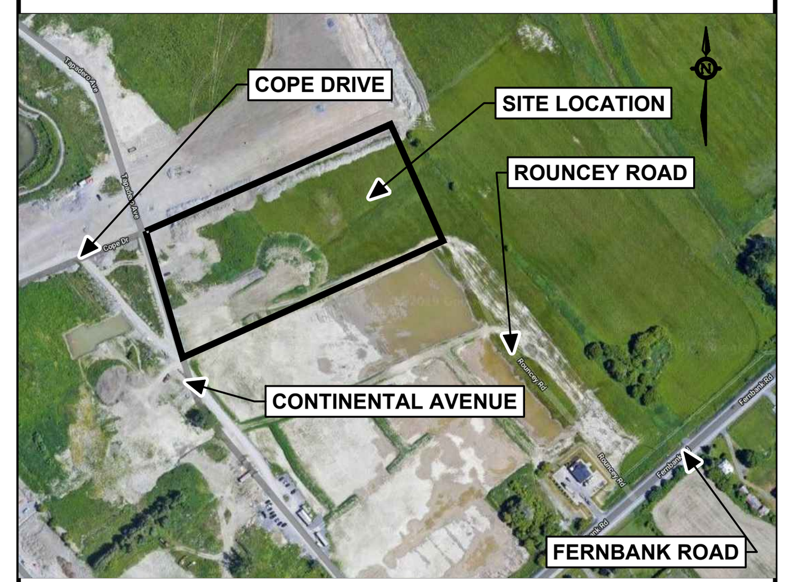

No.	DESCRIPTION	YYYY-MM-DD
3	REVISED PER CITY COMMENTS	2020-02-18
2	ISSUED FOR BUILDING PERMIT	2019-12-19
1	ISSUED FOR SITE PLAN CONTROL	2019-11-28

N45 ARCHITECTURE INC.
43 Eccles Street, 2nd Floor - Ottawa, Ontario, K1R 6S3
tel. 613.224.0095 fax 613.224.9811

project

FERNBANK ELEMENTARY SCHOOL

480 COPE DRIVE, OTTAWA, ONTARIO

seal

drawing title

STORM DRAINAGE PLAN

scale 1:500	drawn by M.S.
date DEC 2019	checked by B.K.
project number	drawing number SD1

CONTRACTOR TO VERIFY ALL DIMENSIONS AND NOTIFY THE ARCHITECT OF ANY DISCREPANCIES BEFORE WORK COMMENCES.

DO NOT SCALE DRAWINGS.

revision

D07-12-19-0200

#18083

Appendix A - Background Excerpts
Stormwater Management

Stantec

Blackstone Phases 4-8

DATE: 2019-04-15
REVISION: 4
DESIGNED BY: DT
CHECKED BY: SG

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401130

DESIGN PARAMETERS

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

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

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

LOCATION			DRAINAGE AREA																					PIPE SELECTION										
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	A x C (2-YEAR) (ha)	ACCUM. AxC (2YR) (ha)	A x C (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	A x C (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	A x C (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$i_{2\text{-YEAR}}$ (mm/h)	$i_{5\text{-YEAR}}$ (mm/h)	$i_{10\text{-YEAR}}$ (mm/h)	$i_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETE (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
Fernbank Crossing P1-4	301	M97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	6451.8	6451.8	6451.8	78.3	1950	1950	CIRCULAR	CONCRETE	-	0.30	8131.0	**79.35%**	2.64	2.60	0.50
LM97A, CM97A	M97	M98	0.67	0.41	0.00	0.00	0.00	0.45	0.70	0.00	0.00	0.303	0.303	0.284	0.284	0.000	0.000	0.000	0.000	10.50	74.93	101.61	119.10	174.09	0.0	6451.8	6594.9	78.0	2100	2100	CIRCULAR	CONCRETE	-	0.20	8089.5	**81.52%**	2.26	2.24	0.58
																				11.08																		
F2006A	2048	2005A	0.00	0.00	0.00	1.35	0.00	0.00	0.00	0.00	0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.541	0.541	10.00	76.81	104.19	122.14	178.56	0.0	0.0	268.3	12.9	525	525	CIRCULAR	CONCRETE	-	0.50	317.2	**84.57%**	1.42	1.42	0.15
																				10.15																		
C2009A, C2009B	2009	2008	0.00	0.34	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.000	0.238	0.238	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	68.8	64.5	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**51.75%**	0.81	0.70	1.54
C2008A	2008	2007	0.00	0.21	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.000	0.150	0.388	0.000	0.000	0.000	0.000	11.54	71.37	96.72	113.34	165.63	0.0	0.0	104.3	64.5	600	600	CIRCULAR	CONCRETE	-	0.20	286.5	**36.41%**	0.98	0.76	1.41
L2007A	2007	2006	0.56	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.219	0.219	0.000	0.388	0.000	0.000	0.000	0.000	12.95	67.08	90.84	106.42	155.47	0.0	0.0	138.8	49.4	750	750	CIRCULAR	CONCRETE	-	0.15	449.8	**30.85%**	0.99	0.73	1.13
C2006A, C2006B	2006	2005A	0.00	0.55	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.219	0.385	0.774	0.000	0.000	0.000	0.000	14.07	64.04	86.67	101.52	148.27	0.0	0.0	225.2	70.3	900	900	CIRCULAR	CONCRETE	-	0.10	597.2	**37.71%**	0.91	0.72	1.64
																				15.71																		
	2005A	2005	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.219	0.000	0.774	0.000	0.000	0.000	0.541	15.71	60.14	81.33	95.23	139.05	0.0	0.0	420.3	22.9	900	900	CIRCULAR	CONCRETE	-	0.10	597.2	**70.37%**	0.91	0.86	0.44
																				16.15																		
C2049A	2049	2005	0.00	2.84	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.000	1.989	1.989	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	575.7	13.0	825	825	CIRCULAR	CONCRETE	-	0.25	748.8	**76.89%**	1.36	1.32	0.16
																				10.16																		
C2005A	2005	2004	0.00	0.38	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.219	0.265	3.028	0.000	0.000	0.000	0.541	16.15	59.17	80.01	93.68	136.77	0.0	0.0	914.4	120.0	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**71.09%**	1.10	1.05	1.91
C2004A, C2004B	2004	2003	0.00	0.63	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.219	0.444	3.471	0.000	0.000	0.000	0.541	18.07	55.37	74.80	87.56	127.80	0.0	0.0	947.0	119.0	1350	1350	CIRCULAR	CONCRETE	-	0.10	1760.8	**53.78%**	1.19	1.04	1.91
	2003	2002	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.219	0.000	3.471	0.000	0.000	0.000	0.541	19.98	52.07	70.30	82.27	120.04	0.0	0.0	889.9	55.9	1350	1350	CIRCULAR	CONCRETE	-	0.10	1760.8	**50.54%**	1.19	1.02	0.92
C2002A	2002	2001	0.00	0.30	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.219	0.209	3.680	0.000	0.000	0.000	0.541	20.89	50.64	68.35	79.98	116.68	0.0	0.0	904.8	56.7	1350	1350	CIRCULAR	CONCRETE	-	0.10	1760.8	**51.39%**	1.19	1.03	0.92
																				21.81																		
L2047A	2047	2046	0.31	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.219	0.219	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	46.7	73.3	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**35.13%**	0.81	0.62	1.96
L2046A	2046	2045	0.49	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.00	0.347	0.566	0.000	0.000	0.000	0.000	0.000	0.000	11.96	70.01	94.86	111.15	162.42	0.0	0.0	110.1	44.9	525	525	CIRCULAR	CONCRETE	-	0.15	173.8	**63.34%**	0.78	0.71	1.05
	2045	2044	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.566	0.000	0.000	0.000	0.000	0.000	0.000	13.01	66.89	90.58	106.12	155.02	0.0	0.0	105.2	44.6	525	525	CIRCULAR	CONCRETE	-	0.15	173.8	**60.52%**	0.78	0.71	1.05
L2044B, L2044C, L2044A	2044	2001	1.20	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.587	1.153	0.000	0.000	0.000	0.000	0.000	0.000	14.07	64.06	86.70	101.55	148.32	0.0	0.0	205.1	44.5	675	675	CIRCULAR	CONCRETE	-	0.15	339.6	**60.40%**	0.92	0.84	0.89
																				14.95																		
L2027B, L2027A	2027	2026	0.79	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.465	0.465	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	99.2	128.6	450	450	CIRCULAR	CONCRETE	-	0.25	148.7	**66.69%**	0.91	0.85	2.53
L2026A	2026	2017	0.34	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.236	0.701	0.000	0.000	0.000	0.000	0.000	0.000	12.53	68.30	92.50	108.38	158.34	0.0	0.0	132.9	105.3	525	525	CIRCULAR	CONCRETE	-	0.20	200.6	**66.25%**	0.90	0.83	2.10
L2017B, L2017A	2017	2015	0.50	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.350	1.051	0.000	0.000	0.000	0.000	0.000	0.000	14.63	62.66	84.77	99.28	144.99	0.0	0.0	182.9	89.5	600	600	CIRCULAR	CONCRETE	-	0.20	286.5	**63.83%**	0.98	0.91	1.65
																				16.28																		
L2016A, L2016B	2016	2015	0.18	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.088	0.088	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	18.9	38.3	300	300	CIRCULAR	PVC	-	0.65	77.5	**24.33%**	1.10	0.76	0.84
																				10.84																		
L2015A	2015	2014	0.27	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.192	1.332	0.000	0.000	0.000	0.000	0.000	0.000	16.28	58.91	79.65	93.26	136.15	0.0	0.0	217.9	91.3	675	675	CIRCULAR	CONCRETE	-	0.40	554.6	**39.29%**	1.50	1.19	1.27
	2014	2013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1.332	0.000	0.000	0.000	0.000	0.000	0.000	17.55	56.34	76.13	89.12	130.08	0.0	0.0	208.4	15.8	675	675	CIRCULAR	CONCRETE	-	0.40	554.6	**37.57%**	1.50	1.18	0.22
L2013A	2013	2012	0.51	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.357	1.689	0.000	0.000	0.000	0.000	0.000	0.000	17.77	55.91	75.55	88.44	129.08	0.0	0.0	262.3	95.7	675	675	CIRCULAR	CONCRETE	-	0.40	554.6	**47.30%**	1.50	1.26	1.27
	2012	2011	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	1.689	0.000	0.000	0.000	0.000	0.000	0.000	19.04	53.63	72.43	84.77	123.70	0.0	0.0	251.6	41.4	675	675	CIRCULAR	CONCRETE	-	0.40	554.6	**45.37%**	1.50	1.25	0.55
L2011A	2011	2010	0.55	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.382	2.071	0.000	0.000	0.000	0.000	0.000	0.000	19.59	52.69	71.15	83.27	121.51	0.0	0.0	303.1	42.1	825	825	CIRCULAR	CONCRETE	-	0.15	580.0	**52.26%**	1.05	0.91	0.77
																				20.37																		
L2042A	2042	2041	0.32	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.235	0.235	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	50.2	70.8	300	300	CIRCULAR	PVC	-	0.65	77.5	**64.78%**	1.10	1.02	1.16
L2041A	2041	2040	0.20	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.150	0.386	0.000	0.000	0.000	0.000	0.000	0.000	11.16	72.61	98.43	115.36	168.59	0.0	0.0	77.8	83.1	375	375	CIRCULAR	PVC	-	0.65	132.9	**58.51%**	1.26	1.13	1.23
																				12.39																		
L2043B, L2043A	2043	2040	0.34	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.251	0.251	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	53.6	107.2	300	300	CIRCULAR	PVC	-	0.65	77.5	**69.08%**	1.10	1.04	1.72
																				11.72																		
L2040A	2040	2036	0.08	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.045	0.682	0.000	0.000	0.000	0.000	0.000	0.000	12.39	68.70	93.06	109.03	159.30	0.0	0.0	130.2	48.3	525	525	CIRCULAR	CONCRETE	-	0.15	173.8	**74.90%**	0.78	0.75	1.07
																				13.46																		
L2039B, L2039A	2039	2036	0.49	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.366	0.366	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	78.0	105.7	375	375	CIRCULAR	PVC	-	0.40	104.3	**74.80%**	0.99	0.96	1.84
																				11.84																		
L2038A	2038	2037	0.35	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.257	0.257	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	54.9	69.9	300	300	CIRCULAR	PVC	-	0.65	77.5	**70.85%**	1.10	1.05	1.11
L2037A	2037	2036	0.36	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.265	0.522	0.000	0.000	0.000	0.000	0.000	0.000	11.11	72.78	98.66	115.62	168.98	0.0	0.0	105.6	83.4	450	450	CIRCULAR	PVC	-	0.75	257.6	**41.01%**	1.57	1.26	1.10
																				12.21																		
L2036A	2036	2032	0.07	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.038	1.608	0.000	0.000	0.000	0.000	0.000	0.000	13.46	65.66	88.89	104.12	152.09	0.0	0.0	293.3	44.0	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**61.93%**	0.86	0.79	0.93
																				14.39																		
	2035	2034	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	85.0	300	300	CIRCULAR	PVC	-	0.40	60.8	**0.00%**	0.86	0.00	0.00
	2034	2033	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	0.0	11.7	300	300	CIRCULAR	PVC	-	0.40	60.8	**0.00%**	0.86	0.00	0.00
L2033A, L2033B	2033	2032	0.73	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.539	0.539	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	115.0	113.4	450	450	CIRCULAR	CONCRETE	-	0.25	148.7	**77.30%**	0.91	0.88	2.14
																				12.14																		
L2032A, L2032B	2032	2029	0.73	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.371	2.518	0.000	0.000	0.000	0.000	0.000	0.000	14.39	63.24	85.57	100.22	146.37	0.0	0.0	442.3	82.0	900	900	CIRCULAR	CONCRETE	-	0.15	731.4	**60.47%**	1.11	1.01	1.35
																				15.74																		
L2031A, L2031B	2031	2030	0.43	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.300	0.300	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	64.0	82.0	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**48.10%**	0.81	0.69	1.99
L2030B, L2030A	2030	2029	0.35	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.214	0.514	0.000	0.000	0.000	0.000	0.000	0.000	11.99	69.92	94.74	111.00	162.20	0.0	0.0	99.7	102.4	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**21.06%**	0.86	0.57	3.02
																				15.01																		
L2029A, L2029B	2029	2028	1.30	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.674	3.705	0.000	0.000	0.000	0.000	0.000	0.000	15.74	60.06	81.23	95.11	138.87	0.0	0.0	618.2	111.7	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**48.07%**	1.10	0.93	1.99
																				17.74																		
L2021A, L2021B	2021	2020	0.81	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.419	0.419	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	89.3	9.7	375	375	CIRCULAR	PVC	-	0.65	132.9	**67.23%**	1.26	1.18	0.14
	2020	2019	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.419	0.000	0.000	0.000	0.000	0.000	0.000	10.14	76.29	103.48	121.30	177.32	0.0	0.0	88.7	35.9	450	450	CIRCULAR	CONCRETE	-	0.20	133.0	**66.71%**	0.81	0.76	0.79
																				10.92																		
L2026B	2026	2025	0.16	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.110	0.110	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	23.5	75.3	300	300	CIRCULAR	PVC	-	0.50	68.0	**34.62%**	0.97	0.74	1.69
	2025	2024	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.110	0.000	0.000	0.000	0.000	0.000	0.000	11.69	70.87	96.04	112.54	164.46	0.0	0.0	21.7	9.6	300	300	CIRCULAR	PVC	-	0.50	68.0	**31.95%**	0.97	0.72	0.22
L2024A, L2024B	2024	2023	0.57	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.400	0.510	0.000	0.000	0.000	0.000	0.000	0.000	11.91	70.17	95.08	111.41	162.80	0.0	0.0	99.4	89.0	600	600	CIRCULAR	CONCRETE	-	0.20	286.5	**34.71%**	0.98	0.75	1.97
L2023A	2023	2022	0.35	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.245	0.755	0.000	0.000	0.000	0.000	0.000	0.000	13.88	64.55	87.37	102.34	149.48	0.0	0.0	135.5	76.1	675	675	CIRCULAR	CONCRETE	-	0.15	339.6	**39.88%**	0.92	0.73	1.73
	2022	2019	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.755	0.000	0.000	0.000	0.000	0.000	0.000	15.61	60.36	81.63	95.59	139.58	0.0	0.0	126.7	12.2	675	675	CIRCULAR	CONCRETE	-	0.15	339.6	**37.30%**	0.92	0.71	0.29
																				15.90																		
L2019A, L2019B	2019	2028	0.64	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.360	1.534	0.000	0.000	0.000	0.000	0.000	0.000	15.90	59.73	80.77	94.57	138.08	0.0	0.0	254.6	81.3	825	825	CIRCULAR	CONCRETE	-	0.10	473.6	**53.76%**	0.86	0.75	1.81
																				17.71																		
	2028	2018	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	5.240	0.000	0.000	0.000	0.000	0.000	0.000	17.74	55.98	75.64	88.54	129.24	0.0	0.0	814.7	11.0	1200	1200	CIRCULAR	CONCRETE	-	0.10	1286.2	**63.34%**	1.10	1.01	0.18
L2018A, L2018B	2018	2010	0.71	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.346	5.585	0.000	0.000	0.000	0.000	0.000	0.000	17.92	55.64	75.17	88.00	128.43	0.0	0.0	863.2	71.4	1350	1350	CIRCULAR	CONCRETE	-	0.10	1760.8	**49.02%**	1.19	1.01	1.18
																				19.10																		
L2010A, L2010B	2010	2001	0.48	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.234	7.890	0.000	0.000	0.000	0.000	0.000	0.000	20.37	51.45	69.45	81.27	118.58	0.0	0.0	1127.6	88.2	1350	1350	CIRCULAR	CONCRETE	-	0.10	1760.8	**64.04%**	1.19	1.10	1.34

Stantec

Blackstone Phases 4-8

DATE: 2019-04-15
REVISION: 4
DESIGNED BY: DT
CHECKED BY: SG

STORM SEWER DESIGN SHEET
(City of Ottawa)

FILE NUMBER: 160401130

DESIGN PARAMETERS

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

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

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

LOCATION			DRAINAGE AREA																				PIPE SELECTION										
AREA ID NUMBER	FROM M.H.	TO M.H.	AREA (2-YEAR) (ha)	AREA (5-YEAR) (ha)	AREA (10-YEAR) (ha)	AREA (100-YEAR) (ha)	AREA (ROOF) (ha)	C (2-YEAR) (-)	C (5-YEAR) (-)	C (10-YEAR) (-)	C (100-YEAR) (-)	AxC (2-YEAR) (ha)	ACCUM. AxC (2YR) (ha)	AxC (5-YEAR) (ha)	ACCUM. AxC (5YR) (ha)	AxC (10-YEAR) (ha)	ACCUM. AxC (10YR) (ha)	AxC (100-YEAR) (ha)	ACCUM. AxC (100YR) (ha)	T of C (min)	$I_{2\text{-YEAR}}$ (mm/h)	$I_{5\text{-YEAR}}$ (mm/h)	$I_{10\text{-YEAR}}$ (mm/h)	$I_{100\text{-YEAR}}$ (mm/h)	$Q_{CONTROL}$ (L/s)	ACCUM. $Q_{CONTROL}$ (L/s)	Q_{ACT} (CIA/360) (L/s)	LENGTH (m)	PIPE WIDTH OR DIAMETE (mm)	PIPE HEIGHT (mm)	PIPE SHAPE (-)	MATERIAL (-)	CLASS (-)	SLOPE %	Q_{CAP} (FULL) (L/s)	% FULL (-)	VEL. (FULL) (m/s)	VEL. (ACT) (m/s)	TIME OF FLOW (min)
																				21.71																					
C2001A	2001	2000	0.00	0.41	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.000	9.262	0.294	3.974	0.000	0.000	0.000	0.541	21.81	49.29	66.51	77.82	113.51	0.0	0.0	2172.9	55.7	1800	1800	CIRCULAR	CONCRETE	-	0.10	3792.1	**57.30%**	1.44	1.29	0.72
C2000A	2000	M98	0.00	0.56	0.00	0.00	0.00	0.00	0.71	0.00	0.00	0.000	9.262	0.396	4.371	0.000	0.000	0.000	0.541	22.53	48.29	65.15	76.21	111.16	0.0	0.0	2200.2	79.7	1800	1800	CIRCULAR	CONCRETE	-	0.10	3792.1	**58.02%**	1.44	1.29	1.03
																				23.56																					
	M98	M99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	9.565	0.000	4.654	0.000	0.000	0.000	0.541	23.56	46.93	63.30	74.04	107.98	0.0	6451.8	8679.2	26.9	2400	2400	CIRCULAR	CONCRETE	-	0.15	8420.8	**103.07%**	2.05	2.17	0.21
																				23.77										2400	2400									
L1054A	1054	1052	1.07	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.631	0.631	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	134.7	13.5	525	525	CIRCULAR	CONCRETE	-	0.20	200.6	**67.13%**	0.90	0.84	0.27
C1052A, C1052B	1052	1050	0.00	0.87	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.631	0.609	0.609	0.000	0.000	0.000	0.000	10.27	75.79	102.80	120.50	176.15	0.0	0.0	306.8	111.4	750	750	CIRCULAR	CONCRETE	-	0.15	449.8	**68.20%**	0.99	0.92	2.01
																				12.28																					
L1053B, L1053A	1053	1050	1.48	0.00	0.00	0.00	0.00	0.58	0.00	0.00	0.00	0.852	0.852	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	181.8	42.6	600	600	CIRCULAR	CONCRETE	-	0.15	248.1	**73.26%**	0.85	0.82	0.87
																				10.87																					
L1051B, C1051A	1051	1050	0.49	0.18	0.00	0.00	0.00	0.47	0.71	0.00	0.00	0.230	0.230	0.127	0.127	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	85.8	58.5	375	375	CIRCULAR	PVC	-	0.65	132.9	**64.60%**	1.26	1.16	0.84
																				10.84																					
L1050B	1050	1049	0.17	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.080	1.794	0.000	0.736	0.000	0.000	0.000	0.000	12.28	69.04	93.52	109.58	160.10	0.0	0.0	535.1	70.0	900	900	CIRCULAR	CONCRETE	-	0.15	731.4	**73.16%**	1.11	1.07	1.09
																				13.37										900	900									
C1009A	1009	1008	0.00	0.50	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.000	0.000	0.361	0.361	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	104.5	53.6	375	375	CIRCULAR	PVC	-	1.00	164.8	**63.38%**	1.56	1.43	0.62
C1008A	1008	1007	0.00	0.64	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.000	0.000	0.462	0.823	0.000	0.000	0.000	0.000	10.62	74.49	101.01	118.39	173.05	0.0	0.0	231.0	110.1	525	525	CIRCULAR	CONCRETE	-	0.80	401.3	**57.56%**	1.80	1.61	1.14
L1007A	1007	1006	0.34	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.158	0.158	0.000	0.823	0.000	0.000	0.000	0.000	11.77	70.63	95.70	112.14	163.87	0.0	0.0	249.9	43.1	600	600	CIRCULAR	CONCRETE	-	0.35	379.0	**65.94%**	1.30	1.21	0.60
																				12.36																					
L1015A	1015	1020	0.11	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.065	0.065	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	13.9	52.8	300	300	CIRCULAR	PVC	-	0.65	77.5	**17.91%**	1.10	0.69	1.27
L1020C, L1020B	1020	1014	0.26	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.148	0.214	0.000	0.000	0.000	0.000	0.000	0.000	11.27	72.24	97.91	114.74	167.69	0.0	0.0	42.8	97.2	375	375	CIRCULAR	PVC	-	0.65	132.9	**32.24%**	1.26	0.94	1.71
																				12.99																					
L1022A	1022	1014	3.14	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	2.197	2.197	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	468.8	15.0	675	675	CIRCULAR	CONCRETE	-	0.50	620.1	**75.60%**	1.68	1.62	0.15
																				10.15																					
	1014	1013	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	2.411	0.000	0.000	0.000	0.000	0.000	0.000	12.99	66.96	90.67	106.22	155.18	0.0	0.0	448.4	69.3	675	675	CIRCULAR	CONCRETE	-	0.65	707.0	**63.43%**	1.91	1.75	0.66
	1013	1012	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	2.411	0.000	0.000	0.000	0.000	0.000	0.000	13.65	65.15	88.20	103.31	150.90	0.0	0.0	436.3	8.9	750	750	CIRCULAR	CONCRETE	-	0.40	734.5	**59.40%**	1.61	1.45	0.10
L1012A	1012	1011	0.15	0.00	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.087	2.498	0.000	0.000	0.000	0.000	0.000	0.000	13.75	64.88	87.82	102.87	150.26	0.0	0.0	450.2	75.8	825	825	CIRCULAR	CONCRETE	-	0.40	947.1	**47.53%**	1.72	1.44	0.88
																				14.63																					
F1021A	1021	1011	0.00	0.00	0.00	0.92	0.00	0.00	0.00	0.00	0.40	0.000	0.000	0.000	0.000	0.000	0.000	0.370	0.370	10.00	76.81	104.19	122.14	178.56	0.0	0.0	183.4	12.5	525	525	CIRCULAR	CONCRETE	-	0.25	224.3	**81.77%**	1.00	0.99	0.21
																				10.21																					
L1011B, L1011A	1011	1010	0.39	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.200	2.697	0.000	0.000	0.000	0.000	0.000	0.370	14.63	62.66	84.78	99.29	145.00	0.0	0.0	618.5	47.2	900	900	CIRCULAR	CONCRETE	-	0.30	1034.4	**59.79%**	1.58	1.42	0.55
																				15.18																					
L1020A	1020	1019	0.27	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.189	0.189	0.000	0.000	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	40.4	44.2	300	300	CIRCULAR	PVC	-	0.65	77.5	**52.13%**	1.10	0.95	0.78
L1019B, L1019C, L1019A	1019	1018	1.11	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.532	0.721	0.000	0.000	0.000	0.000	0.000	0.000	10.78	73.95	100.27	117.52	171.76	0.0	0.0	148.1	108.0	525	525	CIRCULAR	CONCRETE	-	0.45	301.0	**49.21%**	1.35	1.14	1.58
	1018	1017	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	0.721	0.000	0.000	0.000	0.000	0.000	0.000	12.35	68.81	93.21	109.21	159.57	0.0	0.0	137.8	8.8	525	525	CIRCULAR	CONCRETE	-	0.45	301.0	**45.79%**	1.35	1.12	0.13
L1017A	1017	1016	0.35	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.245	0.966	0.000	0.000	0.000	0.000	0.000	0.000	12.48	68.42	92.67	108.58	158.64	0.0	0.0	183.6	104.3	600	600	CIRCULAR	CONCRETE	-	0.45	429.7	**42.73%**	1.47	1.20	1.45
L1016A	1016	1010	0.45	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.315	1.281	0.000	0.000	0.000	0.000	0.000	0.000	13.94	64.40	87.16	102.09	149.11	0.0	0.0	229.1	39.7	675	675	CIRCULAR	CONCRETE	-	0.20	392.2	**58.41%**	1.06	0.95	0.70
																				14.63																					
L1010A, L1010B	1010	1006	0.77	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.337	4.315	0.000	0.000	0.000	0.000	0.000	0.370	15.18	61.34	82.97	97.17	141.89	0.0	0.0	881.0	86.6	1200	1200	CIRCULAR	CONCRETE	-	0.20	1819.0	**48.43%**	1.56	1.32	1.09
																				16.28																					
C1006A	1006	1005	0.00	0.39	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	4.473	0.271	1.094	0.000	0.000	0.000	0.370	16.28	58.91	79.65	93.26	136.15	0.0	0.0	1113.9	61.7	1350	1350	CIRCULAR	CONCRETE	-	0.20	2490.2	**44.73%**	1.69	1.40	0.74
	1005	1004	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	4.473	0.000	1.094	0.000	0.000	0.000	0.370	17.01	57.39	77.58	90.82	132.57	0.0	0.0	1085.1	42.5	1500	1500	CIRCULAR	CONCRETE	-	0.10	2332.0	**46.53%**	1.28	1.07	0.66
	1004	1003	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	4.473	0.000	1.094	0.000	0.000	0.000	0.370	17.67	56.11	75.81	88.75	129.54	0.0	0.0	1060.6	42.5	1650	1650	CIRCULAR	CONCRETE	-	0.10	3006.9	**35.27%**	1.36	1.05	0.68
C1003A	1003	1002	0.00	0.36	0.00	0.00	0.00	0.00	0.65	0.00	0.00	0.000	4.473	0.231	1.325	0.000	0.000	0.000	0.370	18.35	54.85	74.10	86.73	126.58	0.0	0.0	1084.3	43.7	1650	1650	CIRCULAR	CONCRETE	-	0.10	3006.9	**36.06%**	1.36	1.06	0.69
																				19.03																					
C1023A	1023	1002	0.00	7.40	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.000	0.000	5.179	5.179	0.000	0.000	0.000	0.000	10.00	76.81	104.19	122.14	178.56	0.0	0.0	1499.0	21.8	1200	1200	CIRCULAR	CONCRETE	-	0.20	1819.0	**82.41%**	1.56	1.55	0.23
																				10.23																					
	1002	1001	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	4.473	0.000	6.505	0.000	0.000	0.000	0.370	19.03	53.64	72.44	84.79	123.73	0.0	0.0	2102.5	94.7	1650	1650	CIRCULAR	CONCRETE	-	0.10	3006.9	**69.92%**	1.36	1.29	1.22
	1001	1000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	4.473	0.000	6.505	0.000	0.000	0.000	0.370	20.26	51.62	69.70	81.56	118.99	0.0	0.0	2022.9	6.3	1650	1650	CIRCULAR	CONCRETE	-	0.10	3006.9	**67.28%**	1.36	1.28	0.08
																				20.34																					
L1000A	1000	P3	8.33	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	4.912	11.179	0.000	7.240	0.000	0.000	0.000	0.370	20.34	51.50	69.52	81.35	118.69	0.0	0.0	3119.1	43.9	1800	1800	CIRCULAR	CONCRETE	-	0.10	3792.1	**82.25%**	1.44	1.43	0.51
	P3	P2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	11.179	0.000	7.240	0.000	0.000	0.000	0.370	20.85	50.70	68.44	80.09	116.83	0.0	0.0	3071.0	14.0	1800	1800	CIRCULAR	CONCRETE	-	0.10	3792.1	**80.98%**	1.44	1.43	0.16
	P2	P1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	11.179	0.000	7.240	0.000	0.000	0.000	0.370	21.01	50.46	68.11	79.69	116.26	0.0	0.0	3056.0	6.5	1800	1800	CIRCULAR	CONCRETE	-	0.10	3792.1	**80.59%**	1.44	1.42	0.08
																				21.09																					
	P1	HW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.000	11.179	0.000	7.287	0.000	0.000	0.000	0.370	21.09	50.34	67.95	79.51	115.99	0.0	0.0	3057.8	8.4	2100	2100	CIRCULAR	CONCRETE	-	1.00	18088.7	**16.90%**	5.06	3.12	0.05
																				21.13										2100	2100									

Appendix B - Stormwater Management Calculations

Fernbank Elementary School – Cope Drive, Ottawa

Jp2g Consultants Inc.
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B.1.1 - Allowable release rate

Using the criteria for the site from the subdivision Final Serviceability Report Development by Stantec (April 2019), the maximum allowable release rate is up to the 5 year discharge rate. Based on the weighted average the allowable release rate is:

$Q_{allowable} = Q = 2.78\ C\ I\ A$

$Q_{allowable} = 575.7$ l/s ①

B.1.2 - Post-development release rate

ID	Description	Type	Areas (m^2) $C_{0.90}$	Areas (m^2) $C_{0.25}$	Total (m^2)	$C_{post\text{-}5\text{-}year}$	$C_{post\text{-}100\text{-}yr}$*
B1	Front of building	uncontrolled	447	1854	2301	0.38	0.40
A1	Western parking area 1	controlled	945		945	0.90	1.00
A2	Western parking area 2	controlled	960		960	0.90	1.00
A3	Western parking area 3	controlled	1033		1033	0.90	1.00
A4	Western parking area 4	controlled	1041		1041	0.90	1.00
A5	Playground at Daycare area 1	controlled	1140	499	1639	0.70	0.77
A6	Future portables area 1	controlled	43	130	173	0.41	0.44
A7	Playground at Daycare area 2	controlled	1591	517	2108	0.74	0.82
A8	Courts area 1	controlled	1604	829	2433	0.68	0.74
A9	Courts area 2	uncontrolled	970		970	0.90	1.00
A10	Bus loop area 1	uncontrolled	317	106	423	0.74	0.81
A11	Bus loop area 2	uncontrolled	391	65	456	0.81	0.89
A12	Sports Field	controlled	63	4791	4854	0.26	0.26
A13	Future portables area 2	controlled	24	1280	1304	0.26	0.26
A14	Future portables area 3	controlled	24	1040	1064	0.26	0.27
A15	Future portables area 4	controlled	24	1319	1343	0.26	0.26
A16	Back lot area 1	controlled	0	850	850	0.25	0.25
A17	Back lot area 2	uncontrolled	0	645	645	0.25	0.25
R1	Roof	controlled	3890		3890	0.90	1.00
			14507	**13925**	**28432**	**0.58**	**0.63**

**including 25% increase as per City of Ottawa Sewer Design Guidelines*

Calculations for post-development runoff coefficient

$C_{post\text{-}5\text{-}year\ (col.\ D)}$ =(column A * 0.9 + column B * 0.2) / column C

$C_{post\text{-}100\text{-}yr\ (col.\ E)}$ =(column A * 1.0 + column B * 0.2*1.25) / column C

note: 0.90 x 1.25 = 1.125, use max. 1.0

Calculations for average weighted runoff coefficient

$C_{post\text{-}5\text{-}year}$ =((15170*0.9)+(13211*0.25))/28381 0.58

$C_{post\text{-}100\text{-}yr}$ =((15170*1.0)+(13211*0.25*1.25))/28381 0.63

Estimated time of concentration, t_c = **10.0** minutes ***As per City of Ottawa Sewer Design Guidelines (Section 5.4.5.2)**

Based on Ottawa IDF curve, $i_{5\text{-}year} = 998.071/ (t_c+6.053)^{0.814}$ = **104.2** mm/hr

Based on Ottawa IDF curve, $i_{100\text{-}years} = 1735.688/ (t_c+6.014)^{0.820}$ = **178.6** mm/hr

A.1.2.1 - uncontrolled flow

Total uncontrolled area = **0.480** ha

5-year Runoff coefficient, C = **0.54**

100-year Runoff coefficient, C = **0.58**

Estimated time of concentration, t_c = **10.0** minutes

$Q_{uncontrolled\ 5\text{-}year}$ = **74.7** l/s ②

$Q_{net\text{-}allowable\ 5\text{-}year}$ = **501.0** l/s ③ = ①-②

$Q_{uncontrolled\ 100\text{-}year}$ = **138.6** l/s ④

$Q_{net\text{-}allowable\ 100\text{-}year}$ = **437.1** l/s ⑤ = ①-④

B.1.3 - Post-development onsite storage

A.1.3.1 - Overall onsite storage requirements

Total controlled area, A1 to A8 & A12 to A16 & R1	**2.364**	ha	
5-year Runoff coefficient, C	**0.59**		
100-year Runoff coefficient, C	**0.64**		
100 yr net-allowable release rate	**437.1**	l/s	⑤

Table 1.3.1a - 5-year onsite storage requirements

	Time (minutes)	$i_{5\text{-year}}$ (mm/hr)	Q_{actual} (l/s)	$Q_{allowable}$ (l/s)	Q_{stored} (l/s)	V_{stored} (m^3)
peak Vstored --->	10	104.2	404.3	437.1	-32.8	-19.7
	15	83.6	324.2	437.1	-112.9	-101.6
	20	70.3	272.6	437.1	-164.5	-197.4
	25	60.9	236.3	437.1	-200.8	-301.2
	30	53.9	209.2	437.1	-227.8	-410.1
	35	48.5	188.3	437.1	-248.8	-522.5
	40	44.2	171.4	437.1	-265.6	-637.5
	45	40.6	157.6	437.1	-279.4	-754.5
	50	37.7	146.1	437.1	-291.0	-872.9
	55	35.1	136.3	437.1	-300.8	-992.6
	60	32.9	127.8	437.1	-309.3	-1113.3

Therefore **-20** m^3 of onsite storage required during 5-year even

Table 1.3.1b - 100-year onsite storage requirements

	Time (min)	$i_{100\text{-year}}$ (mm/hr)	Q_{actual} (l/s)	$Q_{allowable}$ (l/s)	Q_{stored} (l/s)	V_{stored} (m^3)
	10	178.6	754.3	437.1	317.2	190.3
	15	142.9	603.6	437.1	166.6	149.9
	20	120.0	506.7	437.1	69.6	83.6
peak V_{stored} --->	25	103.8	438.7	437.1	1.6	2.4
	30	91.9	388.1	437.1	-49.0	-88.2
	35	82.6	348.8	437.1	-88.2	-185.3
	40	75.1	317.4	437.1	-119.6	-287.1
	45	69.1	291.7	437.1	-145.4	-392.5
	50	64.0	270.2	437.1	-166.9	-500.7
	55	59.6	251.9	437.1	-185.2	-611.2
	60	55.9	236.1	437.1	-201.0	-723.5

Therefore **190** m^3 of onsite storage required during 100-year even

B.1.3.2 - Estimated detention created by installing roof weirs

Total roof area, A3	**0.389**	ha	
5-year Runoff coefficient, C	**0.90**		
100-year Runoff coefficient, C	**1.00**		
Install 0.6309 l/s weirs at each of the 29 roof drains	**18.3**	l/s	*Watts Drainage Adjustable Flow Control for Roof Drains, or approved equivalent*

Table 1.3.2a - 5-year estimated detention on new roof

	Time (minutes)	$i_{5\text{-year}}$ (mm/hr)	Q_{actual} (l/s)	$Q_{allowable}$ (l/s)	Q_{stored} (l/s)	V_{stored} (m^3)
	10	104.2	101.4	18.3	83.1	49.9
	15	83.6	81.3	18.3	63.0	56.7
peak V_{stored} --->	20	70.3	68.4	18.3	50.1	60.1
	25	60.9	59.3	18.3	41.0	61.5
	30	53.9	52.5	18.3	34.2	61.5
	35	48.5	47.2	18.3	28.9	60.7
	40	44.2	43.0	18.3	24.7	59.3
	45	40.6	39.5	18.3	21.2	57.4
	50	37.7	36.6	18.3	18.4	55.1
	55	35.1	34.2	18.3	15.9	52.4
	60	32.9	32.1	18.3	13.8	49.6

Therefore **62** m^3 estimated roof detention

Table 1.3.2b - 100-year estimated detention on new roof

	Time (min)	$i_{100\text{-year}}$ (mm/hr)	Q_{actual} (l/s)	$Q_{allowable}$ (l/s)	Q_{stored} (l/s)	V_{stored} (m^3)
	10	178.6	193.1	18.3	174.8	104.9
	15	142.9	154.5	18.3	136.2	122.6
	20	120.0	129.7	18.3	111.4	133.7
	25	103.8	112.3	18.3	94.0	141.0
	30	91.9	99.3	18.3	81.1	145.9
peak V_{stored} --->	35	82.6	89.3	18.3	71.0	149.1
	40	75.1	81.3	18.3	63.0	151.1
	45	69.1	74.7	18.3	56.4	152.2
	50	64.0	69.2	18.3	50.9	152.6
	55	59.6	64.5	18.3	46.2	152.4
	60	55.9	60.4	18.3	42.1	151.7

Therefore **153** m^3 estimated roof detention

B.1.4 - Site storage

	100-year event		
overall site storage requirements	190	m^3	*Table B.1.3.1*
Roof storage requirements	153	m^3	
estimated roof ponding volume	153	m^3	*Table B.1.3.2*
roof ponding depth	0.118	m	*maximum allowable: 0.15m*
estimated parking area and school yard volume	184	m^3	
maximum parking area and school yard ponding depth	0.25	m	*maximum allowable: 0.25m*
Sportsfield ponding volume	6	m^3	*Table B.1.3.4*
Maximum sportsfield ponding depth	0.15	m	*maximum allowable: 0.30m*
Total available roof storage	153	m^3	*at maximum ponding depth of 0.15m*
Total available parking area and school yard storage	190	m^3	
Total available onsite storage > overall storage requirements	OK		
Total available onsite storage > estimated detention	OK		

B.1.5 - Release rate for site

Release rate		
Allowable release rate (5-year)	575.7	*Section B.1.1*
Uncontrolled release rate for (100-yr)	138.6	*Section B.1.2.1*
Controlled release rate at roof drain (100-yr)	18.3	*Section B.1.3.2*
Controlled release rate at CBMH-5 (100-yr)	300.0	*Section B.1.3.3*
Controlled release rate at CBMH-7 (100-yr)	60.0	
Total release rate (100-yr)	516.9	
Total release rate (100-yr) < Allowable release rate (5-year)	OK	

Fernbank Elementary School

Jp2g Consultants Inc.
ENGINEERS · PLANNERS · PROJECT MANAGERS

Storm Sewer Pipe Design
Without ICD Flow Control

Definitions
Manning's Coefficient = 0.013
Return Frequency (yrs) = 5
1 acre = 0.4047 hectares

Rational Method
Q = 2.78 CIA (l/s), where
C= Runoff Coefficient
i = Rainfall Intensity (mm/hr)
A = Areas in Hectares (ha)

Notes
1) Used City of Ottawa IDF Curve
2) Min. velocity = 0.8 m/sec
3) Max. velocity = 6.0 m/sec

Designed BK
Checked SM
Dwg. Reference C1
Jp2g project No 19-5070A

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LOCATION		Area no.	AREA (ha)		FLOW					SEWER DATA										
From	To		C= 0.90	C= 0.25	Individual 2.78CA	Cum. 2.78CA	tc (min.)	$i_{5\text{-year}}$ (mm/hr)	$i_{100\text{ years}}$ (mm/hr)	$Flow_{5\text{-year}}$ (l/s)	$Flow_{100\text{ years}}$ (l/s)	Dia. (mm)	actual dia	Slope (%)	Length (m)	Capacity (full) (l/s)	Velocity (full) (m/s)	Sect.Time (minutes)	Tot. Time (minutes)	Utilization (%)
CB-1	CBMH1	A1	0.094		0.24	0.24	10.0	104.2	178.6	24.5	42.0	250	250	0.65	30.6	47.9	1.0	0.5	10.5	51.1
CBMH1	CBMH2	A3	0.103		0.26	0.49	10.5	101.5	173.9	50.0	85.7	375	381	0.40	25.1	115.7	1.0	0.4	10.9	43.3
CB-2	CBMH2	A2	0.096		0.24	0.24	10.0	104.2	178.6	25.0	42.9	250	250	0.65	30.6	47.9	1.0	0.5	10.5	52.2
CBMH2	CBMH3	A4	0.104		0.26	0.99	10.9	99.5	170.4	98.8	169.3	375	381	0.50	32.4	129.3	1.1	0.5	11.4	76.4
RYCB1	CBMH3	A6	0.004	0.013	0.02	0.02	10.0	104.2	178.6	2.1	3.5	250	250	1.00	15.5	59.5	1.2	0.2	10.2	3.5
CBMH3	CBMH4	A5	0.114	0.050	0.32	1.33	11.4	97.2	166.5	129.6	222.0	450	457	0.40	40.0	187.9	1.1	0.6	12.0	69.0
CBMH4	CBMH5	A7	0.151	0.051	0.41	1.75	12.0	94.7	162.1	165.3	283.0	600	610	0.35	39.5	379.6	1.3	0.5	12.5	43.5
CBMH5 **	CBMH6	A8	0.160	0.083	0.46	2.20	12.5	92.5	158.4	204.0	349.1	600	610	0.35	35.7	379.6	1.3	0.5	13.0	53.7
Roof *	CBMH8	R1	0.389	0.000	0.97	0.97	10.0	104.2	178.6	101.4	173.7	300	300	4.00	20.8	193.4	2.7	0.1	10.1	52
CBMH8	CBMH9	A9	0.097		0.24	1.22	12.5	92.5	158.4	112.5	192.6	450	457	0.35	17.1	175.7	1.1	0.3	12.8	64.0
TCB1	RYCB2	A12		0.479	0.33	0.33	15.0	83.6	142.9	27.8	47.6	250	250	0.50	116.5	42.0	0.9	2.3	17.3	66.2
RYCB2	TCB12	A13	0.024	0.128	0.15	0.48	17.3	76.9	131.4	37.1	63.3	300	300	0.50	20.0	68.4	1.0	0.3	17.6	54.2
TCB12	TCB16	A14	0.024	0.104	0.13	0.61	17.6	76.0	129.8	46.7	79.7	300	300	0.50	25.0	68.4	1.0	0.4	18.0	68.3
TCB16	TCB13	A15	0.024	0.110	0.14	0.75	18.0	74.9	127.9	56.2	96.0	300	300	0.50	25.0	68.4	1.0	0.4	18.5	82.2
TCB13	CBMH7	A15	0.024	0.110	0.14	0.89	18.5	73.8	126.1	65.5	111.8	375	375	0.30	25.0	96.0	0.9	0.5	19.0	68.2
CBMH7***	CBMH6	A16		0.085	0.06	0.81	18.5	73.8	126.1	59.8	102.1	375	375	0.30	35.0	96.0	0.9	0.7	19.1	62.2
CBMH6	CBMH10	A17		0.064	0.04	3.06	13.0	90.7	155.2	277.4	474.8	600	610	0.50	32.4	453.7	1.5	0.4	13.3	61.1
CBMH9	CBMH10	A10	0.032	0.011	0.09	1.30	12.8	91.5	156.5	119.1	203.9	450	457	0.35	28.2	175.7	1.1	0.4	13.2	67.8
CBMH10	STMH1	A11	0.039	0.007	0.10	4.46	13.0	90.7	155.2	404.8	692.8	825	825	0.35	20.3	849.2	1.6	0.2	13.2	47.7

Flow control to be installed at outlet

Notes:
* Flow from controlled roof drains is limited to 18.3 L/s
** Flow restricted to 300 L/s
*** Flow from infiltration trench - restricted to 60L/s

Appendix C - Stormwater Management Calculations
Watts Drainage Adjustable Flow Control for Roof Drains – Data Sheet

RD-100

Tag: _____

Large Capacity Roof Drain

Components:

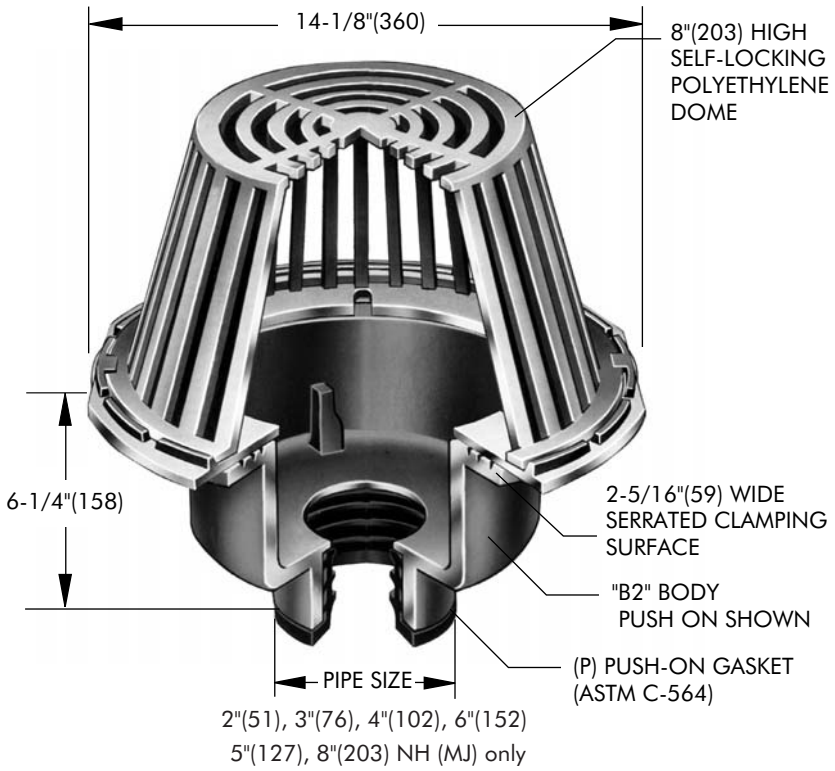

B2


B2-DM


B2-FLG


FC-2

SPECIFICATION: Watts Drainage Products RD-100 epoxy coated cast iron roof drain with deep sump, wide serrated flashing flange, flashing clamp device with integral gravel stop and self-locking polyethylene (standard) dome strainer.



Free Area Sq. In.
137

Deck opening 10" (254) with sump receiver 13-1/4" (337)

** Side Outlet (-SO) option only available in 2"(51), 3"(76), 4"(102) pipe sizes. Underdeck Clamp (-BED and -D options) are not available when -SO is selected.

Order Code: RD-10☐☐-☐-☐

Ex. RD-102P-K

Pipe Sizing (Select One)

Suffix	Description	
2	2"(51) Pipe Size	☐
3	3"(76) Pipe Size	☐
4	4"(102) Pipe Size	☐
5	5"(127) Pipe Size	☐
6	6"(152) Pipe Size	☐
8	8"(203) Pipe Size	☐

Outlet Type (Select One)

Suffix	Description	
NH	No Hub (MJ)	☐
P	Push On	☐
T	Threaded Outlet	☐
X	Inside Caulk	☐

Options (Select One or More)

Suffix	Description	
-A	Accutrol weir (specify # 1-6 slots)	☐
-B	Sump Receiver Flange	☐
-BED	Sump Receiver, Adj Ext., Deck Clamp	☐
-C	Secondary Membrane Clamp	☐
-D	Underdeck Clamp	☐
-E	Adjustable Extension	☐
-GSS	Stainless Steel Ballast Guard	☐
-H	Adj. to 6" IRMA Ballast Guard	☐
-K	Ductile Iron Dome	☐
-K80	Aluminum Dome	☐
-L	Vandal Proof Dome	☐
-R	2" High External Water Dam	☐
-SO	Side Outlet**	☐
-V	Fixed Extension (1-1/2",2",3",4")	☐
-W	Adj. Water Level Regulator	☐
-W-1	Waterproofing Flange	☐
-Z	Extended Integral Wide Flange	☐
-5	Sediment Bucket	☐
-12	Galvanized Dome	☐
-13	All Galvanized	☐
-83	Mesh Covered Dome	☐
-113M	Special Epoxy from 3M Range	☐

Optional Body Material (NH Only)

Suffix	Description	
-60	PVC Body w/Socket Outlet	☐
-61	ABS Body w/Socket Outlet	☐

Job Name _____ Contractor _____

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

Engineer _____ Representative _____

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