STORMWATER MANAGEMENT REPORT

87 Stirling Avenue, Ottawa

Prepared by

E AU Structural & Environmental Services

Ottawa, Ontario, K1Y 4P9
Phone: 613 869 0523
Email: derrick.r.clark@rogers.com

Revision 3

Table of Contents

1. Introduction

EAU Structural and Environmental Services Inc. was retained by Lindsay Blair to prepare a Stormwater Management study for the proposed new residential development at 87 Stirling, Ottawa. The proposed development consists of 3 story and a basement unit located in 87 Stirling Avenue, Ottawa, Ontario.
The pertinent property is currently housing an existing dwelling. The property is 12.2m width by 29.0m depth. Proposed development has been designed to be environmental friendly with permeable landscape around the building and grass in the rear.

2. Stormwater Design

2.1. Design Criteria

Design of the storm sewer system was completed in conformance with the City of Ottawa Design Guidelines (November 2012). Specifically, Section 5 "Storm and Combined Sewer Design" for runoff coefficients and an inlet time were referenced in this design.

The site is currently occupied by an existing residential building with an asphalt driveway. Pre-development conditions will be considered as the lesser of current conditions or conditions resulting in a runoff coefficient of 0.5. Based on the existing ground cover the pre-development runoff coefficient was calculated to be 0.50. Therefore, the allowable release rate for the site is calculated using a runoff coefficient of 0.50, the 5 year storm event, time of concentration of 10 min and store up to the 100 years storm event as per direction from City of Ottawa Sewer Design Guideline.

During all construction activities, erosion and sediment shall be controlled by techniques outlined in Section 5 of this report.

2.2. Minor System Design Criteria

1. The storm sewers and service laterals have been designed and sized based on the rational formula and the Manning's Equation under free flow conditions for the 5-year storm using a 10-minute inlet time.
2. Inflow rates into the minor system are limited to the pre-development rates for up to the 100-year storm, and are based on a time of concentration of 10 minutes.

2.3. Major System Design Criteria

1. The major system has been designed to accommodate on-site detention with sufficient capacity to attenuate the 100-year design storm. Excess runoff above the 100 year event will flow via driveway towards Stirling Avenue.
2. On site storage is provided and calculated for up to the 100-year design storm with maximum ponding of 150mm depth on the roofs. Calculation of the required on-site storage volumes has been supported by calculations provided in appendixes.
3. Calculation of the required storage volumes has been prepared based on the Modified Rational Method as identified in Section 8.3.10.3 of the City's Sewer Guidelines. The depth and extent of surface storage will be illustrated on the applicable grading plan and storm drainage plan.

2.4. Runoff Coefficients

The area for runoff coefficients used for either pre-development or post-development conditions were based on actual areas measured in CAD. Runoff coefficients for impervious surfaces such as roofs, asphalt, and concrete, were taken as 0.90,

The allowable pre-development runoff coefficients for the overall site is based on C=0.50 in general this includes grass and tree areas.

2.5. Allowable Release Rate

As a condition of the site plan approval, the city of Ottawa requires that the storm runoff from the re-development site be released in a controlled manner equivalent to a runoff coefficient C=0.4. As such, the allowable release rate from the site was determined using the modified rational method with a 5 years storm, a runoff coefficient C=0.5, and a time of concentration of 10 minutes as follows;

- Time of Concentration = 10 minutes,
- Drainage Area = 0.035 ha

Q allow = 2.78 C I A

Where:

Q allow	=	Allowable release rate to storm sewer (L/sec)
C	=	Runoff Coefficient (dimensionless) =0.5
I	=	Average Rainfall Intensity for return period (mm/hr)
	=	998.071/ (TC+6.053)0.814 (5-year) =104.2 mm/hr
TC	=	Time of concentration (minutes)
A	=	Drainage Area (hectares) = 0.035

Q Allow = 5.07 L/sec

Therefore the allowable release rate from the site is 5.07 L/sec

3. Stormwater Quantity Control

Post development storm water management design for this site includes 3 general areas; Grass area, Roof and Driveway area.

- Grass area will sheet drain to rear of the property as per natural drainage pattern. During 5 year and 100 year storm event, grass area generates 1.2 L/sec and 2.6 L/sec respectively.
- Drive way dimension remains unchanged with compare to pre-development stage. But it will be converted from regular asphalt to permeable landscape. Any access rain will sheet drain to Stirling Avenue, same as pre-development. The release rate during 5yr and 100yr storm event are 0.87 L/sec and 1.5 L/sec, respectively.
- Roof: Storm runoff during 5yrs and 100yrs storm event will be stored on the roof. In order to ensure that the allowable release rate to the storm sewers is not exceeded, roof drain restrictors will be installed at the roof drains by limiting the rate at which storm runoff is release to the sewers, water will tend to pond upstream of the roof drain. As ponds generally form the shape of the roof, the extend and depth of ponding resulting from the 100-year storm was determined using the following equation;

$$V=1/3 \times A \times d$$

Where:

V	=	Storage volume (cu. m.)
A	=	surface area of pond (sq.m.)
D	=	pond depth at peak (m)

The pre-development allowable release is 5.07L/sec, with presence of 100yr uncontrolled release of 2.6L/sec for grass area and 1.5L/sec for driveway, the roof will be controlled to 0.96 L/sec. The flow control will be done based on 1 roof drains at 0.96 L/sec each for the 5-year storm and 1.00 L/sec each for the 100-year storm. Based on calculation, the maximum volume required for the roof at post development stage for 100yrs storm event would be 7.53 m^3. The maximum ponding height on the roof will come up to be 210mm. The discharge rate from all above connected structure will be controlled via an ICD which is selected based on design head and available manufacturer database, (see appendix) Watts RD100 (¼" opening exposure, 210mm head water) roof drains with adjustable flow control weirs is selected.

4. Erosion and Sediment Control

During all construction activities, erosion and sedimentation shall be controlled by the following techniques:

- installation of filter cloth between frame and cover of catch basins,
- a visual inspection shall be completed daily on sediment control barriers and any damage repaired immediately. Care will be taken to prevent damage during construction operations,
- in some cases barriers may be removed temporarily to accommodate the construction operations. The affected barriers will be reinstated at night when construction is completed,
- the sediment control devices will be cleaned of accumulated silt as required. The deposits will be disposed of as per the requirements of the contract,
- during the course of construction, if the engineer believes that additional prevention methods are required to control erosion and sedimentation, the contractor will install additional silt fences or other methods as required to the satisfaction of the engineer, and
- Construction and maintenance requirements for erosion and sediment controls to comply with Ontario Provincial Standard Specification OPSS 577, and City of Ottawa specifications.

5. Conclusions

This report addresses the storm water management of the proposed site. The proposed 0.035 hectare development, consists of 3 storey with a basement building. The following list below itemizes the conclusions of this report.

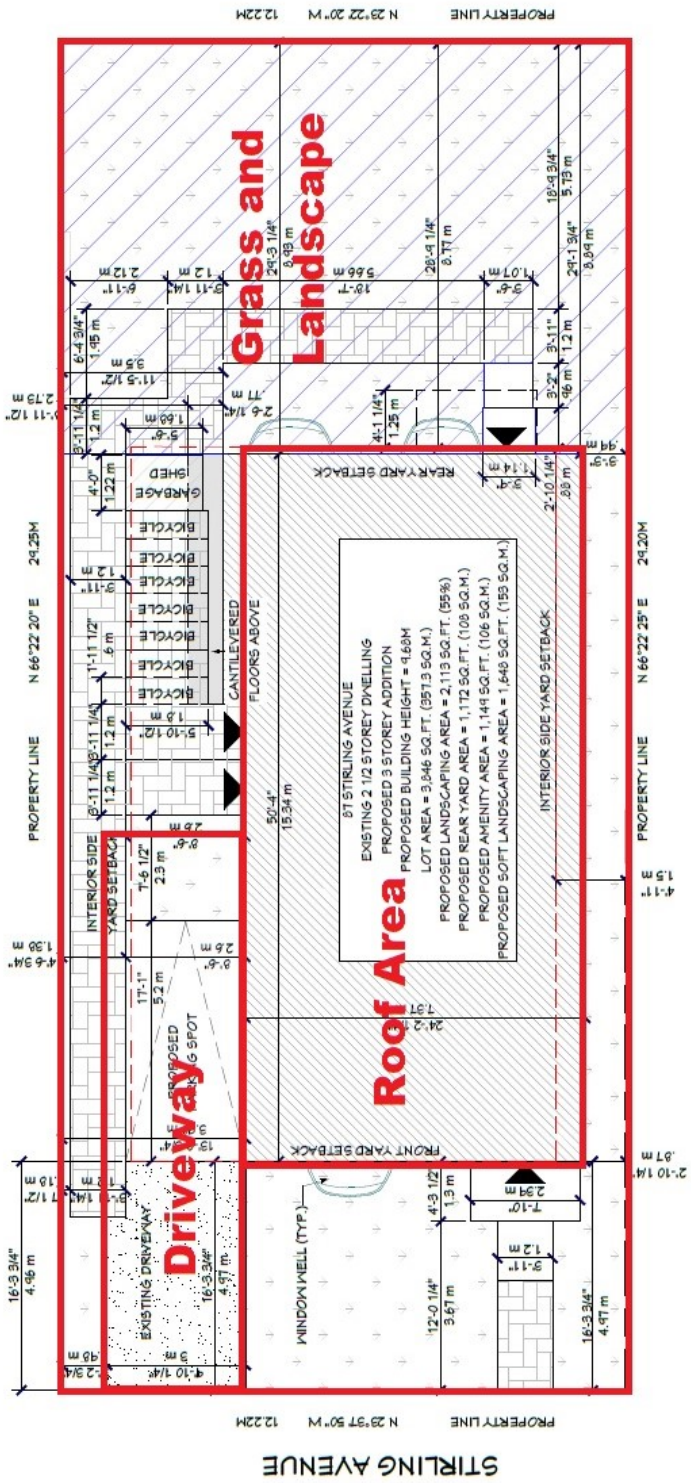
- The allowable release rate for the site is calculated using a runoff coefficient of 0.50, the 5 year storm event, time of concentration of 10 min and store up to the 100 years storm event. Allowable discharge rates of 5.06 L/sec for the 5-year will be the target release rate from this site.
- Grass area and small driveway will sheet drain from the site, same as pre-development. The roof will be controlled to 0.96 L/sec. Based on calculation, the maximum volume required for the roof at post development stage for 100yrs storm event would be 7.53 m^3. The maximum ponding height on the roof will come up to be 210mm. The discharge rate from all above connected structure will be controlled via an ICD which is selected based on design head and available manufacturer database, (see appendix) Watts RD100 roof drains with adjustable flow control weirs is selected.
- During all construction activities, erosion and sedimentation shall be controlled be techniques outlined in this report.

Should you have any question, do not hesitate to let us know.

Derrick R. Clark, PEng.
EAU Structural & Environmental Services
Telephone: (613) 869 0523
derrick.r.clark@rogers.com

APPENDIX A:

Storm Drain Area


Grass and Landscape
Roof Area
Driveway
87 STIRLING AVENUE
EXISTING 2 1/2 STOREY DWELLING
PROPOSED 3 STOREY ADDITION
PROPOSED BUILDING HEIGHT = 9.68M
LOT AREA = 3,846 SQ.FT. (357.3 SQ.M.)
PROPOSED LANDSCAPING AREA = 2,113 SQ.FT. (55%)
PROPOSED REAR YARD AREA = 1,172 SQ.FT. (108 SQ.M.)
PROPOSED AMENITY AREA = 1,141 SQ.FT. (106 SQ.M.)
PROPOSED SOFT LANDSCAPING AREA = 1,648 SQ.FT. (153 SQ.M.)
PROPERTY LINE
N 66°22' 20" E
24.25M
PROPERTY LINE
N 66°22' 25" E
24.20M
INTERIOR SIDE YARD SETBACK
INTERIOR SIDE YARD SETBACK
REAR YARD SETBACK
FRONT YARD SETBACK
CANTILEVERED FLOORS ABOVE
GARBAGE SHED
BICYCLE
PROPOSED 1 PARKING SPOT
EXISTING DRIVEWAY
WINDOW WELL (TYP.)
PROPERTY LINE
N 29°37' 50" W
12.22M
PROPERTY LINE
N 29°22' 20" W
12.22M
STIRLING AVENUE

APPENDIX B:

Stormwater Management Calculation

ALLOWABLE FLOWS FROM SITE (tc = 20 min)

C(max equiv)	I (5yr) mm/h	Area (ha)
0.5	104.2	0.035

Q(allow) 5.07 l/s

SUMMARY OF STORMWATER FLOWS

Area ID	Area (ha)	Runoff 'C'	A x C	C (100yr) (Max of 1.0)	A x C	Type of Flow (Controlled/Uncontrolled)
A1: Proposed Building	0.011	0.9	0.0102	1.0	0.0113	Controlled
A2: Driveway	0.003	0.9	0.0027	1.0	0.0031	Controlled
A3: Grass area	0.021	0.2	0.0041	0.25	0.0052	Uncontrolled sheet drain
Total Site Area (ha)	0.035	---	0.0170	---	0.0195	Total

C(avg) 5-year = 0.49
C(avg) 100-year = 0.56

STORAGE CALCULATIONS

C(5 yr)	C(100 yrl)	Area (ha)
0.49	0.56	0.035

Q(restricted) l/s = **0.96** ← enter restricted release rate

t(c)min	I(5yr) mm/h	Q(unrestricted) l/s	Q(restricted) l/s	Q(stored) l/s	V(stored) m³	
5	141.2	6.69	0.96	5.73	1.72	
10	104.2	4.94	0.96	3.98	2.39	
15	83.6	3.96	0.96	3.00	2.70	
20	70.3	3.33	0.96	2.37	2.84	
25	60.9	2.89	0.96	1.93	2.89	←
30	53.9	2.56	0.96	1.60	2.87	
35	48.5	2.30	0.96	1.34	2.81	
40	44.2	2.09	0.96	1.13	2.72	
45	40.6	1.93	0.96	0.97	2.61	
50	37.7	1.78	0.96	0.82	2.47	
55	35.1	1.66	0.96	0.70	2.33	
60	32.9	1.56	0.96	0.60	2.17	
65	31.0	1.47	0.96	0.51	1.99	
70	29.4	1.39	0.96	0.43	1.82	
75	27.9	1.32	0.96	0.36	1.63	
80	26.6	1.26	0.96	0.30	1.44	
85	25.4	1.20	0.96	0.24	1.24	
90	24.3	1.15	0.96	0.19	1.03	
95	23.3	1.10	0.96	0.14	0.82	
100	22.4	1.06	0.96	0.10	0.61	
105	21.6	1.02	0.96	0.06	0.40	
110	20.8	0.99	0.96	0.03	0.18	

Max Vol stored **2.89** ← enter Vol(m³)

STORAGE TABLE (100 Yr Storm)

t(c)min	I(100yr) mm/h	Q(actual) l/s	Q(restricted) l/s	Q(stored) l/s	V(stored) m³	
5	242.7	13.2	1.0	12.2	3.66	
10	178.6	9.7	1.0	8.7	5.24	
15	142.9	7.8	1.0	6.8	6.11	
20	120.0	6.5	1.0	5.5	6.66	
25	103.8	5.6	1.0	4.7	7.01	
30	91.9	5.0	1.0	4.0	7.24	
35	82.6	4.5	1.0	3.5	7.39	
40	75.1	4.1	1.0	3.1	7.48	
45	69.1	3.7	1.0	2.8	7.52	
50	64.0	3.5	1.0	2.5	7.53	←
55	59.6	3.2	1.0	2.3	7.51	
60	55.9	3.0	1.0	2.1	7.46	
65	52.6	2.9	1.0	1.9	7.40	
70	49.8	2.7	1.0	1.7	7.31	
75	47.3	2.6	1.0	1.6	7.22	
80	45.0	2.4	1.0	1.5	7.11	
85	43.0	2.3	1.0	1.4	6.99	
90	41.1	2.2	1.0	1.3	6.86	
95	39.4	2.1	1.0	1.2	6.72	
100	37.9	2.1	1.0	1.1	6.58	
105	36.5	2.0	1.0	1.0	6.43	
110	35.2	1.9	1.0	1.0	6.27	

Max Vol stored **7.53** ← enter Vol(m³)

APPENDIX C:

Engineering Catalogue

WATTS® DRAINAGE

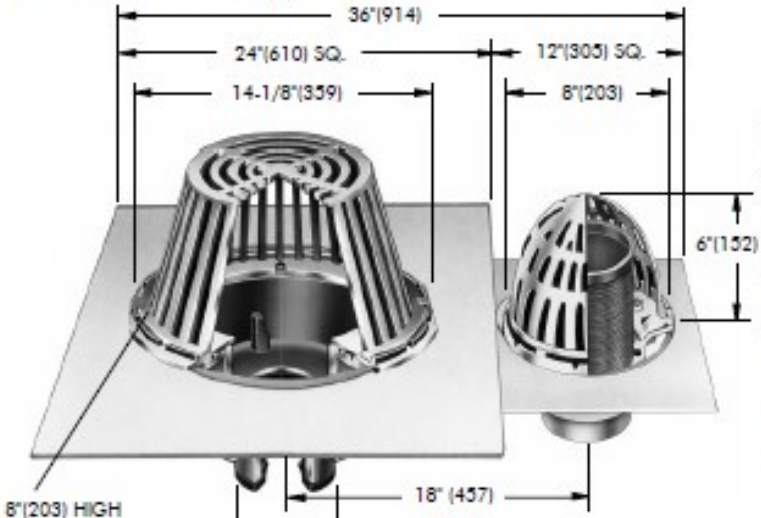
RD-100-O

Tag: _____

Combined Roof Drain & Secondary Overflow System

Components:

SPECIFICATION: Watts Drainage Products RD-100-O combined roof drain and secondary overflow system, consisting of galvanized sump receivers; one large sump epoxy coated cast iron body, one small sump epoxy coated cast iron body, combined flashing rings and gravel stop, polyethyene dome strainers and one adjustable 4"(102) diameter ABS overflow standpipe.



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

Free Area Sq. In.
137

Deck opening 6-1/2"(165) with sump receiver 8"(203)

Order Code: RD-10☐☐-O-☐-☐

Ex. RD-102P-O-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)	☐
-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	☐
-KBB	Aluminum Dome	☐
-L	Vandal Proof Dome	☐
-R	2" High External Weir Dam	☐
-SO	Side Outlet**	☐
-V	Fixed Extension (1-1/2",2",3",4")	☐
-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	☐

** 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.

Job Name _____ Contractor _____

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

Engineer _____ Representative _____

WATTS DRAINAGE CANADA: 5435 North Service Road, Burlington, ON, L7L 5H7 TEL: 905-332-4716 TOLL-FREE: 1-888-208-8927 Website: www.wattsdrainage.ca

ES-WD-RD-100-O CANADA 0515

(Dimension) Denotes Millimeters

WATTS® DRAINAGE

Adjustable Accutrol Weir

Tag: _____

Adjustable Flow Control for Roof Drains

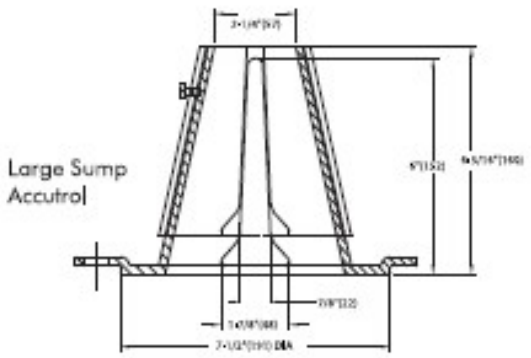
ADJUSTABLE ACCUTROL(for Large Sump Roof Drains only)

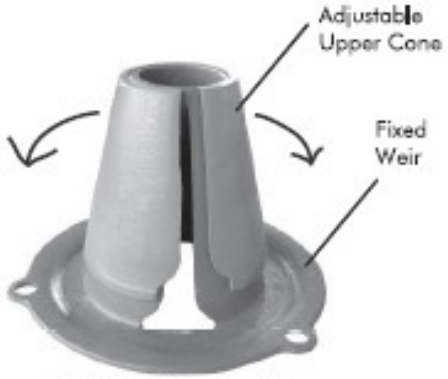
For more flexibility in controlling flow with heads deeper than 2", Watts Drainage offers the Adjustable Accutrol. The Adjustable Accutrol Weir is designed with a single parabolic opening that can be covered to restrict flow above 2" of head to less than 5 gpm per inch, up to 6" of head. To adjust the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

EXAMPLE:

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

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





1/2 Weir Opening Exposed Shown Above

TABLE 1. Adjustable Accutrol Flow Rate Settings

Weir Opening Exposed	Head of Water					
	1"	2"	3"	4"	5"	6"
	Flow Rate (gallons per minute)					
Fully Exposed	5	10	15	20	25	30
3/4	5	10	13,75	17,5	21,25	25
1/2	5	10	12,5	15	17,5	20
1/4	5	10	11,25	12,5	13,75	15
Closed	5	10	10	10	10	10

Job Name _____ Contractor _____

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

Engineer _____ Representative _____

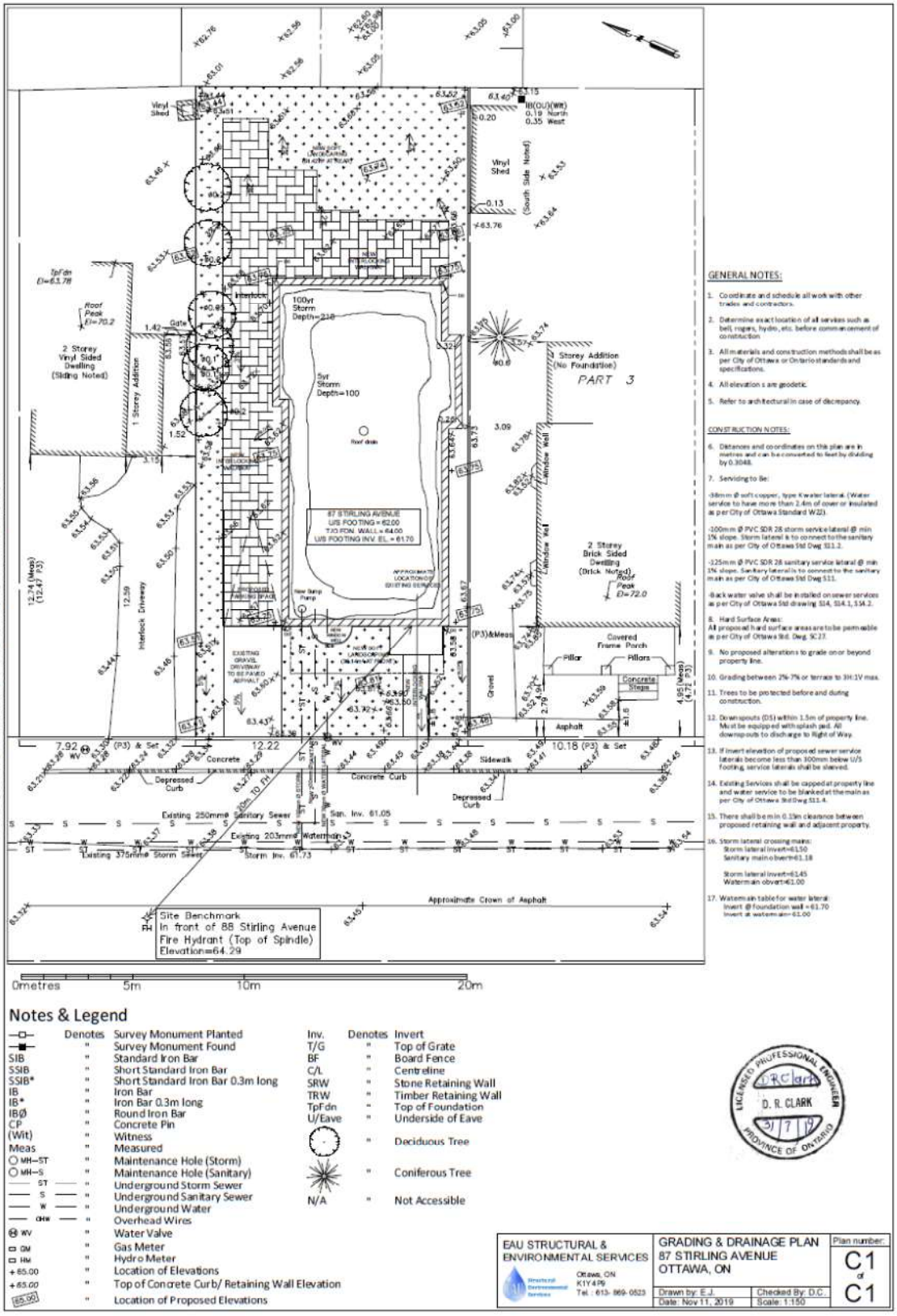
WATTS DRAINAGE CANADA: 5435 North Service Road, Burlington, ON, L7L 5H7 TEL: 905-332-4718 TOLL-FREE: 1-800-268-8927 Website: www.wattsdrainage.ca

ES-WD-RD-ACCUTROLADJ CANADA 0512

(Dimension) Denotes Millimeters

APPENDIX D:

PLANS


GENERAL NOTES:
1. Coordinate and schedule all work with other trades and contractors.
2. Determine exact location of all services such as bell, rogers, hydro, etc. before commencement of construction.
3. All materials and construction methods shall be as per City of Ottawa or Ontario standards and specifications.
4. All elevation s are geodetic.
5. Refer to architectural in case of decrepancy.
CONSTRUCTION NOTES:
6. Distances and coordinates on this plan are in metres and can be converted to feet by dividing by 0.3048.
7. Servicing to Be:
-38mm Ø soft copper, type K water lateral. (Water service to have more than 2.4m of cover or insulated as per City of Ottawa Standard W20).
-100mm Ø PVC SDR 28 storm service lateral @ min 1% slope. Storm lateral is to connect to the sanitary main as per City of Ottawa Std Dwg S11.2.
-125mm Ø PVC SDR 28 sanitary service lateral @ min 1% slope. Sanitary lateral is to connect to the sanitary main as per City of Ottawa Std Dwg S11.
-Back water valve shall be installed on sewer services as per City of Ottawa Std drawing S14, S14.1, S14.2.
8. Hard Surface Areas:
All proposed hard surface areas are to be permeable as per City of Ottawa Std. Dwg. SC27.
9. No proposed alterations to grade on or beyond property line.
10. Grading between 2%-7% or terrace to 3H:1V max.
11. Trees to be protected before and during construction.
12. Downspouts (DS) within 1.5m of property line. Must be equipped with splash pad. All downspouts to discharge to Right of Way.
13. If invert elevation of proposed sewer service laterals become less than 300mm below U/S footing, service laterals shall be sleeved.
14. Existing Services shall be capped at property line and water service to be blanked at the main as per City of Ottawa Std Dwg S11.4.
15. There shall be min 0.15m clearance between proposed retaining wall and adjacent property.
16. Storm lateral crossing mains:
Storm lateral invert=61.50
Sanitary main obvert=61.18
Storm lateral invert=61.45
Watermain obvert=61.00
17. Watermain table for water lateral:
Invert @ foundation wall =61.70
Invert at watermain=61.00
87 STIRLING AVENUE
U/S FOOTING = 62.00
T/O PONI WALL = 64.00
U/S FOOTING INV. EL. = 61.70
100yr Storm Depth=218
5yr Storm Depth=100
2 Storey Addition (No Foundation)
PART 3
2 Storey Vinyl Sided Dwelling (Siding Noted)
2 Storey Brick Sided Dwelling (Brick Noted)
Interlock Driveway
Existing GRAVEL DRIVEWAY TO BE PAVED ASPHALT
Covered Frame Porch
Pillar
Pillars
Concrete Steps
Gravel
Asphalt
Concrete
Depressed Curb
Concrete Curb
Sidewalk
Existing 250mmø Sanitary Sewer
San. Inv. 61.05
Existing 203mmø Watermain
Existing 375mmø Storm Sewer
Storm Inv. 61.73
Approximate Crown of Asphalt
Site Benchmark
In front of 88 Stirling Avenue
Fire Hydrant (Top of Spindle)
Elevation=64.29
0metres
5m
10m
20m
Notes & Legend
Denotes Survey Monument Planted
Survey Monument Found
SIB Standard Iron Bar
SSIB Short Standard Iron Bar
SSIB* Short Standard Iron Bar 0.3m long
IB Iron Bar
IB* Iron Bar 0.3m long
IBØ Round Iron Bar
CP Concrete Pin
(Wit) Witness
Meas Measured
MH–ST Maintenance Hole (Storm)
MH–S Maintenance Hole (Sanitary)
ST Underground Storm Sewer
S Underground Sanitary Sewer
W Underground Water
OHW Overhead Wires
WV Water Valve
GM Gas Meter
HM Hydro Meter
+65.00 Location of Elevations
+65.00 Top of Concrete Curb/ Retaining Wall Elevation
65.00 Location of Proposed Elevations
Inv. Denotes Invert
T/G Top of Grate
BF Board Fence
C/L Centreline
SRW Stone Retaining Wall
TRW Timber Retaining Wall
TpFdn Top of Foundation
U/Eave Underside of Eave
Deciduous Tree
Coniferous Tree
N/A Not Accessible
LICENSED PROFESSIONAL ENGINEER
D. R. CLARK
PROVINCE OF ONTARIO
EAU STRUCTURAL & ENVIRONMENTAL SERVICES
Ottawa, ON K1Y 4P9
Tel.: 613- 869-0823
GRADING & DRAINAGE PLAN
87 STIRLING AVENUE
OTTAWA, ON
Drawn by: E.J.
Checked By: D.C.
Date: Nov 11, 2019
Scale: 1:150
Plan number:
C1 of C1