BLOOM RESORTS SANDBANKS

37-38 LAKE AVENUE LANE, CHERRY VALLEY, ONTARIO, PRINCE EDWARD COUNTY

STORMWATER MANAGEMENT BRIEF: DRAINAGE SYSTEM ADJACENT TO NEIGHBOURING PROPERTIES

Prepared for:
Bloom Resorts Sandbanks

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TABLE OF CONTENTS

PAGE

APPENDICES

1 INTRODUCTION

This stormwater management brief has been prepared by Gunnell Engineering Ltd. to support the Site Plan Application and address any current and potential drainage issues at 37-38 Lake Avenue Lane, Cherry Valley, Ontario, specifically in the vicinity of the four (4) neighbouring properties - 59, 61, 67/73, 77 Lake Avenue Lane, adjacent to Bloom Resorts Sandbanks – formerly known as Sun Retreats Sandbanks. The proposed solution to managing stormwater runoff will include the construction and implementation of grass swales, storm grates with catch-basin shields, sumps, subsurface piping, an earthen road-side berm to prevent ponding and overland flow towards the adjacent neighbouring properties as well as an outlet bioswale ahead of the final receiver – East Lake. Currently there are no stormwater management practices in place in this area and the proposed works provide safe, re-directed conveyance of stormwater and an improved level of treatment of ahead of East Lake utilizing the minimal area available.

2 PRE AND POST DEVELOPMENT FLOWS

The rational method (Q = CIA) was used to calculate runoff volumes. These calculations were completed in order to determine the size and appropriate strategies to re-direct and mitigate stormwater runoff in the specified area of re-development.

Pre-Development Flows

The overall area contributing to potential surface runoff towards the adjacent properties was calculated to be 12,728 m^2. Of that total area, 1,981 m^2 is already developed with ten (10) trailer lots / units and road area. Areas were calculated for each surface type with their corresponding runoff coefficients to get an average surface runoff coefficient for the pre-development (existing conditions) of 0.332. Refer to drawing SPCA-4.1 indicating the drainage area (shaded blue) as well as areas broken down into road area, trailer area, driveway, grassed areas, etc. (Appendix C).

The time of concentration (tc) was referenced using *Airport Drainage, Federal Aviation Administration, 1965 – Figure for Overland Time of Flow* chart based on average coefficient, distance and slope. Based on C = 0.33, distance of 119.5 m (392 ft), slope of 5.3%, a tc of 18 minutes was estimated. Referencing *Short Duration Rainfall Intensity-Duration-Frequency Data* chart dated October 31, 2022 for nearby Picton, Ontario (Appendix D) the maximum rate of runoff (Q) for a 5-year storm, was calculated to be approximately 245.1 m^3/hr or 0.068 m^3/s.

$$Q = CIA = 0.332 \times 0.058 \text{ m/hr} \times 12{,}728 \text{ m}^2 = 245.1 \text{ m}^3\text{/hr.}$$

Post Development Flows

Utilizing the same overall area and adjusting the calculations for the added trailer lots / units, roads and grassed areas that are part of the minor re-development, a revised average surface runoff coefficient was calculated to be 0.413 due to the increase in impervious area. Appendix C provides the breakdown of these areas and calculations.

Similar methodology was used to determine the post development flows and based on a C = 0.41, distance of 119.5 m (392 ft), and slope of 4.9% (regrading), a tc of 15 minutes was estimated. Referencing *Short Duration Rainfall Intensity-Duration-Frequency Data* chart dated October 31, 2022 for nearby Picton, Ontario (Appendix D) the maximum rate of runoff (Q) for a 5-year storm, was calculated to be approximately 352.2 m^3/hr or 0.0978 m^3/s. The 5-year storm was selected as the Quinte Conservation Stormwater Management Submission Guidelines 2012 provides that minor systems must be capable of handling post development flows up to the 5-year frequency.

$$Q = CIA = 0.413 \times 0.067 \text{ m/hr} \times 12{,}728 \text{ m}^2 = 352.20 \text{ m}^3\text{/hr.}$$

3 MITIGATION PLAN AND LOW IMPACT DESIGN

Drawings SPCA-4.1, SPCA-4.2 and SPCA-5 (Appendix A), included in this report detail information on the proposed mitigation elements for the stormwater management works that will re-direct and provide treatment to the runoff generated in this area. The proposed plan provided here has been expanded to include mitigation and re-direction of overland flows away from all four (4) of the adjacent properties.

Grassed Swales

A total of four (4) grassed swales (0.20 m deep with slopes varying between 1.2 to 2.6 %) are to be constructed between Lake Avenue Lane and the adjacent neighbouring property boundary, as detailed on drawing SPCA-5. The swales have been designed with a trapezoidal shape (with a very low “b” value, making them essentially triangular). The maximum volume of flow in the 1.2% swale (least carrying capacity) has been calculated to carry a flow of 108 L/s which is adequate for the 5-year post development flow is 98 L/s, as referenced in the previous section and also in Appendix B. The flow from the multiple swales will drain into four (4) storm grates / catch basins with sumps and catch basin shields (TSS removal) which then outlet into smooth walled PVC storm piping to maintain gravity flow as there are limitations on existing site grades.

Storm Grates / Catch Basins and Piping

Four (4) storm grates are to be provided which will allow water from the swales to discharge into the PVC storm piping. Grates detailed on Drawing SPCA-5 will have a sump and catch basin shield insert (Appendix E) to collect and separate any sediment and suspended solids that may be present within the flow. Storm piping to be installed is 250 to 355 mm PVC smooth walled piping with slopes ranging from 0.5% to 1.5%. The water within the storm pipes will be carried to the central western part of the property where the piping will outlet into a constructed bioswale with native vegetation for additional total suspended solids removal ahead of the final receiver, East Lake.

Bioswale

The subsurface piping will outlet to a small constructed bioswale west of trailer Lot S8. The bioswale construction will consist of stone, piping, geotextile filter fabric, native grasses, sedges and plantings. This end-of-pipe discharge is considered more appropriate versus a typical pipe to daylight as there is some water uptake by native vegetation as well as quality control in the form of total suspended solids removal.

Earthen Berm

Above the portion of PVC storm pipe travelling northwest towards the Lake, a proposed 300 mm (12”) high road-side earthen berm is to be constructed adjacent to south-west property boundary of 59 Lake Avenue Lane. This berm will aid as a prevention barrier for any overland flow, including the discharged stormwater, from reaching 59 Lake Avenue Lane. Any surface water flowing towards this neighbouring property will reach the berm and either infiltrate into the soils and/or be redirected from the berm.

4 QUANTITY AND QUALITY CONTROL

Quantity Control

Quinte Conservation previously provided comment that quantity control is not required if safe conveyance to East Lake can be demonstrated.

Quality Control

Previous correspondence from Prince Edward County Engineering provided that Total Suspended Solids (TSS) would require an enhanced level of protection with an average of 80% removal before entering East Lake. Quinte Conservation has previously provided that lot level controls and best management practices are normally sufficient.

This level of protection will be achieved through the use of the following features. The development area provides intermittent grassed areas on individual lots and there is also a grassed strip ahead of the proposed swales which receive water from the drainage area. In combination with the swales, these areas are estimated to remove 15-20% of TSS from the runoff. The four (4) swales re-direct the stormwater into the four (4) storm grates where catch basin shields will be provided and help promote sediment settlement within the sumps. These shields provide up to 50% of TSS retainment and with portions of the catchment area feeding different catch basins, the flow through each catch basin is only a portion of the overall runoff, providing less flow through each and therefore more settlement.

Subsurface piping then transfers the stormwater through one final combined catch basin / sump (no grate) which receives the full flow of stormwater. Although there is a sump and some TSS will settle out, it is not expected that a significant amount of settlement will occur here as flows are seen as more turbulent. After the final catch basin, the stormwater flows will outlet to a constructed bioswale, approximately 2m in width and 3m in length. This bioswale will provide the final 15-20% of TSS removal through stone, piping, geotextile filter fabric, native grasses, sedges and plantings ahead of the final receiver, East Lake.

These proposed works will provide the desired outcomes of re-directing overland stormwater flows away from the four (4) adjacent neighbouring properties, achieve significantly improved stormwater quality versus the existing measures in place and provide safe conveyance to East Lake.

5 MAINTENANCE

Sediment and debris will accumulate over time and with use of the system. It is important that cleaning and removal of the sediment accumulation from the multiple swales, catch basins and storm grates as well as the bioswale is undertaken on a regular basis. If not properly maintained and serviced, the quality of the stormwater discharged may, over time, become unacceptable to the municipality and conservation authority.

6 CONCLUSION

The proposed stormwater management and mitigation strategies, as described in this brief are a significant improvement and will provide the desired outcomes of re-directing overland stormwater flows away from the four (4) adjacent neighbouring properties, achieve significantly improved stormwater quality versus the existing measures in place and safe conveyance to East Lake.

Please contact our office directly should you have any queries regarding this report.

Sincerely,
GUNNELL ENGINEERING LTD.

LICENCED PROFESSIONAL ENGINEER
Jun. 20, 2025
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Project Engineer

APPENDIX A

GUNNELL ENGINEERING DRAWINGS

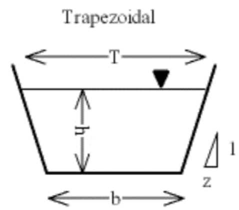
SPCA-4.1, SPCA-4.2, SPCA-5, REVISION #8 STAMPED JUNE 20, 2025

APPENDIX B

SWALE CALCULATIONS

Trapezoidal Channel
Flow Area
A = h(b+T)/2

h =	0.2	m	depth of water
b =	0.01	m	width of base
T =	1.4	m	width of to water level
A =	0.141	m^2	Cross Sectional Area



Wetted Perimeter
P = b + 2(((T - b)/2)^2 +h^2)^(1/2)

P = 1.456409 m

Hydraulic Radius
Rh = (h(b+T)/2/(b+2(((T-b)/2)^2+h^2)^(1/2))

Rh = 0.096813 m

Manning's Formula and Gravity Flow
(Calculate Cross Sectional Average Velocity Flow in Open Channels
v = (kn/n)*Rh^(2/3)S^(1/2)

kn =	1.0		For SI Units (1.486 for Imperial Units)
n =	0.030		Manning's Roughness Coefficient (Use Table to the right →)
Rh =	0.096813	m	Hydraulic Radius (Use based on type of channel you have, calculated above ↑)
S =	0.012	m/m	Slope or gradient
v =	0.769886	m/s	Cross-Sectional Mean Velocity

Volume of Flow in the Channel can be Calculated as Follows:
q = A*v

q =	0.108554	m^3/s	Channel Flow Volume
	108.5539	L/s	

Manning's Roughness Coefficients vs. Channel Type

Surface Material	Manning's Roughness Coefficient *-n-*
Asbestos cement	0.011
Asphalt	0.016
Brass	0.011
Brick and cement mortar sewers	0.015
Canvas	0.012
Cast or Ductile iron, new	0.012
Clay tile	0.014
Concrete - steel forms	0.011
Concrete (Cement) - finished	0.012
Concrete - wooden forms	0.015
Concrete - centrifugally spun	0.013
Copper	0.011
Corrugated metal	0.022
Earth, smooth	0.018
Earth channel - clean	0.022
Earth channel - gravelly	0.025
Earth channel - weedy	0.03
Earth channel - stony, cobbles	0.035
Floodplains - pasture, farmland	0.035
Floodplains - light brush	0.05
Floodplains - heavy brush	0.075
Floodplains - trees	0.15
Galvanized iron	0.016
Glass	0.01
Gravel, firm	0.023
Lead	0.011
Masonry	0.025
Metal - corrugated	0.022
Natural streams - clean and straight	0.03
Natural streams - major rivers	0.035
Natural streams - sluggish with deep pools	0.04
Natural channels, very poor condition	0.06
Plastic	0.009
Polyethylene PE - Corrugated with smooth inner walls	0.009 - 0.015
Polyethylene PE - Corrugated with corrugated inner walls	0.018 - 0.025
Polyvinyl Chloride PVC - with smooth inner walls	0.009 - 0.011
Rubble Masonry	0.017 - 0.022
Steel - Coal-tar enamel	0.01
Steel - smooth	0.012
Steel - New unlined	0.011
Steel - Riveted	0.019
Vitrified clay sewer pipe	0.013 - 0.015
Wood - planed	0.012
Wood - unplaned	0.013
Wood stave pipe, small diameter	0.011 - 0.012
Wood stave pipe, large diameter	0.012 - 0.013

APPENDIX C

RUNOFF COEFFICIENT CALCULATIONS

Pre-Development Conditions

Areas	Units	m²	C	Ac	%	
Total Drainage Basin Area		12728	Various	#N/A	1	
Road Area		1258	0.8	1006.4	0.098837	
Trailer Unit Area (37.16m²/unit)	10	371.6	0.95	353.02	0.029195	
Gravel Driveway + Trailer Pad		723	0.5	361.5	0.056804	
Gravel Driveway + Trailer Pad less Trailer Unit		351.4	0.5	175.7	0.027608	
Grassed Area		10747	0.25	2686.75	0.844359	
						Average C
	Check	12728				0.331699

37.16 Trailer Unit Area (37.16m²/unit)
72.3 m² gravel pad area (driveway + trailer pad):

Post-Development Conditions

Areas		m²	C	Ac	%	
Total Drainage Basin Area		12728	Various	#N/A	1	
Road Area		1908	0.8	1526.4	0.149906	
Trailer Unit Area (37.16m²/unit)	29.5	1096.22	0.95	1041.409	0.086127	
Gravel Driveway + Trailer Pad		2132.85	0.5	1066.425	0.167571	
Gravel Driveway + Trailer Pad less Trailer Unit		1036.63	0.5	518.315	0.081445	
Grassed Area		8687.15	0.25	2171.788	0.682523	
						Average C
	Check	12728				0.413098

Pre-Development Conditions

time of concentration (tc) Kirpich Equation
tc = 0.0078*L^(0.77)*S^(-0.385)
tc = time of concentration, min
L = length of travel (ft)
S = slope of the flow path from the most remote part of the basin to the calculation point divided by the horizontal distance between the two points, ft/ft

	m	ft
Length	119.5	392.0604
	%	
Slope	5.3	
tc =	2.399552	

*Note tc cannot be less than 5 minutes, therefore:
Reference Airport Draingage, Federal Aviation Administration, 1965 - Figure for Overland Time of Flow chart which was used based on the average C, distance, and slope.
tc = 18mins estimated based on chart using C = 0.34, distance = 392ft, and slope of 5.3%

Post-Development Conditions

time of concentration (tc) Kirpich Equation
tc = 0.0078*L^(0.77)*S^(-0.385)
tc = time of concentration, min
L = length of travel (ft)
S = slope of the flow path from the most remote part of the basin to the calculation point divided by the horizontal distance between the two points, ft/ft

	m	ft
Length	119.5	392.0604
	%	
Slope	4.9	
tc =	2.473152	

*Note tc cannot be less than 5 minutes, therefore:
Reference Airport Draingage, Federal Aviation Administration, 1965 - Figure for Overland Time of Flow chart which was used based on the average C, distance, and slope.
tc = 15mins estimated based on chart using C = 0.42, distance = 392ft, and slope of 4.9%

Pre-Development Conditions

Rational Formula
Q = CIA
Q = Max rate of runoff, (m3/hr or cfs)
C = runoff coefficient
I = avg rainfall intensity for a duration equal to the time of concentration, in (m/hr or in./hr)
A = Drainage area contributing to the design location, (m2 or acres)

C =	0.331699		
	mm/hr	m/hr	in./hr
I =	58	0.058	2.2834658
		m²	acres
A =		12728	3.14515244
		m³/hr	cfs
Q =		244.8685	2.382214704
		m³/s	check
		0.068019	0.067456774

Post-Development Conditions

Rational Formula
Q = CIA
Q = Max rate of runoff, (m3/hr or cfs)
C = runoff coefficient
I = avg rainfall intensity for a duration equal to the time of concentration, in (m/hr or in./hr)
A = Drainage area contributing to the design location, (m2 or acres)

C =	0.413098		
	mm/hr	m/hr	in./hr
I =	67	0.067	2.6377967
		m²	acres
A =		12728	3.14515244
		m³/hr	cfs
Q =		352.2801	3.427173773
		m³/s	check
		0.097856	0.097046704

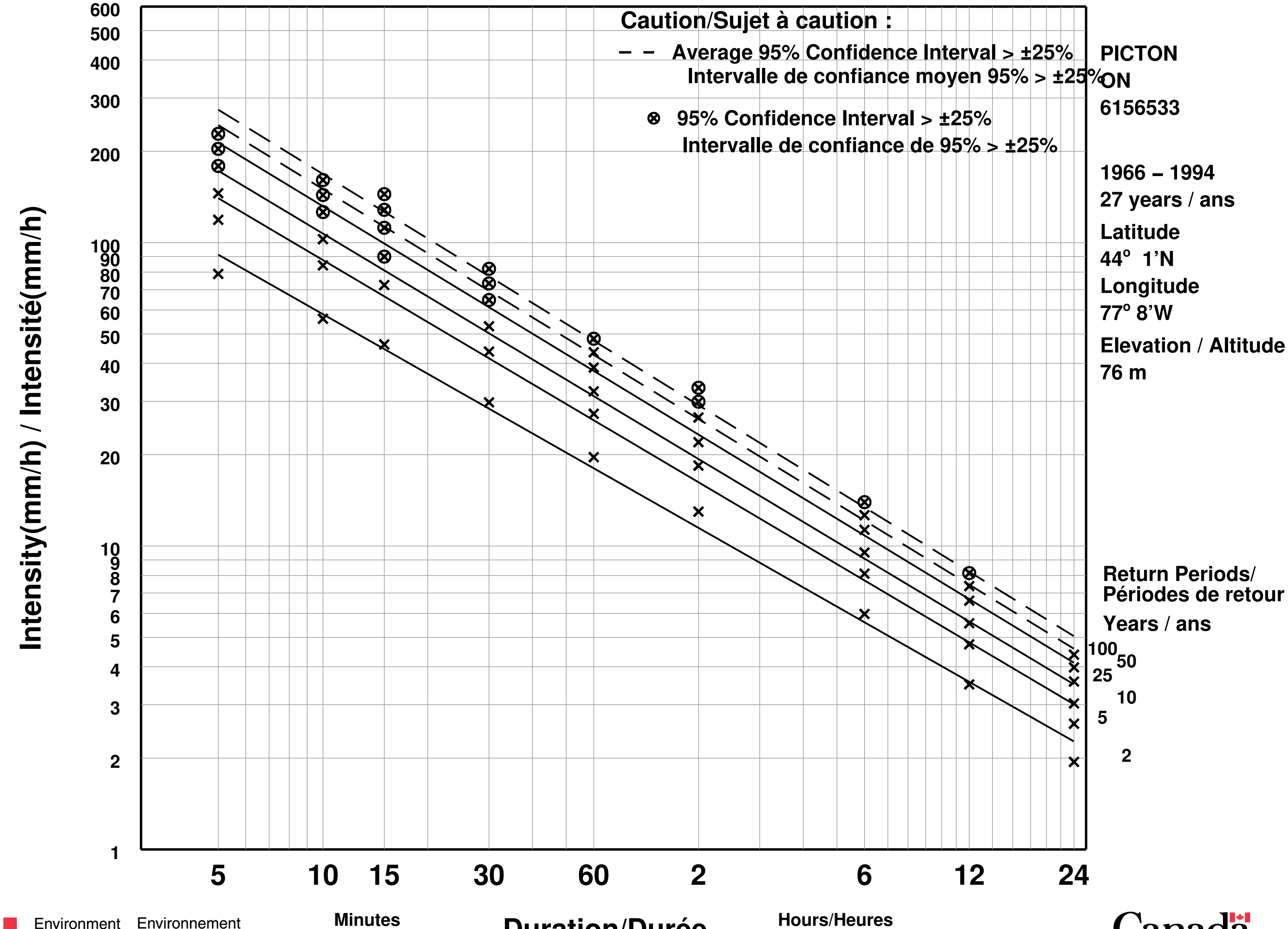
APPENDIX D

SHORT DURATION RAINFALL INTENSITY – DURATION – FREQUENCY DATA FOR PICTON ONTARIO, DATED OCTOBER 31, 2022

Short Duration Rainfall Intensity−Duration−Frequency Data

2022/10/31

Données sur l’intensité, la durée et la fréquence des chutes de pluie de courte durée



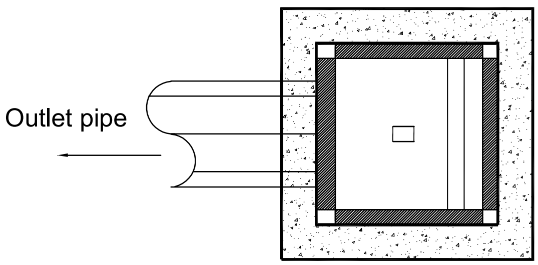
APPENDIX E

CATCH BASIN SHIELD DETAIL

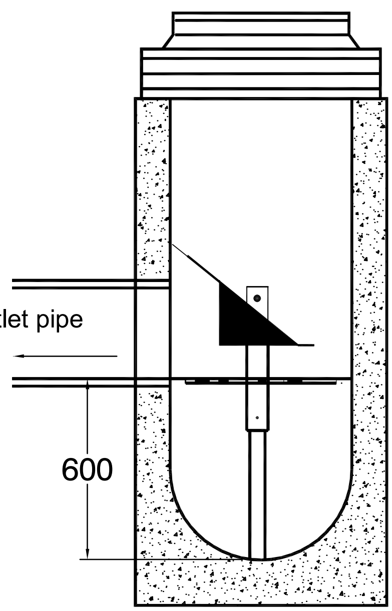
Notes

1 Recommended depth t/g - invert = 1.2m
Maximum depth t/g - invert = 2.4m

1. CB Shield to be installed in non frozen conditions.
2. The frame and cover should be well aligned with the catchbasin.
3. The sump must be clean before installation
4. The grate is at the same elevation as pipe invert.
5. Pipes must be cut flush with inside walls



Top view



Profile view

600 x 600 CB
CB Shield (600mm Sump)