

Stormwater Management Strategy

**Friends, Williams, Hoopers and
Willung Roads Rosedale**

Client

Helen McMillan, Noreen Brand, Kelly Callah

Issued

11/10/2022



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Revision Table

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A	Stormwater Strategy	7/09/21	CC
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Glossary of terms

Alphabetical list of terms and abbreviations used in report

AHD	Australian Height Datum A common national surface level datum approximately corresponding to mean sea level.
AEP	Annual Exceedance Probability. Probability of a flood event occurring in any year.
Authorities	Organisations responsible for supply and management of sewer, water, gas, electricity and telecommunications, roads and transport
BPEMG	Best Practice Environmental Management Guidelines
BWCo	Beveridge Williams & Co Pty Ltd
Client	Helen McMillan, Noreen Brand, Kelly Callah
Council	Wellington Shire
DSS	Drainage Services Scheme
Q ₁₀	Stormwater flow generated from 10% AEP (1 in 10 year) storm event.
Q ₁₀₀	Stormwater flow generated from 1% AEP (1 in 100 year) storm event.
Q _{gap}	Flow difference between Q ₁₀ and Q ₁₀₀ storm event.

1 INTRODUCTION

Beveridge Williams has been commissioned by Helen McMillan, Noreen Brand, Kelly Callah to prepare a Stormwater Management Strategy (SWMS) for a proposed development located at Friends, Williams, Hoopers and Willung Roads Rosedale. The total site area is approximately 75.84 ha and is proposed to be developed into 85 residential lots.

This SWMS is intended to provide sufficient evidence that the stormwater discharges from the proposed development can meet stormwater Best Practice Environmental Management guidelines (BPEMG) and that stormwater discharging from the proposed development shall be to the satisfaction of West Gippsland Catchment Management Authority (WGCMA), Wellington Shire Council and other stakeholders.

1.1 SITE OVERVIEW

The existing site is a large low-density rural residential area located approximately 1.5 km south of the township of Rosedale. It is bounded by Williams Road to the north, Friends Road to the west, Willung Road to the east and Hoopers Road to the south. Along the eastern boundary, there is a property which is not part of the current site extents (refer to **Figure 1**). The site contains several residential properties and associated driveways as well as various dams, however it is primarily vacant land. Additionally, Blind Joe Creek is located approximately 500 m west of the site. The site locality is displayed in **Figure 1**.

The site is covered by an easement for the regional outfall sewer that crosses the central part of the site, as shown in Figure 3.



Figure 1: Site Locality

2 EXISTING CONDITIONS

2.1 TOPOGRAPHY AND DRAINAGE

The site grades in a northerly direction, with a slope of approximately 1 in 80. The site has an external catchment to the south which drains into the site. Site surface water flow follows topographic conditions and is expected to flow from south to north, eventually draining offsite into vacant land.

Site topography and surface water drainage is shown in **Figure 2**.



Figure 2: Surface Water Flow Direction

storage to cater for the additional flows due to development of the site. Stormwater quantity management is further discussed in **Section 4**. To manage stormwater quality, rainwater tanks and swales are suggested. Stormwater quality management is further discussed in **Section 5**.

4 STORMWATER QUANTITY MANAGEMENT

4.1 CATCHMENT AREAS

4.1.1 PRE-DEVELOPED CATCHMENTS

The pre-developed catchments were delineated using the best available elevation data from the Elevation Information System (ELVIS). The site has a considerable upstream catchment of approximately 107.2 ha. It is assumed that there are no culverts underneath Hoopers Road, hence the upstream catchment discharges to site predominantly via sheet flow. There are three inferred outlet points along the northern boundary of the site (refer to **Figure 4**).

The predeveloped catchment plan and flow paths are shown below in **Figure 4**.



Figure 4: Pre-Developed Catchment Plan (Not to scale)

The post developed catchments delineated are based on the indicative subdivision plan (refer to **Figure 3**). It is assumed that the external southern catchments remain unaltered, and that these flows will still enter the site. Given the indicative subdivision plan, there are four outlet points in the post developed scenario (refer to **Figure 5**). Additionally, sub-catchment M has been separated out, as this offsite area is not being altered as part of the development. Catchments F, G, J and K will have flow redirected to the two internal roads, whereas catchments L, M, N, H and I will flow in a northerly direction through each respective sub catchment.

The post development catchment plan is shown in **Figure 5**.



Figure 5: Post-Developed Catchment Plan (Not to scale)

4.2 HYDROLOGY

RORB modelling was utilised to calculate the stormwater runoff flows for both the pre- and post-developed conditions using the Australian Rainfall & Runoff 2019 (AR&R) methodology. Input rainfall data was obtained from the online datahub and Bureau of Meteorology (BoM) websites.

Calibration of the predeveloped RORB model (refer to **Figure 4** for catchment plan) was conducted against results obtained using the Regional Flood Frequency Estimation (RFFE) and rational methods. These results are attached in **Appendix B**. Various kc calculations were trialled and the results of the calibration are presented in **Table 2**. Given the size of the total catchment (1.88 km²) and as well as a conservative measure (greater flows compared to the rational method), the predeveloped RORB model was calibrated against the RFFE. As such the VIC MAR<800 mm calculation for kc was selected, to establish a flow of 16.40 m³/s for the total catchment. This value is within 16% of the RFFE result and therefore deemed suitable and appropriate for the purposes of further modelling.

Table 2: Pre Developed RORB Model Calibration

Location	Rational	RFFE	RORB (VIC MAR <800 mm)	RORB (Aerial Equation)	RORB (Pearse et. al.)
Total catchment	9.62 m ³ /s	14.2 m ³ /s	16.48 m ³ /s	5.04 m ³ /s	10.81 m ³ /s
Kc	-	-	0.74	3.01	1.28

The post developed RORB model was established on the basis of the indicative subdivision plan (refer to **Figure 3**) and the post development catchment plan (refer to **Figure 5**). The change in sub catchment layout is also accompanied by changes in the fraction impervious (f. imp). Within the predeveloped scenario, all sub catchments were given a f. imp of 0.1 due to the predominantly vacant nature of the land. In the post-developed scenario, external sub-catchments (A-E and M) maintained a f. imp of 0.1, however due to the planned development the internal sub catchments were given a f. imp of 0.15. This assumes that all lots have residential properties of 500 m² and associated driveways, and takes into account the two internal roads traversing the site. This is displayed in **Table 3**.

Table 3: Post Developed Catchment Areas and Corresponding f. imp

Sub Catchment	Area (Ha)	Post Developed – f. imp
A-E	107.14	0.1
F	12.55	0.15
G	12.15	0.15
H	5.84	0.15
I	6.07	0.15
J	16.31	0.15
K	11.97	0.15
L	6.59	0.15
M	4.25	0.15
N	5.42	0.15

To calibrate the post developed RORB model, the kc parameter was changed to maintain the kc/d.ave ratio as per the pre developed model. The parameters for both models are presented in **Table 4**.

Table 4: RORB Input Parameters

Parameter	Pre-Developed	Post-Developed
d.ave	1.02	0.98
Kc	0.74	0.71
m	0.8	0.8
IL (mm)	22	22
CL (mm/hr)	3.6	3.6

The results of the RORB modelling are presented below in **Table 5** and attached in **Appendix C**.

Table 5: 1% AEP Peak Flows

1% AEP Flow	Pre Developed	Post Developed (Undetained)
Total Catchment	16.48 m ³ /s (1.5 hr)	16.64 m ³ /s (1.5 hr)

4.3 DETENTION REQUIREMENTS

Boyd's method was used to determine the storage requirement of 864 m³ to detain the 1% AEP peak post development flow back to pre development levels (refer to **Table 5**). This total storage volume was then spread out over 85 lots, therefore requiring 10 m³ of storage at each lot. This will ideally be done using rainwater tanks. Detailed calculations are provided in **Appendix D**.

4.4 SUBJECT SITE OVERLAND FLOW

Overland flow from the site will be directed via the roads for the central portion of the site (catchments F, G, J and K) with the outer portions following natural topographical conditions (catchments L, M, N, I and H). Ultimately the site will continue to discharge to the vacant land abutting the northern boundary of the site. The proposed overland flow path is presented in **Figure 6**.



Figure 6: Site Overland Flow Path

4.5 GAP FLOW - PC CONVEY ASSESSMENT

Given that the site will not have any subsurface drainage, and flows are to be conveyed using roadside swales, the gap flow is the same as the 1% AEP flow. The gap flow results at the locations highlighted in **Figure 6** are presented in **Table 6**. Note that Point A and B are equivalent to the flows at Outlet 2 and 3 respectively, this is done as a conservative measure. The results below are from the original RORB model which includes the external catchments.

Table 6: Gap Flow Results

Location	1% AEP
Point A	7.41 m ³ /s (1.5 hr)
Point B	6.60 m ³ /s (1.5 hr)

The above results (**Table 6**) indicate that Point A would have the highest expected gap flow, therefore a PC convey assessment was completed at this location. As this location has the largest peak gap flow it would also be expected to provide the most conservative results. The PC convey assessment of a 20 m road reserve with a conservative longitudinal slope of 1 in 200, has the capacity to contain a peak gap flow of 7.41 m³/s as well as satisfy the flood safety criteria. A typical cross section is shown below in **Figure 7** and the calculation results is included in **Appendix E**.

For the road pavement area only, the average velocity (V_{av}) x average depth (d_{av}) is 0.16 m²/s, which is less than 0.35 m²/s, the d_{av} of 0.16 m is less than 0.30m and the V_{av} of 0.99 m/s is less than 1.5 m/s. The gap flow is therefore considered to be within flood safety criteria. Note that these values are for the road section only and do not include the swales.

To further accommodate for the gap flow, further filling of the lots may be required to achieve 300 mm freeboard.

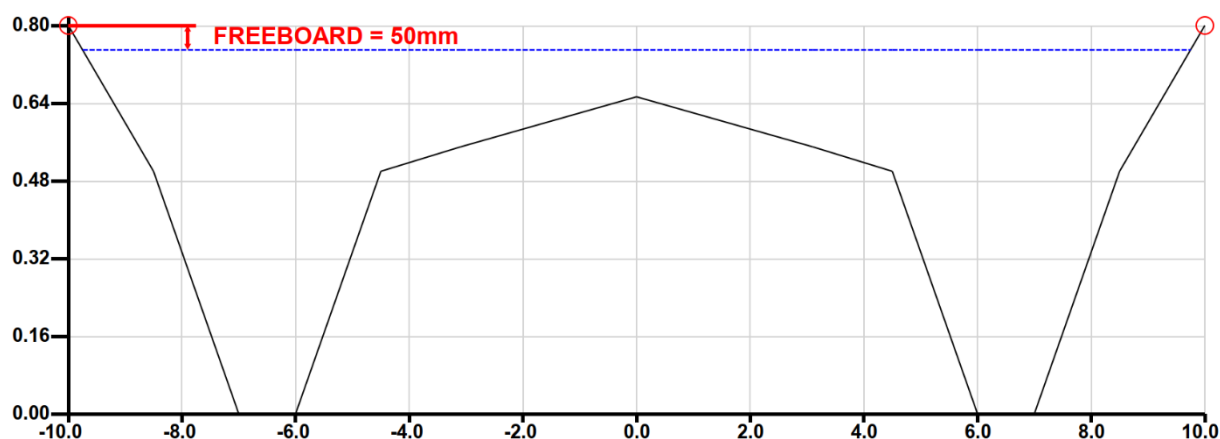


Figure 7: PC Convey Result – Gap Flow at Point A for a 20 m Road Reserve with Swales (Typical Section)

5 STORMWATER QUALITY MANAGEMENT

It is a Victorian Government requirement that quality of stormwater runoff from the proposed development meets the Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG), which are required under Clause 56 of the Victorian Planning Provisions (VPP). The targets are:

- 70% removal of the Total Gross Pollutant Load (Litter);
- 80% removal of Total Suspended Solids (TSS);
- 45% removal of Total Phosphorous (TP); and
- 45% removal of Total Nitrogen (TN).

This site will meet the water quality treatment requirements through the use of rainwater tanks and roadside swales. An indicative layout for these assets is shown in **Figure 8** and results in **Table 7**. As mentioned previously it is assumed that each lot has a 500 m² residential dwelling. It should be noted that internal site catchments H, I, L and N do not contribute flows to the roadside swales.



Figure 8: Stormwater Quality Assets

Table 7: MUSIC Modelling Results

	Target Reduction	Reduction Achieved
Gross Pollutants	70.0%	87.0%
Total Suspended Solids (TSS)	80.0%	75.5%
Total Phosphorus (TP)	45.0%	54.5%
Total Nitrogen (TN)	45.0%	45.8%

Although the results indicate that the suspended solids reduction is under target, the other two pollutant loads meet best practice. The MUSIC model only included the internal roadside swales as a conservative measure, however existing roadside swales that receive flows from the lots along the edges of the development will in reality improve the results greater than those listed in **Table 7**.

Due to the conservative approach in the modelling and the unreasonable need for additional treatment measures that would otherwise be needed to increase the sediment removal result, it is considered that the stormwater treatment arrangement for such a low density site is reasonable.

Details of the treatment assets are provided below in **Table 8**. Note that the rainwater tank volume is for treatment only, the 10 kL (10 m³) storage as determined in **Section 4.3**, is additional to the 10 kL reuse. In total the tanks will require a combined volume of 20 kL.

Table 8: Stormwater Quality Assets

Swale	Value	Rainwater Tank	Value
Number of Swales	5	Number of Tanks	85
Base Width	1.0 m	Volume (treatment only)	10 kL
Top Width	4 m		
Depth	0.5 m		
Batter	1 in 3		

6 CONCLUSION

This report has identified an overall drainage management strategy for the proposed development site located at Friends, Williams, Hoopers and Willung Roads Rosedale. The strategy provides a Stormwater Management Strategy that is constructible and implementable. The strategy covers the following investigations:

- The 20% AEP post-developed flow from the site will be detained to pre-developed levels via onsite detention rainwater tanks. 10 m³ of storage within each lot will be required.
- Stormwater quality treatment from the proposed development will be catered by four roadside swales and rainwater tanks on each lot. The tanks will require at least 10 kL reuse capacity.
- To manage both stormwater quantity and quality each lot will require a combined 20 kL of storage within rainwater tanks, split between reuse and detention with an outlet set halfway up the tank.

The above strategy can be implemented, and all Council's development requirements can be achieved in line with the regulatory requirements for both Council and CMA.

BEVERIDGE WILLIAMS & CO PTY LTD

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Approved for issue by

Chris Curnow

Project Manager

APPENDIX A: INDICATIVE DEVELOPMENT PLAN

LEGEND

Development Plan boundary (approx.)

Internal Title boundaries (approx.)

Standard Density lots

Naturestrip/Swale (indicative)

Road pavement (indicative)

Easement (indicative)

Stage Boundary (Sealed Roads to be constructed in stage order)



- Notes:
- This plan was prepared as a **PROPOSAL** only and should not be used for any other purpose.
 - This plan is subject to Council approval.
 - All dimensions and areas are subject to survey and final computations.
 - Existing dams located within construction areas will be filled during construction.
 - Further investigation may be required for fire buffers, vegetation retention and removal, site access and egress, and aboriginal and cultural heritage.
 - All roads are 28m local access level 1 unless noted otherwise.
 - Road pavement is indicative only based on Infrastructure Design Association Local Government and subject to detailed engineering design.
 - NO ALLOWANCE** has been made for Public Open Space within this development.
 - Arc dimensions shown are length of arc (not chord)
 - This plan boundaries are based on VICMAP data only and subject to survey.
 - A Management Plan will set out infrastructure requirements, i.e. drainage, electricity supply, water supply and road sealing.
 - A landscape plan will show a planting regime for street trees in the road reserve, "i.e. 1 every 10 Meters" and "no development should occur with the Tree Protection Zone of any remnant native trees of more than 10 years in age."

Site (Approx.) VIC MAP only		75.841 ha
* Residential Lots		70.373 ha
* Non-Arterial Roads		5.467 ha
Net Developable Area		75.841 ha
Lot Yield (Standard Density)	85 lots 8279m² average lot size	

* Indicates inclusion in NDA

40

0

40

80

120

160

200

240m

APPENDIX B: RFFE AND RATIONAL METHOD



Pre-Developed Flow Calculations

Client:	0.00	Date:	30.08.2021
Project:	Friends Road Rosedale		
Subject:	PRE-DEVELOPMENT FLOW CALCULATIONS		
Job No:	2100603	By:	RR

Location : Traralgon

ARI Year : 100

Coefficients						
a	b	c	d	e	f	g
4.03822	-0.68446	-0.06823	0.00755	0.00428	-0.00008	-0.00014

INPUT 1 2 3 4A 5A 6

Catchment	Area	Catchment Category	Catchment Type (For Fp)	Calculated Tc	Manual Input Tc	Selected Tc	Selected f _p	Weighted f _p	Calculated C	Manual Input C	Selected C	Ae	ΣAe	I ₁₀₀	Q ₁₀₀
	ha			mins	mins				100			ha	ha	mm/hr	m ³ /s
Total Site	187.290	RURAL1	Rural - Environmental	57.88		57.88	0.1	0.100	0.318		0.318	59.58	59.578	58.14	9.621
TOTAL	187.290	RURAL1		57.88		57.88		0.100	0.318				59.578	58.14	9.621

Tc Calculated using :

$$t_c = 0.76 \times A^{0.38}$$

Equation 5.4 AR&R

Weighted Frac Imperv using :

$$f = \sum \left(f_{area1} \times \frac{A_{area1}}{A_{total}} \right) + \left(f_{area2} \times \frac{A_{area2}}{A_{total}} \right)$$

C10 Calculated using :

$$C_{10} = 0.1 + 0.0133(I_1 - 2.5)$$

$$C_{10} = 0.9 \times f + C_{10} \times (1 - f)$$

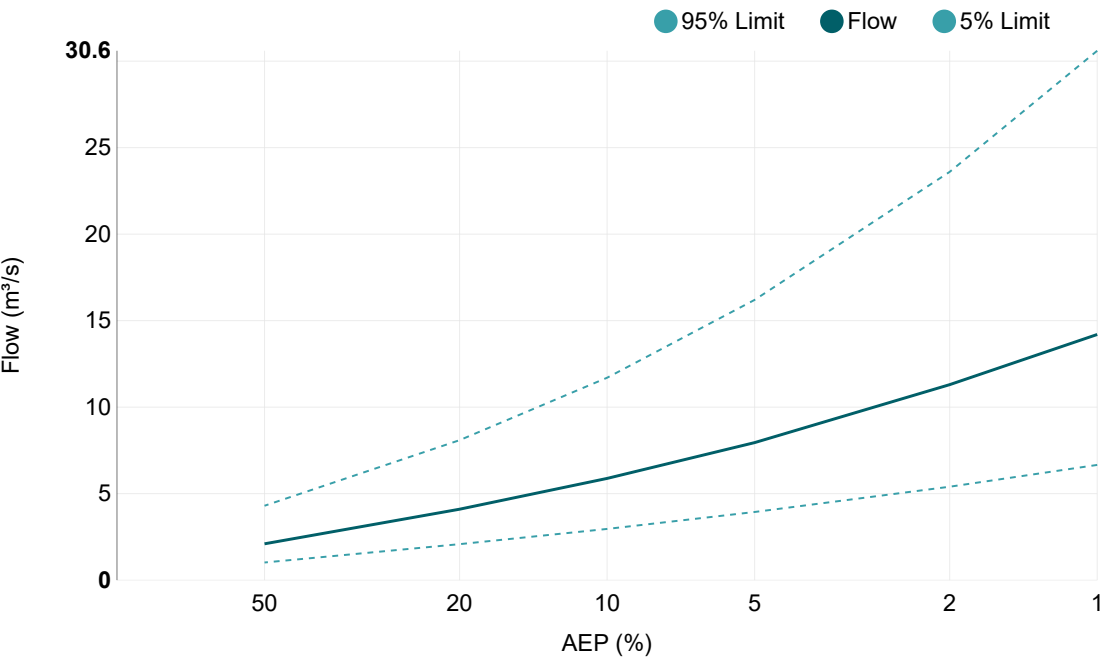
Equation 14.11 and 14.12 AR&R

Q Calculated using :

$$Q = \frac{A_e \times i}{360}$$

Rational Method

Results | Regional Flood Frequency Estimation Model



AEP (%)	Discharge (m³/s)	Lower Confidence Limit (5%) (m³/s)	Upper Confidence Limit (95%) (m³/s)
50	2.10	1.02	4.30
20	4.10	2.08	8.09
10	5.88	2.96	11.7
5	7.95	3.94	16.2
2	11.3	5.40	23.6
1	14.2	6.66	30.6

Statistics

Variable	Value	Standard Dev
Mean	0.443	0.448
Standard Dev	0.760	0.153
Skew	0.103	0.029

Note: These statistics come from the nearest gauged catchment. Details.

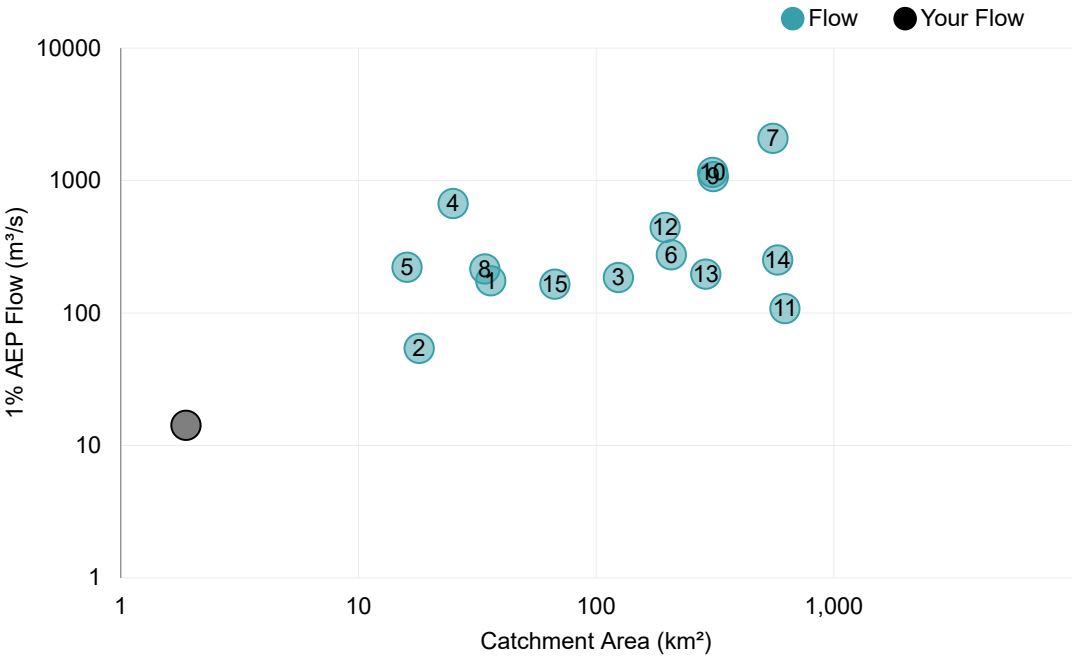
Correlation

Correlation

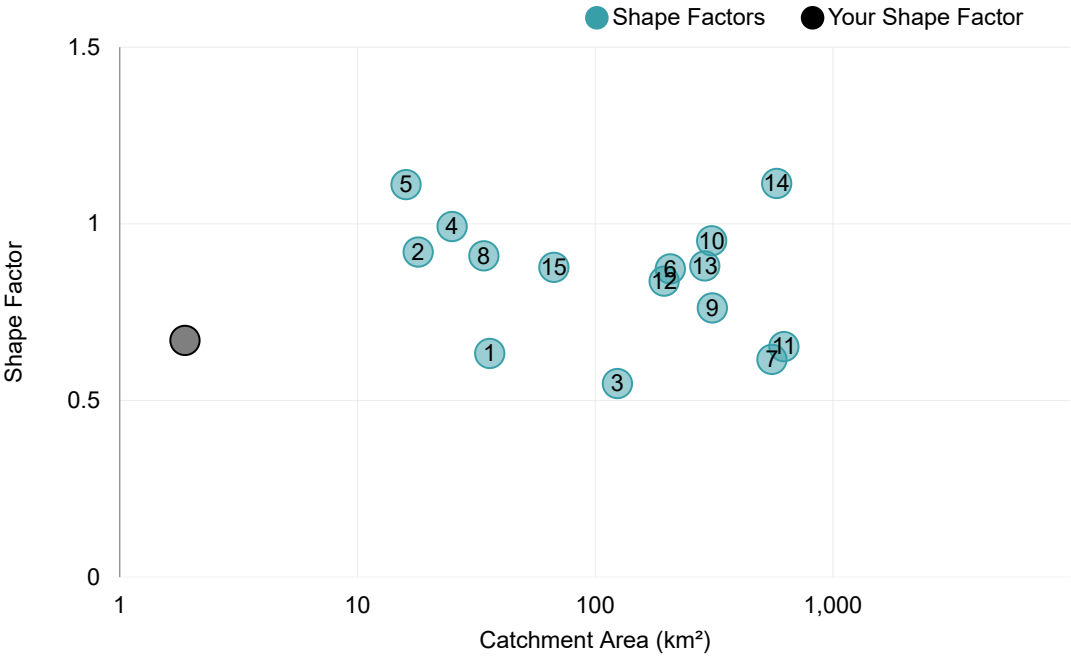
1.000		
-0.330	1.000	
0.170	-0.280	1.000

Note: These statistics are common to each region. Details.

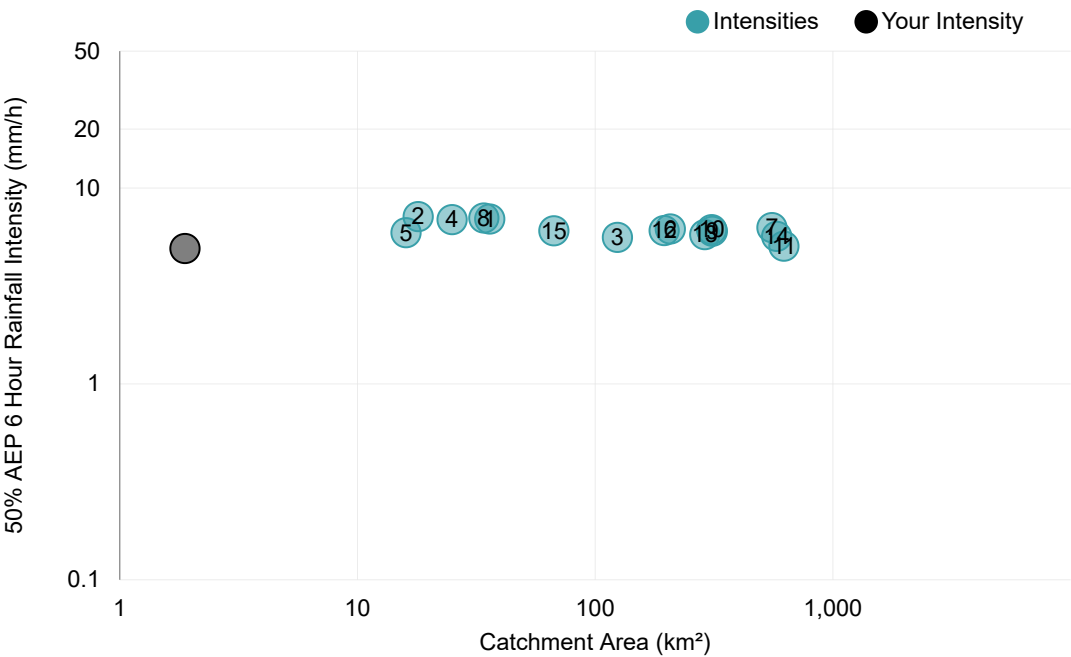
1% AEP Flow vs Catchment Area



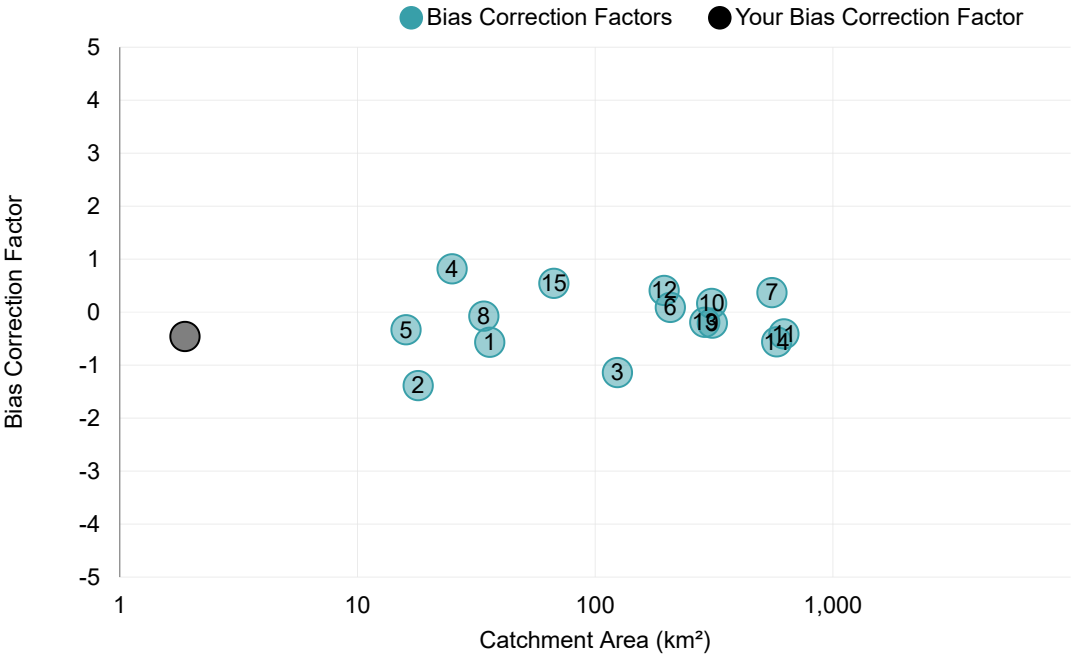
Shape Factor vs Catchment Area



Intensity vs Catchment Area



Bias Correction Factor vs Catchment Area



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⬇️ TXT

⬇️ Nearby

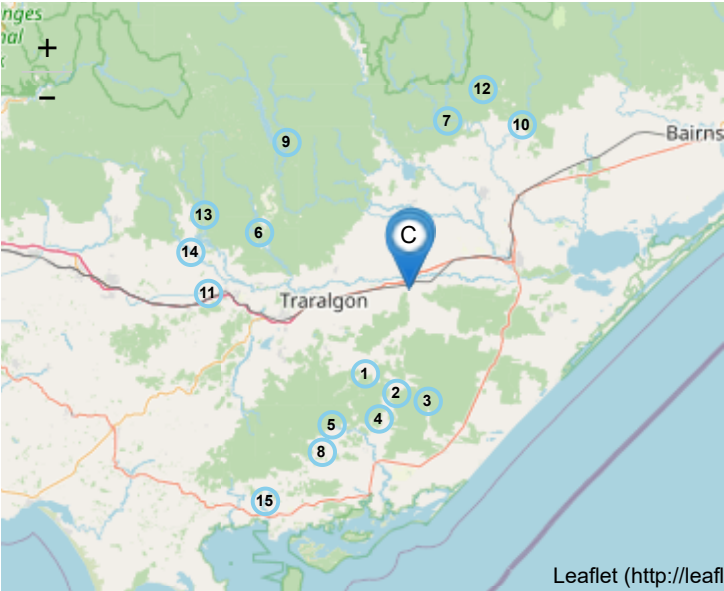
⬇️ JSON

Input Data

Date/Time	2021-08-24 17:04
Catchment Name	Catchment1
Latitude (Outlet)	-38.1651398415
Longitude (Outlet)	146.780424374
Latitude (Centroid)	-38.1733540483
Longitude (Centroid)	146.778734106
Catchment Area (km²)	1.88
Distance to Nearest Gauged Catchment (km)	24.48
50% AEP 6 Hour Rainfall Intensity (mm/h)	4.913284
2% AEP 6 Hour Rainfall Intensity (mm/h)	12.042881
Rainfall Intensity Source (User/Auto)	Auto
Region	East Coast

Input Data

Region Version	RFFE Model 2016 v1
Region Source (User/Auto)	Auto
Shape Factor	0.67
Interpolation Method	Natural Neighbour
Bias Correction Value	-0.459



Leaflet (<http://leafletjs.com>) | © OpenStreetMap (<http://osm.org/copyright>) contributors

Method by Dr Ataur Rahman and Dr Khaled Haddad from Western Sydney University for the Australian Rainfall and Runoff Project. Full description of the project can be found at the project page (<http://arr.ga.gov.au/revision-projects/project-list/projects/project-5>) on the ARR website. Send any questions regarding the method or project here (<mailto:admin@arr-software.org>).



APPENDIX C: RORB CALCULATIONS

ROBWin Batch Run Summary

Program version : 4.45 (not updated) 20th March 2019
Coordinate : Monash University and
Date : run: 26 Aug 2022 9:42
Catchment file : K:\Jobs\2022\100 - Friends, Williams, Hoopers & Willing Roads, Rosedale\Dev1100003-ROB-PrdDev.cfg
Spatial pattern : AR2016 point temporal patterns
Areal fact. : uniform
Lois factors : 1 Constant with AR

Parameter kc = 0.74 m = 0.8

Lois parameter initial loss (mm) Cont. loss (mm/h)

22 3.6

Peak Description

1 Calculated hydrograph AB
2 Calculated hydrograph Outlet
3 Calculated hydrograph D
4 Calculated hydrograph Outlet
5 Calculated hydrograph Outlet
6 Calculated hydrograph Total

Run Duration Unit AEP Thst Rain(mm) AB Peak0001 Peak0002 Peak0003 Peak0004 Peak0005 Peak0006

1 1.6667 hour 1% 21 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 24 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 26 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 27 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 28 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 29 25.3 0.96 0.632 0.7402 0.592 1.1734 0.3479 2.2615

1 1.6667 hour 1% 30 31.1 0.97 1.6898 1.9809 1.4105 2.9148 0.8515 5.7472

2 0.25 hour 1% 21 31.1 0.97 1.6898 1.9809 1.4105 2.9148 0.8515 5.7472

2 0.25 hour 1% 25 31.1 0.97 1.7179 2.0105 1.4933 3.0349 0.8925 5.9379

2 0.25 hour 1% 24 31.1 0.97 1.7149 2.0072 1.4838 3.0209 0.8883 5.9164

2 0.25 hour 1% 26 31.1 0.97 1.8061 2.1133 1.6306 3.2714 0.9663 6.3551

2 0.25 hour 1% 27 31.1 0.97 1.711 2.0204 1.4715 3.0026 0.8824 5.8874

2 0.25 hour 1% 28 31.1 0.97 1.711 2.0204 1.4715 3.0026 0.8824 5.8874

2 0.25 hour 1% 29 31.1 0.97 1.7201 2.013 1.4987 3.0446 0.8957 5.9533

2 0.25 hour 1% 30 31.1 0.97 1.8061 2.1133 1.6306 3.2714 0.9663 6.3551

3 0.3333 hour 1% 21 31.1 0.97 1.8061 2.1133 1.6306 3.2714 0.9663 6.3551

3 0.3333 hour 1% 25 31.1 0.97 2.4793 2.8846 1.8847 4.3114 1.5116 8.2776

3 0.3333 hour 1% 26 31.1 0.97 2.4793 2.8846 1.8847 4.3114 1.5116 8.2776

3 0.3333 hour 1% 27 31.1 0.97 2.4793 2.8846 1.8847 4.3114 1.5116 8.2776

3 0.3333 hour 1% 28 31.1 0.97 2.4793 2.8846 1.8847 4.3114 1.5116 8.2776

3 0.3333 hour 1% 29 31.1 0.97 2.4793 2.8846 1.8847 4.3114 1.5116 8.2776

3 0.3333 hour 1% 30 31.1 0.97 2.4793 2.8846 1.8847 4.3114 1.5116 8.2776

3 0.3333 hour 1% 21 38.9 0.97 2.9215 3.758 2.1963 4.8543 1.9407 9.9733

3 0.3333 hour 1% 25 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

3 0.3333 hour 1% 24 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

3 0.3333 hour 1% 26 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

3 0.3333 hour 1% 27 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

3 0.3333 hour 1% 28 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

3 0.3333 hour 1% 29 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

3 0.3333 hour 1% 30 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 21 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 25 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 24 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 26 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 27 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 28 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 29 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

4 0.4167 hour 1% 30 38.9 0.97 3.2479 3.9319 2.4946 5.4689 1.5138 10.9356

5 0.5 hour 1% 21 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

5 0.5 hour 1% 25 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

5 0.5 hour 1% 24 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

5 0.5 hour 1% 26 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

5 0.5 hour 1% 27 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

5 0.5 hour 1% 28 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

5 0.5 hour 1% 29 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

5 0.5 hour 1% 30 41.7 0.98 3.513 4.544 2.6539 5.862 1.6148 11.9275

6 0.75 hour 1% 21 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

6 0.75 hour 1% 25 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

6 0.75 hour 1% 24 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

6 0.75 hour 1% 26 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

6 0.75 hour 1% 27 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

6 0.75 hour 1% 28 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

6 0.75 hour 1% 29 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

6 0.75 hour 1% 30 47.8 0.98 4.1213 6.0336 3.0561 7.0652 1.902 14.4022

7 1 hour 1% 21 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

7 1 hour 1% 25 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

7 1 hour 1% 24 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

7 1 hour 1% 26 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

7 1 hour 1% 27 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

7 1 hour 1% 28 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

7 1 hour 1% 29 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

7 1 hour 1% 30 52.1 0.98 4.657 6.6466 3.2604 7.9263 2.0403 16.0882

8 1.5 hour 1% 21 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

8 1.5 hour 1% 25 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

8 1.5 hour 1% 24 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

8 1.5 hour 1% 26 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

8 1.5 hour 1% 27 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

8 1.5 hour 1% 28 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

8 1.5 hour 1% 29 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

8 1.5 hour 1% 30 58.2 0.98 4.3717 6.9912 2.8817 7.8905 1.8164 16.2975

9 2 hour 1% 21 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

9 2 hour 1% 25 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

9 2 hour 1% 24 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

9 2 hour 1% 26 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

9 2 hour 1% 27 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

9 2 hour 1% 28 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

9 2 hour 1% 29 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

9 2 hour 1% 30 62.7 0.98 4.8231 8.0523 2.4435 7.024 1.5451 15.2099

10 3 hour 1% 21 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

10 3 hour 1% 25 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

10 3 hour 1% 24 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

10 3 hour 1% 26 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

10 3 hour 1% 27 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

10 3 hour 1% 28 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

10 3 hour 1% 29 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

10 3 hour 1% 30 69.5 0.98 4.8771 8.8143 2.9528 8.1906 1.8893 19.8943

11 4.5 hour 1% 21 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

11 4.5 hour 1% 25 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

11 4.5 hour 1% 24 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

11 4.5 hour 1% 26 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

11 4.5 hour 1% 27 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

11 4.5 hour 1% 28 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

11 4.5 hour 1% 29 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

11 4.5 hour 1% 30 77.1 0.99 4.951 1.9513 1.595 4.7621 1.0081 10.7216

12 6 hour 1% 21 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

12 6 hour 1% 25 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

12 6 hour 1% 24 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

12 6 hour 1% 26 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

12 6 hour 1% 27 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

12 6 hour 1% 28 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

12 6 hour 1% 29 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

12 6 hour 1% 30 83.3 0.99 2.8529 3.0508 1.8316 5.292 1.1994 11.5021

13 9 hour 1% 21 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

13 9 hour 1% 25 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

13 9 hour 1% 24 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

13 9 hour 1% 26 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

13 9 hour 1% 27 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

13 9 hour 1% 28 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

13 9 hour 1% 29 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

13 9 hour 1% 30 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 21 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 25 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 24 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 26 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 27 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 28 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 29 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.347 11.5836

14 12 hour 1% 30 93.5 0.99 1.0127 1.5661 1.9775 5.4977 1.

RORWin Batch Run Summaryv 1% PostDev

Program version 6.45 (last updated 20th March 2019)
Copyright Moushav University and Hydrology and Consulting
Date run: 7 Sep 2021 9:32
Catchment file : K:\Jobs Data\210X Friends, Williams, Hoopers & Willing Roads, Rosedale\ Dev\2100603 RORWin PostDev.catz
Rainfall location: User defined
Temporal pattern : ARR2016 point temporal patterns
Spatial pattern Uniform
Anal Red Fact. Based on ARI
Loss factors : Constant with ARI

Parameter kc = 0.71 m = 0.8
Loss parameter Initial loss (mm) Cont. loss (mm/hr)
22 3.6

Peak Description
1 Calculated hydrograph AB 2
2 Calculated hydrograph Outlet
3 Calculated hydrograph D
4 Calculated hydrograph Outlet 3
5 Calculated hydrograph Outlet 4
6 Calculated hydrograph Outlet 1
7 Calculated hydrograph Total

Run	Duration	Unit	AEP	TPat	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004	Peak0005	Peak0007	
1	0.166667	hour	1%	21	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	22	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	23	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	24	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	25	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	26	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	27	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	28	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	29	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
1	0.166667	hour	1%	30	25.3	0.96	0.6258	0.9711	0.5872	1.0722	0.5768	0.3927	3.0128
2	0.25	hour	1%	21	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	22	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	23	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	24	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	25	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	26	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	27	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	28	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	29	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
2	0.25	hour	1%	30	31.1	0.97	1.0742	2.1206	1.4488	2.3125	1.1862	0.8313	4.0607
3	0.333333	hour	1%	21	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	22	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	23	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	24	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	25	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	26	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	27	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	28	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	29	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
3	0.333333	hour	1%	30	35.5	0.97	1.4572	2.8312	1.8732	2.9949	1.5125	1.025	4.8389
4	0.416667	hour	1%	21	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	22	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	23	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	24	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	25	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	26	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	27	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	28	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	29	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
4	0.416667	hour	1%	30	38.9	0.97	1.3407	3.6776	2.4211	3.7863	1.911	1.3065	5.2504
5	0.5	hour	1%	21	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	22	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	23	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	24	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	25	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	26	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	27	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	28	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	29	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
5	0.5	hour	1%	30	41.7	0.98	1.7824	3.8205	2.7382	4.2	2.032	1.4895	5.1579
6	0.75	hour	1%	21	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	22	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	23	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	24	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	25	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	26	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	27	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	28	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	29	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
6	0.75	hour	1%	30	47.8	0.98	3.1373	5.8935	3.6713	5.1578	2.0119	1.4165	11.4397
7	1	hour	1%	21	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	22	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	23	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	24	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	25	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	26	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	27	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	28	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	29	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
7	1	hour	1%	30	52.1	0.98	4.7558	8.8811	5.6795	5.9376	1.971	1.375	15.5479
8	1.5	hour	1%	21	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	22	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	23	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	24	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	25	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	26	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	27	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	28	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	29	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
8	1.5	hour	1%	30	58.2	0.98	6.3328	11.244	7.2315	7.382	2.4541	1.536	18.1189
9	2	hour	1%	21	62.7	0.98	8.4847	15.062	9.5626	9.5118	3.098	1.9454	21.3685
9	2	hour	1%	22	62.7	0.98	8.4847	15.062	9.5626	9.5118	3.098	1.9454	21.3685
9	2	hour	1%	23	62.7	0.98	8.4847	15.062	9.5626	9.5118	3.098	1.9454	21.3685
9	2	hour	1%	24	62.7	0.98	8.4847	15.062	9.5626	9.5118	3.098	1.9454	21.3685
9	2	hour	1%	25	62.7	0.98	8.4847	15.062	9.5626	9.5118	3.098	1.9454	21.3685
9	2	hour	1%	26	62.7	0.98	8.4847	15.062	9.5626	9.5118	3.098	1.9454	21.3685
9	2	hour	1%	27	62.7	0.98	8.4847	15.062	9.5626	9.5118	3.098	1.9454	21.3685
9	2	hour	1%	28	62.7	0.98	8.4847</						

APPENDIX D: DETENTION CALCULATION



Client:	0.00	Date:	07.09.2021
Project:	0.00		
Subject:	Friends, Williams, Hoopers and Willung Roads Rosedale 1% AEP Detention		
Job No:	2100603.00	By:	RR

Storm Duration	I	Sum CA	Peak Inflow	Inflow Volume V _I	Peak Allowable	1-Qp/Ip	Smax
			Ip		Qp		(m ³)
min	mm/hr	(ha)	(m ³ /s)	(m ³)	(m ³ /s)		
90			16.640	89856.00	16.480	0.01	864.00

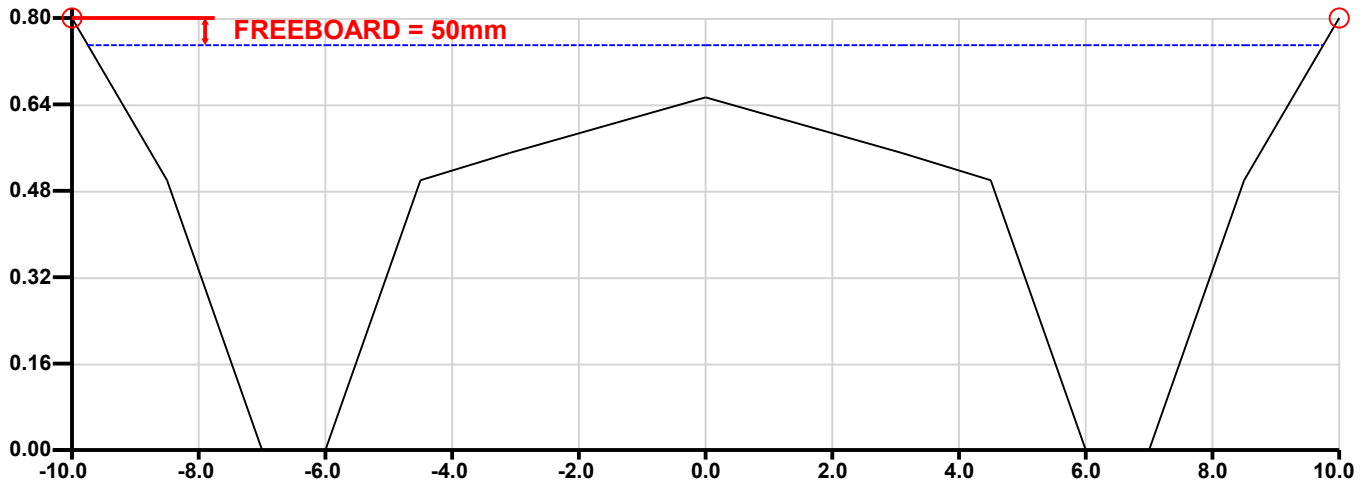
Required Detention, m ³	864.00
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Boyd's Formula

$$Q_P = I_P \left[1 - \frac{S_{\max}}{V_I} \right]$$

Inflow volume is determined from simplified triangular hydrograph

APPENDIX E: PC CONVEY ASSESSMENT

1. CROSS-SECTION:2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 7.41 cumecs

There is no pipe discharge

Overland / Channel / Watercourse discharge = 7.410 cumecs

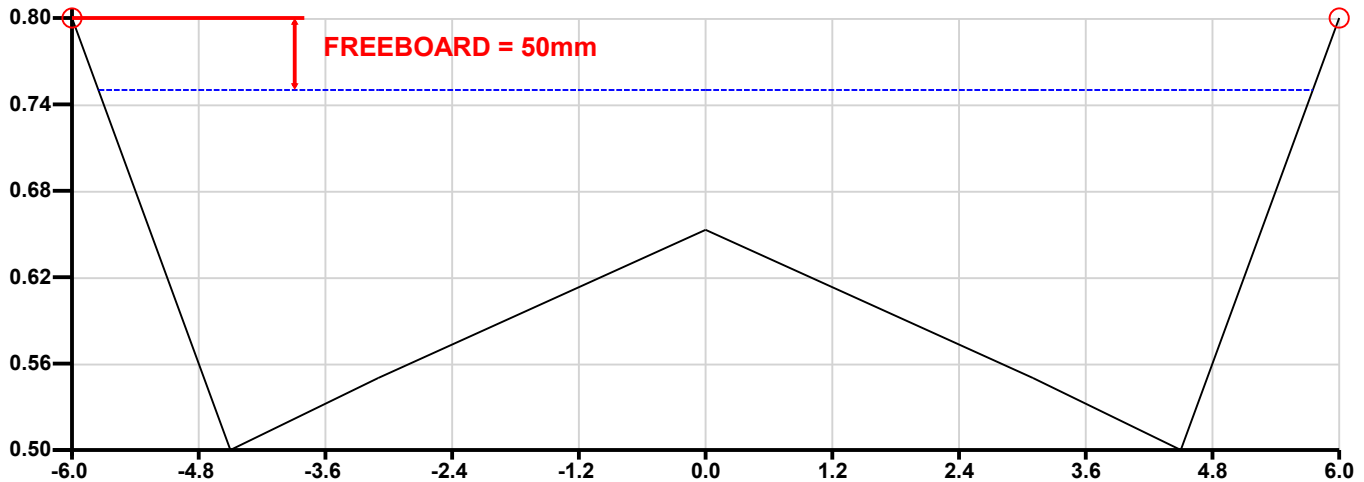
3. RESULTS: Water surface elevation = 0.750m

High Flow Channel grade = 1 in 80, Main Channel / Low Flow Channel grade = 1 in 200.

	<u>LEFT</u> <u>OVERBANK</u>	<u>MAIN</u> <u>CHANNEL</u>	<u>RIGHT</u> <u>OVERBANK</u>	<u>TOTAL</u> <u>CROSS-SECTION</u>
Discharge (cumecs):	0.00	7.71	0.00	7.71
D(Max) = Max. Depth (m):	0.00	0.75	0.00	0.75
D(Ave) = Ave. Depth (m):	0.00	0.33	0.00	0.33
V = Ave. Velocity (m/s):	0.00	1.21	0.00	1.21
D(Max) x V (cumecs/m):	0.00	0.91	0.00	0.91
D(Ave) x V (cumecs/m):	0.00	0.40	0.00	0.40
Froude Number:	0.00	0.68	0.00	0.68
Area (m ²):	0.00	6.36	0.00	6.36
Wetted Perimeter (m):	0.00	19.88	0.00	19.88
Flow Width (m):	0.00	19.50	0.00	19.50
Hydraulic Radius (m):	0.00	0.32	0.00	0.32
Composite Manning's n:	0.000	0.027	0.000	0.027
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA:

<u>SEGMENT NO.</u>	<u>LEFT HAND POINT</u>		<u>RIGHT HAND POINT</u>		<u>MANNING'S N</u>
	<u>CHAINAGE (m)</u>	<u>R.L. (m)</u>	<u>CHAINAGE (m)</u>	<u>R.L. (m)</u>	
1	-10.000	0.800	-8.500	0.500	0.035
2	-8.500	0.500	-7.000	0.000	0.035
3	-7.000	0.000	-6.000	0.000	0.035
4	-6.000	0.000	-4.500	0.500	0.035
5	-4.500	0.500	-3.100	0.550	0.013
6	-3.100	0.550	0.000	0.653	0.013
7	0.000	0.653	3.100	0.550	0.013
8	3.100	0.550	4.500	0.500	0.013
9	4.500	0.500	6.000	0.000	0.035
10	6.000	0.000	7.000	0.000	0.035
11	7.000	0.000	8.500	0.500	0.035
12	8.500	0.500	10.000	0.800	0.035

1. CROSS-SECTION:2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 1.8 cumecs

There is no pipe discharge

Overland / Channel / Watercourse discharge = 1.800 cumecs

3. RESULTS: Water surface elevation = 0.750m

High Flow Channel grade = 1 in 80, Main Channel / Low Flow Channel grade = 1 in 200.

	<u>LEFT OVERBANK</u>	<u>MAIN CHANNEL</u>	<u>RIGHT OVERBANK</u>	<u>TOTAL CROSS-SECTION</u>
Discharge (cumecs):	0.00	1.85	0.00	1.85
D(Max) = Max. Depth (m):	0.00	0.25	0.00	0.25
D(Ave) = Ave. Depth (m):	0.00	0.16	0.00	0.16
V = Ave. Velocity (m/s):	0.00	0.99	0.00	0.99
D(Max) x V (cumecs/m):	0.00	0.25	0.00	0.25
D(Ave) x V (cumecs/m):	0.00	0.16	0.00	0.16
Froude Number:	0.00	0.79	0.00	0.79
Area (m ²):	0.00	1.86	0.00	1.86
Wetted Perimeter (m):	0.00	11.55	0.00	11.55
Flow Width (m):	0.00	11.50	0.00	11.50
Hydraulic Radius (m):	0.00	0.16	0.00	0.16
Composite Manning's n:	0.000	0.021	0.000	0.021
Split Flow?	-	-	-	No

4. CROSS-SECTION DATA:

<u>SEGMENT NO.</u>	<u>LEFT HAND POINT</u>		<u>RIGHT HAND POINT</u>		<u>MANNING'S N</u>
	<u>CHAINAGE (m)</u>	<u>R.L. (m)</u>	<u>CHAINAGE (m)</u>	<u>R.L. (m)</u>	
1	-6.000	0.800	-4.500	0.500	0.035
2	-4.500	0.500	-3.100	0.550	0.015
3	-3.100	0.550	0.000	0.653	0.015
4	0.000	0.653	3.100	0.550	0.015
5	3.100	0.550	4.500	0.500	0.015
6	4.500	0.500	6.000	0.800	0.035