Beveridge Williams
development & environment consultants

32 Grundy Avenue, Nyora

Stormwater Management Strategy

Dec 2018

DOCUMENT CONTROL DATA

	Beveridge Williams Melbourne Office 1 Glenferrie Road Malvern Vic 3144 PO Box 61 Malvern Vic 3144 Tel: (03) 9524 8888 Fax: (03) 9524 8899 www.beveridgewilliams.com.au	**Title**	Stormwater Management Strategy – 32 Grundy Ave, Nyora
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		Checked	Aram Manjikian
		Project Manager	Andrea Boully
		Synopsis	*Stormwater discharge strategy for the proposed residential development located at 32 Grundy Ave, Nyora*

Reference: 1601444

Client: Wayne Allen

Revision Table

Rev	Description	Date	Authorised
A	Initial Submission	06/12/2018	AB
B	Updated Survey Plan	20/12/2018	AB

Distribution Table

Date	Revision	Distribution
06/12/2018	A	*Council, Beveridge Williams, Client, Drainage Authority*
20/12/2018	B	*Council, Beveridge Williams, Client, Drainage Authority*

CONTENTS

APPENDICES

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
CMA	South Gippsland Catchment Management Authority
Client	Wayne Allen
Council	South Gippsland Shire Council
IDM	Infrastructure Design Manual
NTWL	Normal Top Water Level
Q_5	Storm water flow generated from 5-year AEP storm event.
Q_{10}	Storm water flow generated from 10-year AEP storm event.
Q_{100}	Storm water flow generated from 100-year AEP storm event.
Q_{gap}	Flow difference between Q_5 and Q_{100} storm event.
RB	Retardation Basin
SEPP	State Environment Protection Policy
WSUD	Water Sensitive Urban Design

1 INTRODUCTION

Beveridge Williams have been commissioned by Wayne Allen to prepare a preliminary Stormwater Management Strategy (SWMS) for a proposed residential development site located at 32 Grundy Ave, Nyora. The total site area is approximately 1.643 ha and it is proposed to develop the land into 14 residential lots.

This SWMS report is intended to provide sufficient evidence that drainage strategy from the proposed development site can meet Stormwater Best Practice Environmental Management Guidelines (BPEMG) and to the satisfaction of South Gippsland Shire Council and other relevant authorities.

1.1 Site Overview

The subject site is located approximately 100km South East of Melbourne and is currently occupied by rural properties. The site is irregular in shape with a total area of 1.64 hectares and fronts Grundy Avenue to the east (see Figure 1). The site is bounded by low density residential area to the north and south and by vacant land to the west.

Figure 1: Location Plan (Aerial) *(Source: Near Map - Not to Scale)*

2 EXISTING CONDITIONS

2.1 Topography

There is a row of plants/trees on the eastern boundary of the site, parallel to Grundy Ave and a cluster of plants/trees around the centre area. The topography is undulating, and majority of the slope falls from the west to north east direction. The remaining of the slope falls from east to north/north west and south direction. The site is moderately steep, with an approximate 1 in 20 grade that is relatively constant throughout the whole site.

The high point (RL 142m) is located on the centre of the site and the low point (RL 136m) is located on the north east corner. The survey conducted by SK Spatial Land Surveying Consultants is shown in Figure 2 below (and Appendix A).

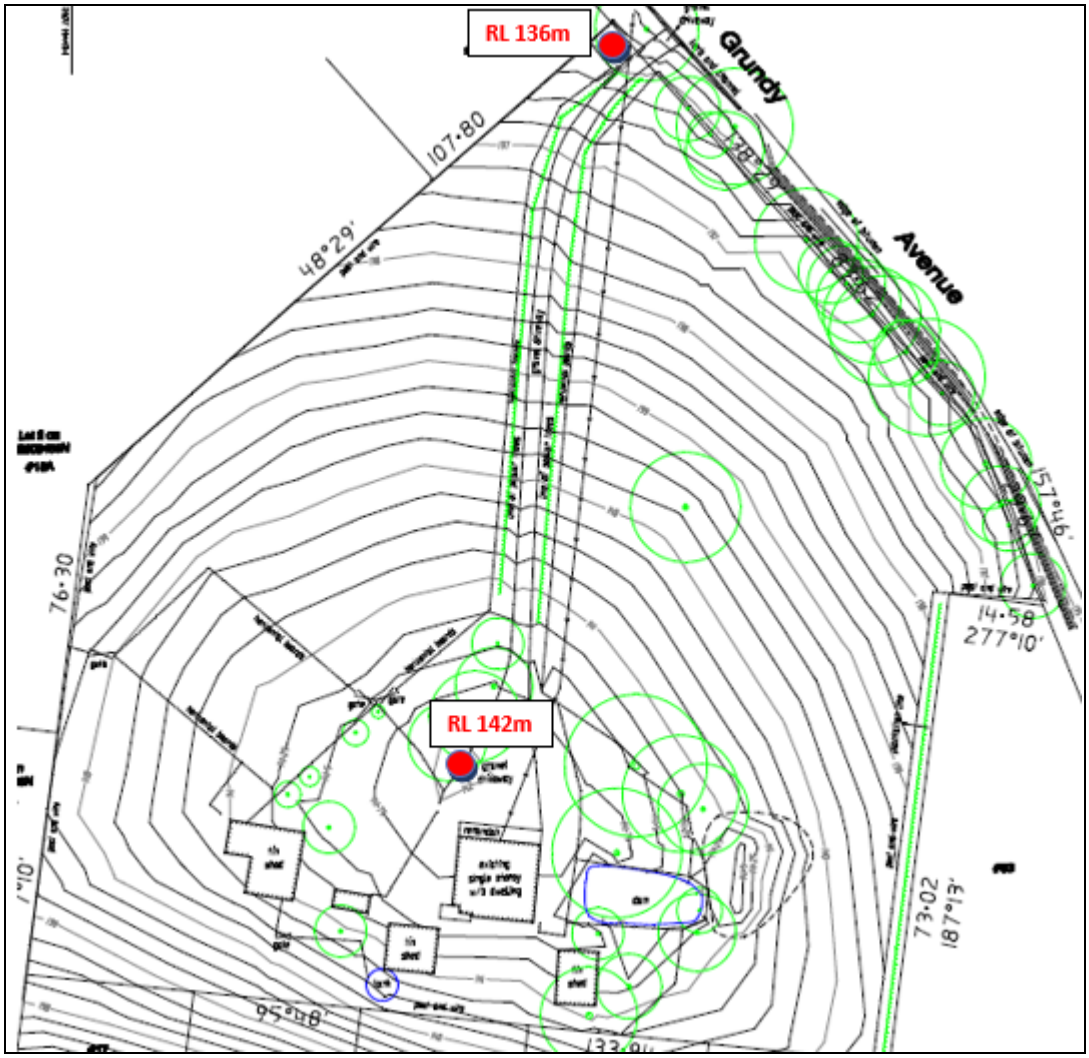


Figure 2: Site Topography Plan *(Not to Scale) (Source: SK Spatial Land Surveying Consultants)*

2.2 Surface Water and Drainage

As previously mentioned, the site slope generally falls from west to north east direction. Surface water flows from the high point on the centre of the site to mainly north east direction. The remaining flows drain to north/north west and south directions (Refer to Figure 3 below).

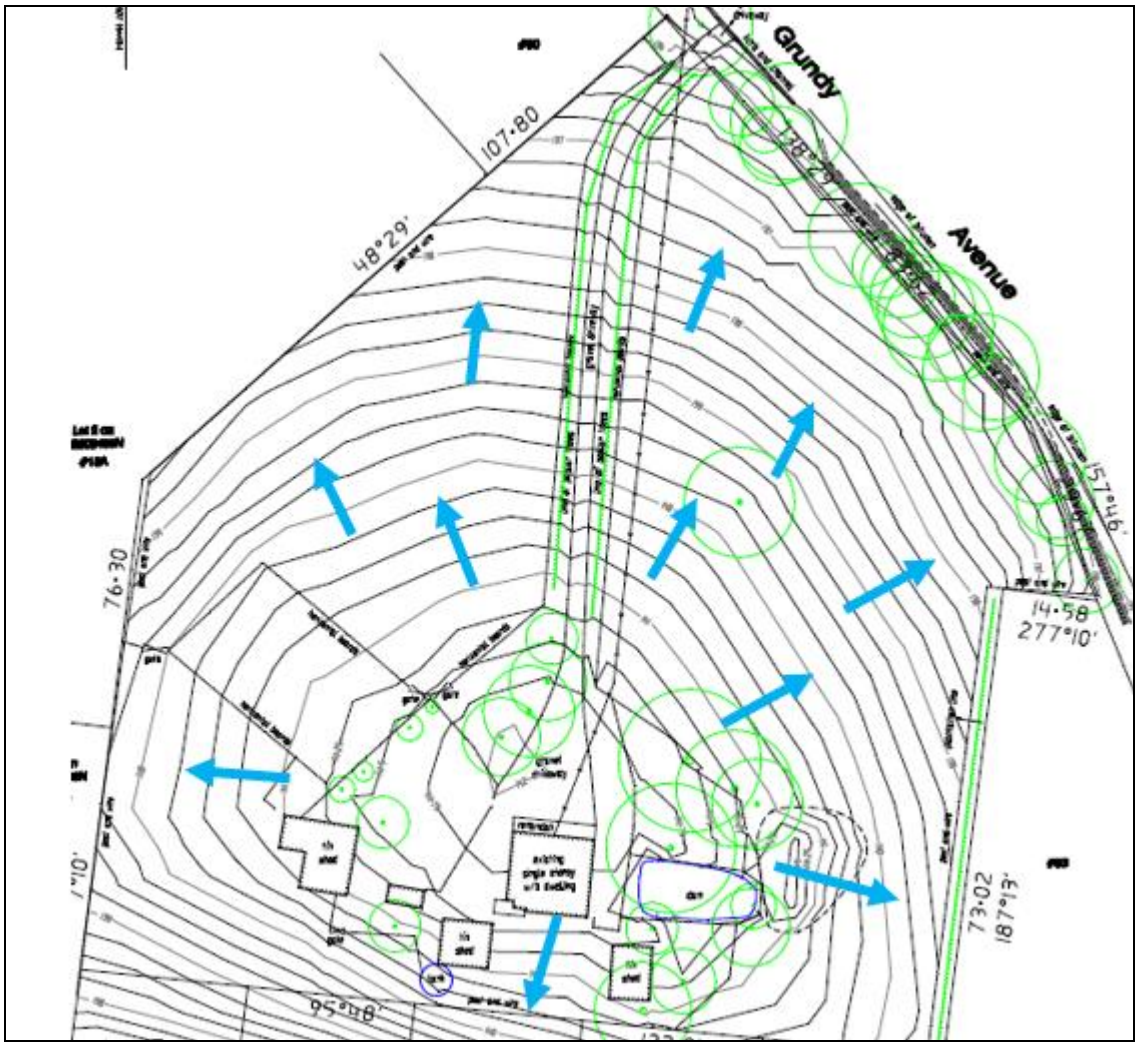


Figure 3: Site Flow Analysis Plan *(Not to Scale)* *(Source: SK Spatial Land Surveying Consultants)*

3 DESIGN INTENT

3.1 Proposed Development

The proposal of the subdivision site intends to form 14 residential lots with an average lot size of 923m^2. The site includes road (0.257 ha) as well as open space area (0.094 ha) (Refer to Figure 4 below and Appendix B).

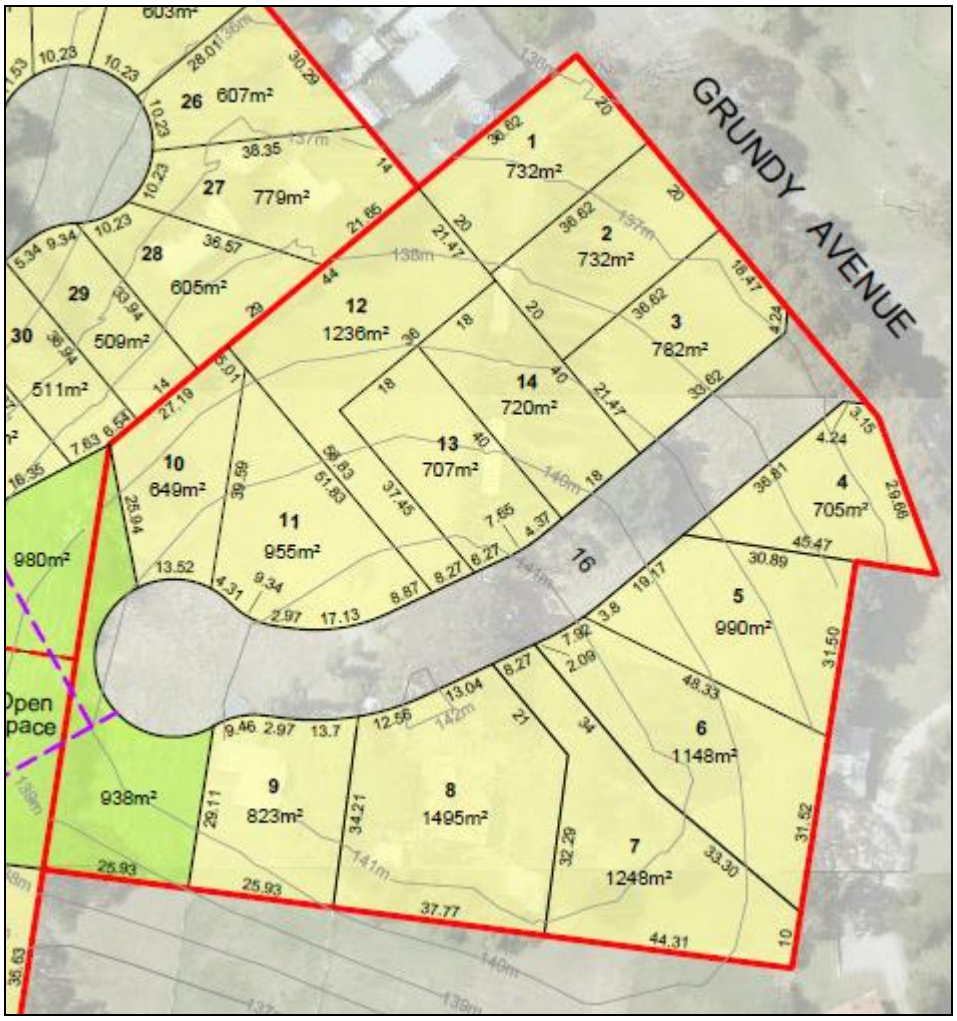


Figure 4: Indicative Subdivision Plan *(Not to Scale)*

Details of the indicative subdivision development plan are shown in Table 1 below.

Table 1: Details of Indicative Subdivision Plan of 32 Grundy Avenue, Nyora

Details	Area
Standard Density Lots (19 Lots)	1.292 ha
Road	0.257 ha
Passive open Space	0.094 ha
Total Area	**1.643 ha**

3.2 Proposed Stormwater Management Strategy

This SWMS has been proposed to follow the existing natural features of the pre-developed site.

For stormwater quantity management, it is proposed to provide two separate detention storage systems to cater for the flow from the development site. The strategy is to provide stormwater detention storage to detain the Q_{10} post development site flow to pre-development level. This is in accordance with Council's confirmation for the neighbouring site and previously outlined in the Stormwater Management Strategy Report for 18 A Davis Street, Nyora, prepared by Beveridge Williams (July 2018).

Storage detention will be provided for both western part (0.611 ha) and eastern part (1.032 ha) of the site development (Refer to the Catchment Plan on Figure 5 below).

For stormwater quality management, it is proposed to provide proprietary devices within the road reserve to provide the stormwater treatment for the development site. The treatment system will also include mandated rainwater tanks in each individual lot.

Details of both the stormwater quantity and quality management are discussed in sections 4 and 5.

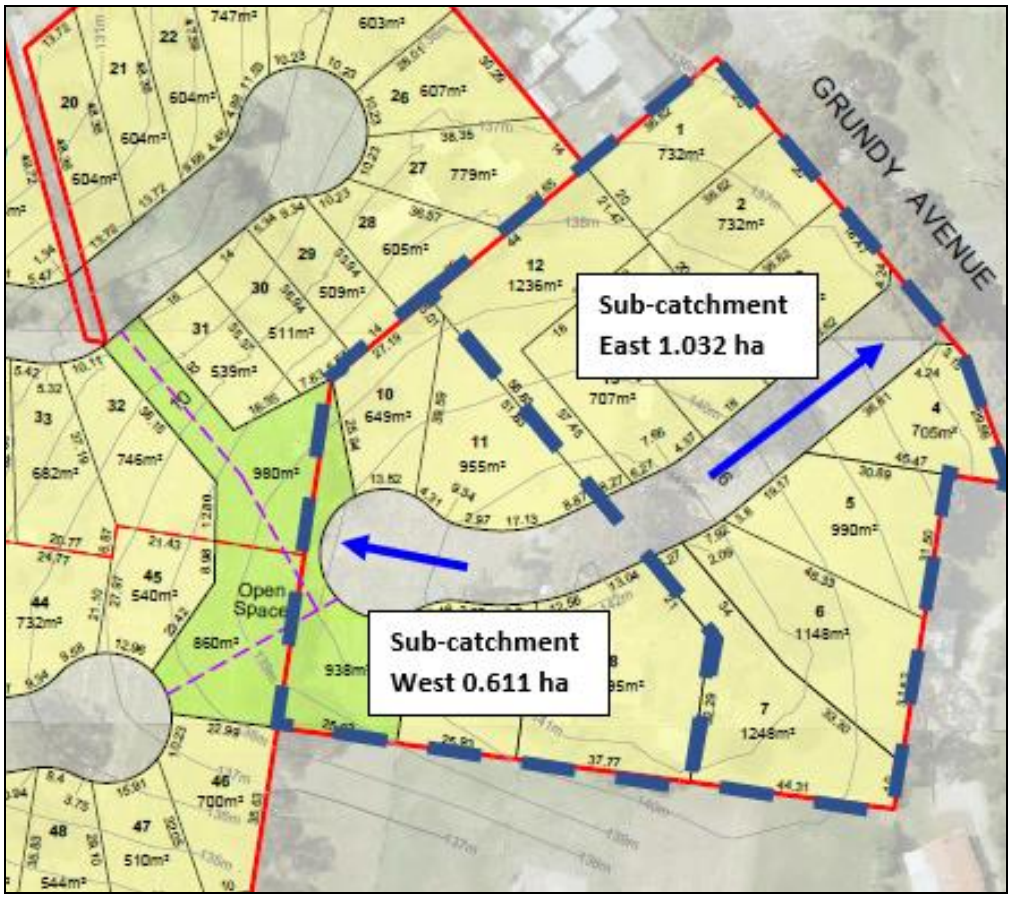


Figure 5: Catchment Plan *(Not to Scale)*

4 STORMWATER QUANTITY MANAGEMENT

As per section 3.2, stormwater runoff for the 1 in 10-year AEP event will need to be detained from the post development to pre-development condition. Details of stormwater quantity management are discussed in the following sections.

4.1 Hydrology

Pre and Post Development Flows Overall Site

The hydrological analysis of the 1 in 5, 10 and 100-year AEP flows for the proposed development site was undertaken using Rational Method to determine the pre-developed flow and design flows for the post developed scenarios.

The calculations for both catchment outlets (western and eastern sites) are included in Appendix C and the results are shown in Tables 2 and 3 below.

Table 2: Rational Method Results for the 5-year, 10-year and 100-year AEP Peak Pre-and Post-Development Flows for Eastern Site

AEP Event	Pre-Development Flow	Post Development Flow without Detention
5 Year	0.033 m^3/s	0.113 m^3/s
10 Year	0.043 m^3/s	0.140 m^3/s
100 Year	0.097 m^3/s	0.296 m^3/s

Table 3: Rational Method Results for the 5-year, 10-year and 100-year AEP Peak Pre-and Post-Development Flows for Western Site

AEP Event	Pre-Development Flow	Post Development Flow without Detention
5 Year	0.021 m^3/s	0.067 m^3/s
10 Year	0.028 m^3/s	0.083 m^3/s
100 Year	0.063 m^3/s	0.175 m^3/s

Pre and Post Development Flows for Detention of Eastern and Western Area (1 in 10-year AEP)

The hydrological analysis of the 1 in 10-year AEP flows for the eastern and western area of the development site was undertaken using Rational Method to determine the pre-developed flow, design flows for the post developed scenarios and storage volume for detention. The results are shown on Tables 4 and 5 below.

Table 4: Rational Method Results for the 10-year AEP Peak Pre-and Post-Development Flows and Storage Volume (Eastern Site)

1 in 10 year AEP Peak Flows for 32 Grundy Avenue, Nyora (Eastern Area)			Total Storage Volume Required for the Detention
Pre-Development Flow	Post Development Flow without Detention	Post Development Flow with Detention	
0.043 m^3/s	0.140 m^3/s	0.043 m^3/s	72 m^3

The above peak flows results indicate that the 1 in 10-year AEP post development peak flows can be detained to the pre-development level by providing detention storage of 72 m^3.

Table 5: Rational Method Results for the 10-year AEP Peak Pre-and Post-Development Flows and Storage Volume (Western Site)

1 in 10 year AEP Peak Flows for 32 Grundy Avenue, Nyora (Western Area)			Total Storage Volume Required for the Detention
Pre-Development Flow	**Post Development Flow without Detention**	**Post Development Flow with Detention**	
0.028 m^3/s	0.083 m^3/s	0.028 m^3/s	40 m^3

The above peak flows results indicate that the 1 in 10-year AEP post development peak flows can be detained to the pre-development level by providing detention storage of 40 m^3.

4.2 Sub-surface Drainage (1 in 5-year AEP)

The Legal Points of Discharge for the eastern site of the proposed development will be to the existing drainage pipe in Grundy Avenue on the external east of the site (subject to Council approval). The Legal Points of Discharge for the western site of the proposed development will be to the proposed residential development on the external west of neighbouring site.

The subsurface drainage network from the development site will convey all pipe flows to the main drainage pipe, via the proposed water quality treatment facilities (on the east site) and detention storages (on the east and west of the sites). The pipe network will be adequately sized to convey the 1 in 5-year AEP storm event flows through the proposed development drainage network.

4.3 Subject Site Overland Flow

Overland flow from the eastern part of the site will be directed via the road to an underground detention storage, which is sized to detain for the Q_{10} post development flow to pre-development level, prior to discharge on to Grundy Ave.

Overland flow from the western area will be directed via the road to an underground detention storage, which is sized to detain for the Q_{10} post development flow to pre-development level, prior to discharge on to Davis Street via overland flow paths on the external neighbouring site (Refer to the Overland Flow Path Plan in Figure 6).

The internal road for the development, will be designed to ensure that the Qgap overland flows through the site are within the safe hydraulic capacity of road floodway.

Underground Detention Storage

Stormwater detention for up to 1 in 10-year ARI will be provided for the both eastern and western parts of the site and the required storages are 72m^3 and 40m^3. It is proposed to provide underground storages within the road reserve to detain the 1 in 10-year AEP post development peak flows to the pre-development level. The details of the storages are provided in Table 6 below and indicative storage location is shown in Figure 6.

Table 6: Details of the Proposed Indicative Storage Detentions

Details	Underground Detention (Eastern)	Underground Detention (Western)
Catchment Area	1.032 ha	0.611 ha
Box Culvert Size (mm)	900 (h) x 1800 (w)	900 (h) x 1800 (w)
Box Culvert Length	45 m	25 m
Storage Capacity	72 m^3	40 m^3
Outlet Control (mm)	135Ø Orifice	110Ø Orifice

Gap Flow (Eastern Area)

Gap flow, which is the difference between the 100-year ARI and 5-year ARI post development flows, was calculated right before the detention basins as this is the location where the highest flow would be occurring within the development. The calculations are included in Appendix C and the results are shown in Table 7 below.

Table 7: RORB Results for the Gap Flow (Eastern Area)

Assessment Location	100-year AEP Flow	5-year AEP Flow	Gap Flow
Eastern Area	0.296 m^3/s	0.113 m^3/s	0.183 m^3/s

A PC Convey assessment of the road reserve shows that the Q_{gap} flow can be contained within floodway safety criteria. A typical cross section is shown in Figure 7 and the calculation result is included in Appendix D.

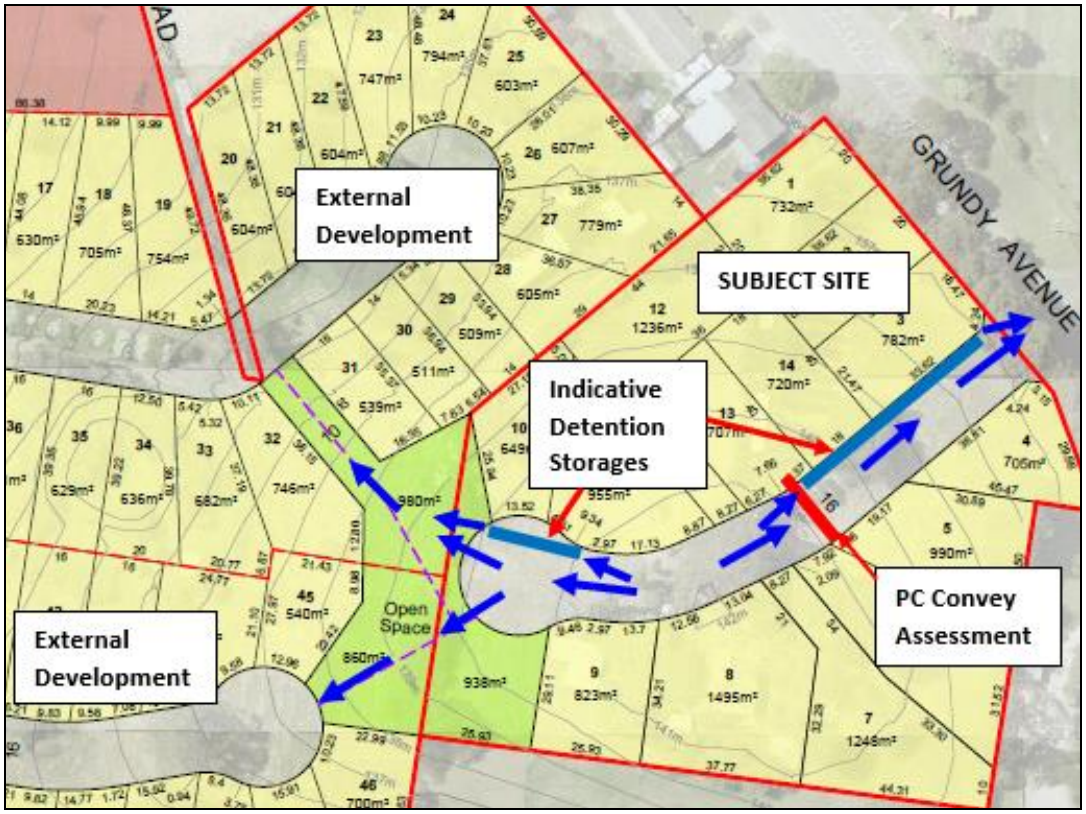


Figure 6: Indicative Overland Flow Path *(Not to Scale)*

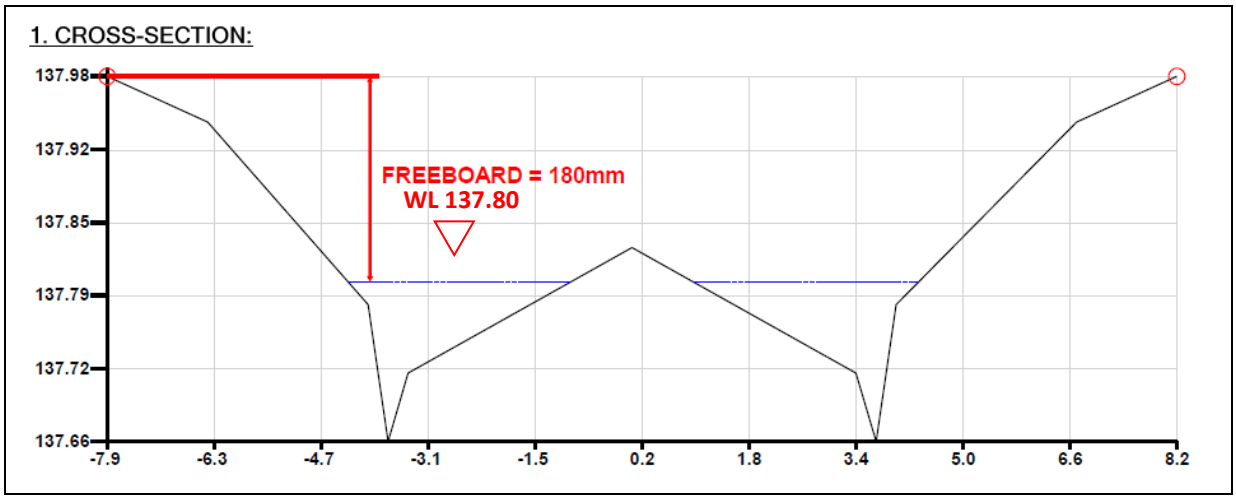


Figure 7: PC Convey Results for 16m Road Reserve Section *(Not to Scale)*

5 STORMWATER QUALITY TREATMENT

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:

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

Stormwater quality modelling was conducted using MUSIC (Model for Urban Stormwater Improvement Conceptualisation) for the proposed development site. The weather station used was obtained from the Narre Warren North weather station from the Melbourne Water rainfall template, as shown in light blue colour in Figure 8.

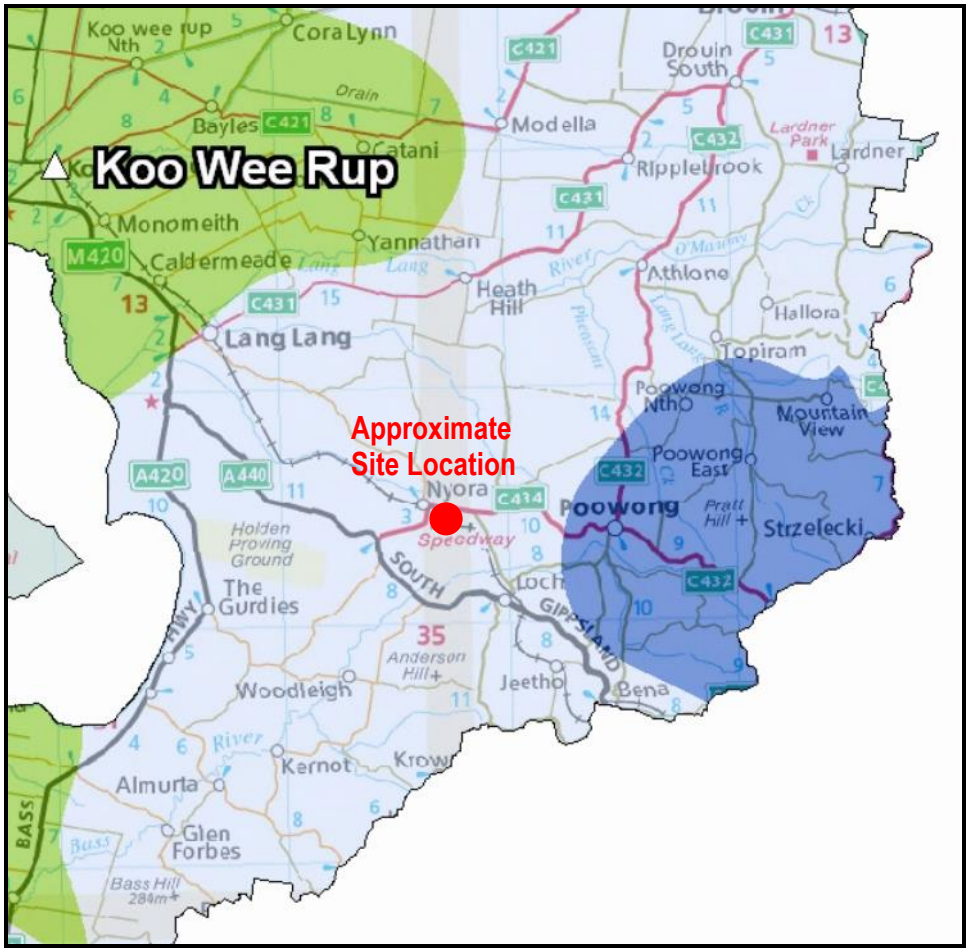


Figure 8: Greater Melbourne Rainfall Distribution *(Source: Melbourne Water Music Guidelines – Not to Scale)*

The layout of the MUSIC Model is shown in Figure 9 and results of the MUSIC model is shown in Table 8. The proposed stormwater treatment train will be a Stormceptor and a Hydrosystem units (or equivalent) located within the road reserve of the eastern site, and the provision of **rainwater tanks of 5,000 L for each lot** with daily demand water re-use of 500 L/day.

The stormwater treatment system will over treat the eastern sub catchment of 1.032 ha to allow the western sub catchment to be untreated.

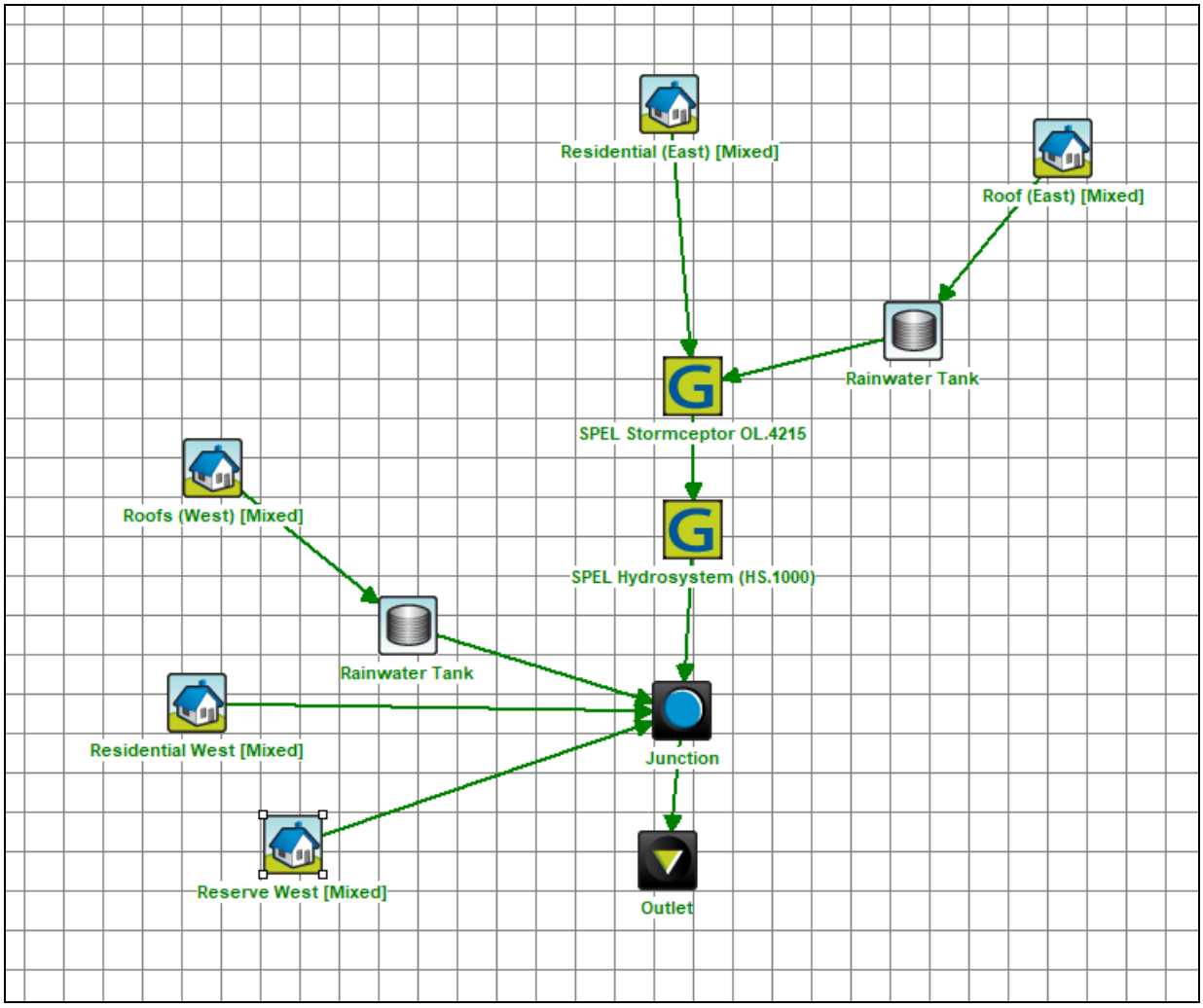


Figure 9: MUSIC Model Layout

Table 8: MUSIC Model Results

Site Treatment	% Removal	BPEMG Target % Removal
Total Suspended Solids (Kg/yr)	80.3	80
Total Phosphorus (Kg/yr)	56.9	45
Total Nitrogen (Kg/yr)	54.3	45
Gross Pollutants (Kg/yr)	86.4	70

As shown in Table 8 above, the results show that the best practice BPEMG target is achieved for all the pollutant types with the proposed treatment assets.

Indicative stormceptor and hydrosystem units' location is shown on Figure 10. Detailed design of the proposed stormwater treated will be submitted to South Gippsland Shire Council during the detail design phase.

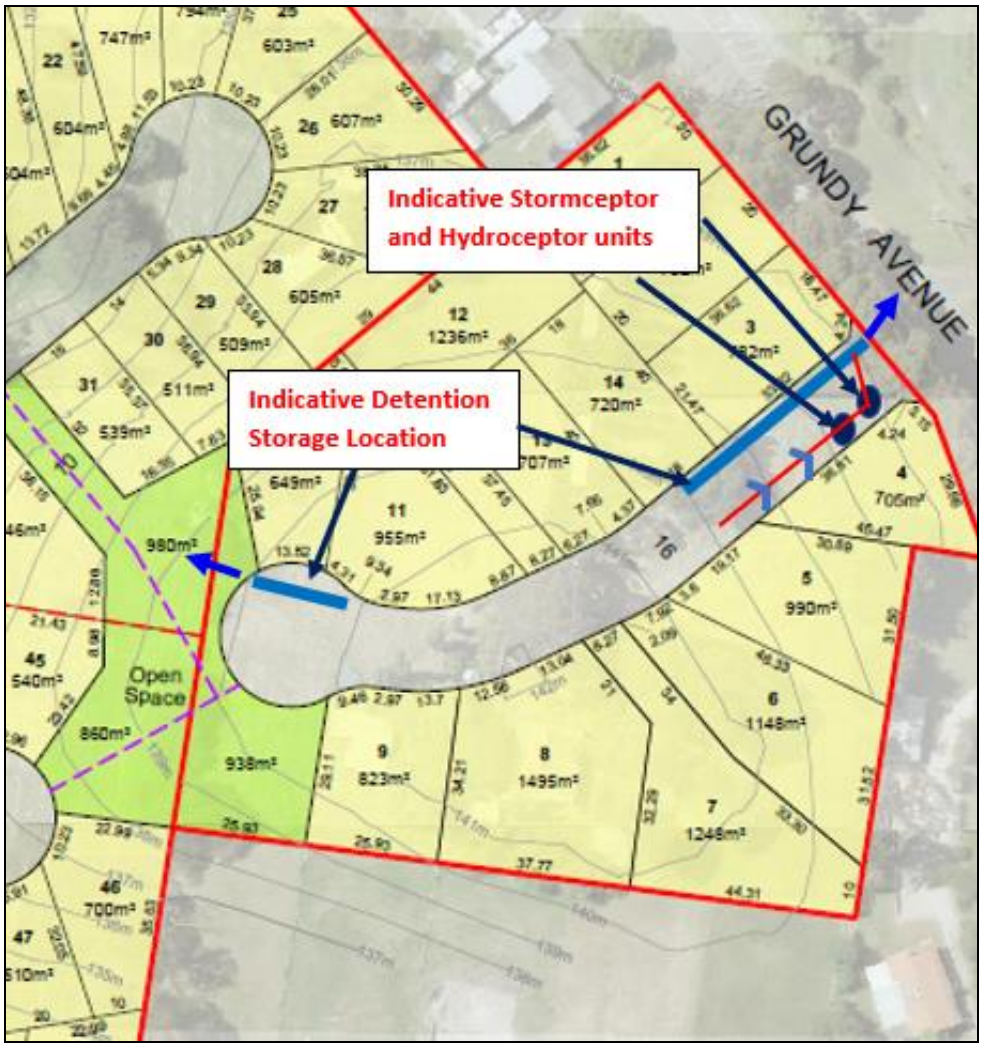


Figure 10: Concept Drainage Strategy Layout Plan

6 CONCLUSION

This report has identified an overall stormwater management strategy for the proposed residential development located at 32 Grundy Avenue, Nyora. This strategy is preliminary only and be subject to further changes.

The strategy provides a methodology for the management of stormwater on the subject site which includes:

- Volume of stormwater detention requirement of 72 m^3 and 40 m^3 for the eastern and western parts of the development site to detain 1 in 10-year peak post development flow to pre-development level. These volumes will be catered by detention storage box culverts located under the main road reserves on both eastern and western sites.
- Stormwater quality treatment system requirement to meet BPMEG standard will be a Stormceptor and a Hydrosystem units (or equivalent) located in the road reserve of the eastern site and rainwater tanks within residential lots.

The above strategy can be implemented to satisfy South Gippsland CMA and Council's development requirements with no net effect on the downstream properties.

7 REFERENCE

18A Davis Street, Nyora: Stormwater Management Strategy, *Beveridge Williams (July 2018)*

BEVERIDGE WILLIAMS & CO PTY LTD

Prepared by

Lola Nurhalim

Senior Water Resources Engineer

Reviewed by

Aram Manjikian

Manager Water Resources

Approved by

Andrea Boully

Project Manager

APPENDIX A
Topography Plan

MGA94 ZONE 55

N

#30

Grundy Avenue

existing gravel driveway

kerb and channel

138°29'

83.62

edge of bitumen

post and wire

157°46'

29.61

edge of bitumen

post and wire

14.58

277°10'

#33

plantation line

73.02

187°13'

133.94

107.80

48°29'

post and wire

76.30

post and wire

Lot 2 on PS609455N #18A

gate

horizontal boards

horizontal boards

gate

gate

horizontal boards

line of poplar trees

horizontal boards

line of poplar trees

gravel driveway

gravel driveway

tin shed

verandah

existing single storey w/b dwelling

dam

tin shed

tank

tin shed

Lot 3 on PS609455N #18A

7°10'

post and wire

95°48'

post and wire

#17

#19

#23

#27

#31

136 137 138 139 140 141 142

141.25 141.5 141.75

- This is not a Title Survey
- Only visable services are shown on this plan.
- Data on this plan may only be manipulated with permission from SK Spatial Pty Ltd.

Sheet 1 of 1.

Site Context Plan

OnePlan Land Development Group

SK spatial Land Surveying Consultants

P:1300 853 157 F:8456 5995 M:0400 543 157
sks@oneplangroup.com.au www.oneplangroup.com.au
GIPPSLAND - MELBOURNE

3 0 3 6 9 12

Lengths are in metres

Notations

Levels are to the Australian Height Datum (AHD)

Re-establishment datum vide PS715873B

Contour interval: 0.25m
Total site area: 1.643ha

Mr. Wayne Allen
32 Grundy Avenue, Nyora, 3987

South Gippsland Shire

Plan No.	Scale	Drawn
16570 SC-2	1:300 - A1 1:600 - A3	01/08/2016

Parish of Lang Lang East
Crown Allotment 10, 28 & 29

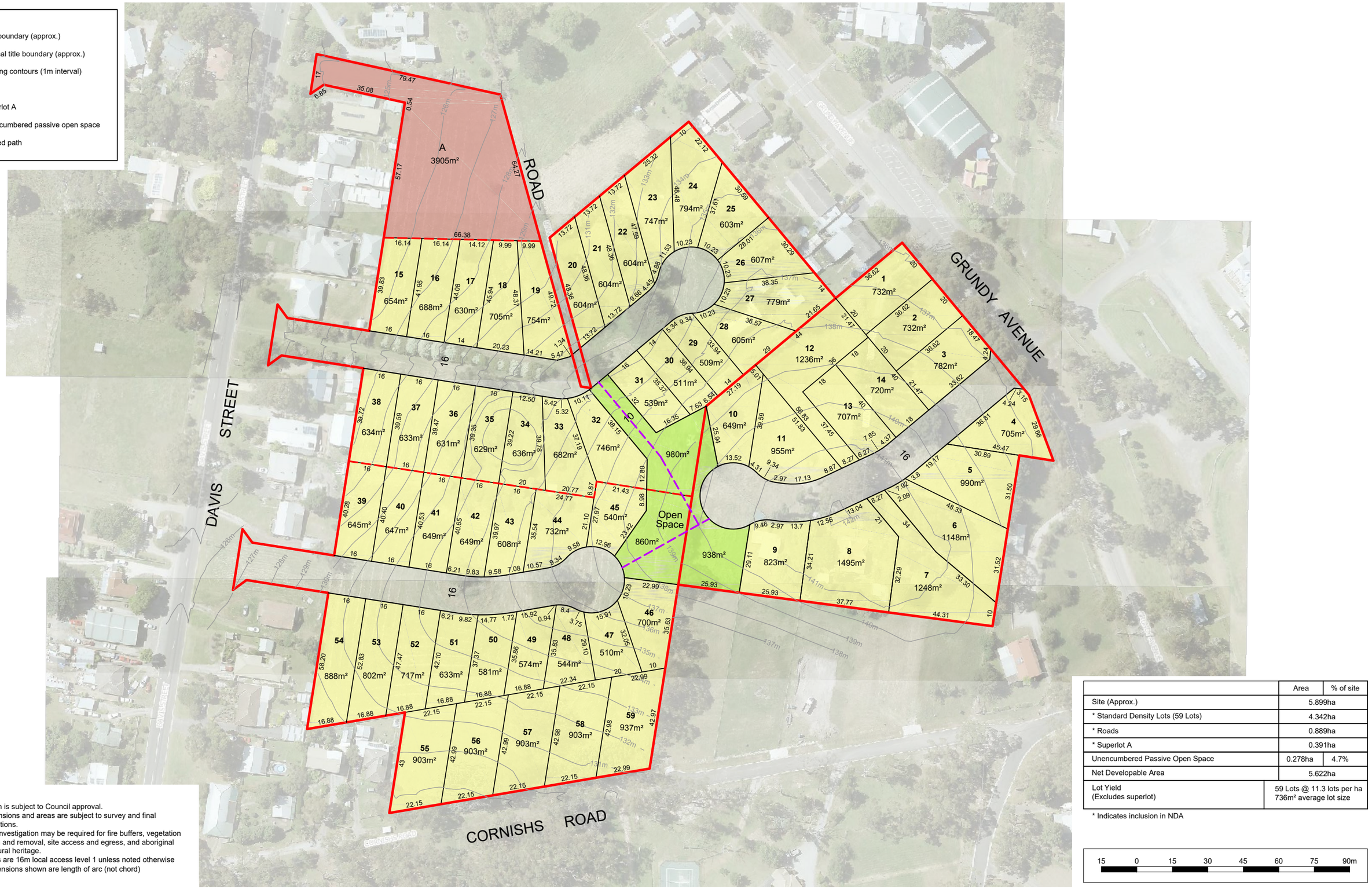
Lot 6 on PS715873

Paracentroid (MGA94) : E 384 190, N 5755 880

APPENDIX B
Indicative Subdivision Plan

LEGEND

- Title boundary (approx.)
- Internal title boundary (approx.)
- Existing contours (1m interval)
- Lots
- Superlot A
- Unencumbered passive open space
- Shared path



Notes:

- This plan is subject to Council approval.
- All dimensions and areas are subject to survey and final computations.
- Further investigation may be required for fire buffers, vegetation retention and removal, site access and egress, and aboriginal and cultural heritage.
- All roads are 16m local access level 1 unless noted otherwise
- Arc dimensions shown are length of arc (not chord)

	Area	% of site
Site (Approx.)	5.899ha	
* Standard Density Lots (59 Lots)	4.342ha	
* Roads	0.889ha	
* Superlot A	0.391ha	
Unencumbered Passive Open Space	0.278ha	4.7%
Net Developable Area	5.622ha	
Lot Yield (Excludes superlot)	59 Lots @ 11.3 lots per ha 736m² average lot size	

* Indicates inclusion in NDA

15 0 15 30 45 60 75 90m

Combined Development Plan

18A Davis Street & 32 Grundy Avenue, Nyora

Kufner Textiles (Australia) P/L & Wayne Allen

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Version	Date	Description	Drafted	Approved
01	16.10.17	Initial issue	CK	LN
02	01.03.18	Plan amended	TG	AB
03	12.11.18	Plan amended	TG	AB

Date: 12.11.18
Version No: 03
Job No: 1601444
Scale (A1): 1:750
(A3): 1:1500

N

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APPENDIX C
Rational Method Calculations

Pre-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Eastern Site)		
Subject:	PRE-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	MA

Location : Nyora

ARI Year : 100

Coefficients						
a	b	c	d	e	f	g
3.72392	-0.64046	0.00137	0.00588	-0.00194	0.00024	-0.00003

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 100	Manual Input C	Selected C 100	Ae	ΣAe	I 100	Q 100
	ha			mins	mins	mins						ha	ha	mm/hr	m^3/s
Site Catchment	1.032	RURAL1	Rural - Environmental	8.02		8.02	0.1		0.245		0.245	0.25	0.253	138.23	0.097
TOTAL	1.032	RURAL1		8.02		8.02		0.000	0.143				0.253	138.23	0.097

Tc Calculated using :

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

Equation 5.4 AR&R

Weighted Frac Imperv using :

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

0.000

$$C_{10} = 0.1 + 0.0133 \left(I_{10} - 25 \right)$$

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

Equation 14.11 and 14.12 AR&R

Q Calculated using :

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

Rational Method

Post-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Eastern Site)		
Subject:	POST-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	LN

Location : Nyora

ARI Year : 100

Coefficients

ARI	a	b	c	d	e	f	g
100	3.72392	-0.6404646	0.001367	0.005876	-0.001942	0.000241	-2.595E-05

INPUT 1 2 3 4 4A 5 5A 6

Catchment	Area	Length (L)	Slope (S)	Surface	n (n*)	tI0.4	Calculated Tc	Manual Input Tc	Selected Tc	Catchment Category (For Fp)	Selected f_p	Weighted f_p	Calculated C 100	Manual Input C	Selected C 100	Ae	ΣAe	I 100	Q 100
	ha	m	m/m				mins	mins	mins							ha	ha	mm/hr	m^3/s
S3	0.41	135.00	0.037	Range	0.013	26.15	7.00		7.00	Resi Medium Density	0.6		0.701		0.701	0.29	0.287	147.38	0.117
S4	0.13	82.00	0.061	Range	0.013	16.69	7.00		7.00	Road Zone Cat 2	0.6		0.701		0.701	0.09	0.092	147.38	0.037
S5	0.49	183.00	0.027	Range	0.013	34.50	7.00		7.00	Resi Medium Density	0.6		0.701		0.701	0.34	0.344	147.38	0.141
TOTAL	1.031								7.000		0						0.722	147.377	0.296

-0.83

Tc Calculated using :

$$t = 6.94 * \frac{(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.30}}$$

C10 Calculated using :

$$C_1^{10} = 0.1 + 0.0133(I_1^{10} - 25)$$

$$C_{10} = 0.9 \times f + C_1^{10} \times (1 - f)$$

Q Calculated using :

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

Weighted Fraction Impervious using:

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

Go to Fraction Impervious Table

Directions:

1 Enter longest length of Catchment
2 Enter average slope of Catchment (Metre/Metre)
3 Choose surface type of catchment from drop down list (See n value table)
4 Enter Area of Catchment (Ha)
5 Choose Catchment category to determine fraction impervious
6 Sum effective areas of catchments to determine Q

Pre-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Eastern Site)		
Subject:	PRE-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	MA

Location : Nyora

ARI Year : 10

Coefficients						
a	b	c	d	e	f	g
3.24768	-0.61613	-0.00907	0.00724	-0.00138	-0.00004	0.00000

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 10	Manual Input C	Selected C 10	Ae	ΣAe	I 10	Q 10
	ha			mins	mins	mins						ha	ha	mm/hr	m^3/s
Site Catchment	1.032	RURAL1	Rural - Environmental	8.02		8.02	0.1		0.189		0.189	0.19	0.195	79.10	0.043
TOTAL	1.032	RURAL1		8.02		8.02		0.000	0.110				0.195	79.10	0.043

Tc Calculated using :

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

Equation 5.4 AR&R

Weighted Frac Imperv using :

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

0.000

$$C_{10} = 0.1 + 0.0133 \left(I_{10} - 25 \right)$$

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

Equation 14.11 and 14.12 AR&R

Q Calculated using :

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

Rational Method

Post-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Eastern Site)		
Subject:	POST-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	LN

Location : Nyora

ARI Year : 10

Coefficients

ARI	a	b	c	d	e	f	g
10	3.247683	-0.61612678	-0.009066	0.007236	-0.001382	-3.77E-05	2.97E-06

INPUT 1 2 3 4 4A 5 5A 6

Catchment	Area	Length (L)	Slope (S)	Surface	n (n*)	tI0.4	Calculated Tc	Manual Input Tc	Selected Tc	Catchment Category (For Fp)	Selected f_p	Weighted f_p	Calculated C 10	Manual Input C	Selected C 10	Ae	ΣAe	I 10	Q 10
	ha	m	m/m				mins	mins	mins							ha	ha	mm/hr	m^3/s
S3	0.41	135.00	0.037	Range	0.013	26.15	7.00		7.00	Resi Medium Density	0.6		0.584		0.584	0.24	0.239	83.96	0.056
S4	0.13	82.00	0.061	Range	0.013	16.69	7.00		7.00	Road Zone Cat 2	0.6		0.584		0.584	0.08	0.076	83.96	0.018
S5	0.49	183.00	0.027	Range	0.013	34.50	7.00		7.00	Resi Medium Density	0.6		0.584		0.584	0.29	0.287	83.96	0.067
TOTAL	1.032								7.000		0						0.602	83.962	0.140

-0.83

Tc Calculated using :

$$t = 6.94 * \frac{(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.30}}$$

C10 Calculated using :

$$C^1_{10} = 0.1 + 0.0132(I_{10} - 25)$$

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

Q Calculated using :

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

Weighted Fraction Impervious using:

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

Go to Fraction Impervious Table

Directions:

1 Enter longest length of Catchment
2 Enter average slope of Catchment (Metre/Metre)
3 Choose surface type of catchment from drop down list (See n value table)
4 Enter Area of Catchment (Ha)
5 Choose Catchment category to determine fraction impervious
6 Sum effective areas of catchments to determine Q

Detention Storage Calculator

SELECT LOCATION	Nyora
PRE-DEVELOPMENT ARI	10
POST-DEVELOPMENT ARI	10

Coefficients						
a	b	c	d	e	f	g
3.24768	-0.61613	-0.00907	0.00724	-0.00138	-0.00004	0.00000
3.24768	-0.61613	-0.00907	0.00724	-0.00138	-0.00004	0.00000

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Eastern Site)		
Subject:	RATIONAL / POERTNER METHOD DETENTION REQUIREMENT CALCULATIONS		
Job No:	1601444	**By:**	LN

PRE-DEVELOPMENT

Total Catchment Area	CA 10	Tc	I	Input Manual Restrictive Outflow	Calculated Restrictive Outflow
ha	ha	mins	mm/hr	m^3/s	m^3/s
1.0320	0.195	8.020	79.10	0.043	0.04

POST-DEVELOPMENT

Total Catchment Area	CA 10	Tc	I	Q 10
ha	ha	mins	mm/hr	m^3/s
1.032	0.602	7.000	83.962	0.140

Time Interval Start	7	(mins)
Storm Duration Time Interval (c)	2	(mins)
Pump / Outflow Outage Duration (to)	0	(mins)
Pump / Outflow Outage Duration (to)	0.00	(hrs)

Change only if required Default = Tc

Vary Time interval until maximum storage volume is achieved See graph below

Change only if required

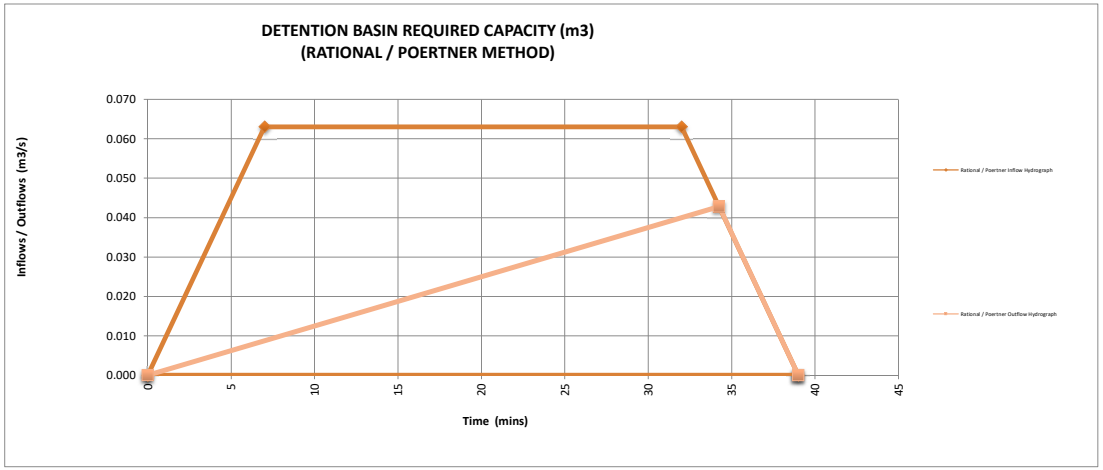
Change only if required

Formulas used

$$C^1_{10} = 0.1 + 0.0133 \times ({}^{10}I_1 - 25)$$

C Value

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



TOTAL DETENTION STORAGE REQUIRED (m^3)	Rational / Poertner Inflow Hydrograph			Rational / Poertner Outflow Hydrograph		
	Qi m^3/s	Time mins		Qo m^3/s	Time mins	
72	0.000	0.0		0.000	0.0	
72	0.054	7.0	(tc)	0.043	42.5	(tx2)
72	0.054	41.0	(ts)	0.000	48.0	(2tc+c)
72	0.000	48.0		0.000	48.0	
	0.000	0.0				

TOTAL STORAGE REQUIRED

Detain ARI of 1 in 10 Year Post to 1 in 10 Year Pre

RATIONAL / POERTNER METHOD

m^3

72

Pre-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora		
Subject:	PRE-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	MA

Location : Nyora

ARI Year : 5

Coefficients						
a	b	c	d	e	f	g
3.11307	-0.60649	-0.01285	0.00758	-0.00122	-0.00013	0.00001

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 5	Manual Input C	Selected C 5	Ae	ΣAe	I 5	Q 5
	ha			mins	mins	mins						ha	ha	mm/hr	m^3/s
Site Catchment	1.032	RURAL1	Rural - Environmental	8.02		8.02	0.1		0.170		0.170	0.18	0.175	67.02	0.033
TOTAL	1.032	RURAL1		8.02		8.02		0.000	0.099				0.175	67.02	0.033

Tc Calculated using :

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

Equation 5.4 AR&R

Weighted Frac Imperv using :

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

0.000

$$C_{10} = 0.1 + 0.0133 \times (I_{10} - 25)$$
$$C_{10} = 0.9 \times f + C_{10} \times (1 - f)$$

Equation 14.11 and 14.12 AR&R

Q Calculated using :

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

Rational Method

Post-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora		
Subject:	POST-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	LN

Location : Nyora

ARI Year : 5

Coefficients

ARI	a	b	c	d	e	f	g
5	3.11307	-0.60649079	-0.012849	0.007581	-0.001218	-0.00013	1.464E-05

INPUT 1 2 3 4 4A 5 5A 6

Catchment	Area	Length (L)	Slope (S)	Surface	n (n*)	tI0.4	Calculated Tc	Manual Input Tc	Selected Tc	Catchment Category (For Fp)	Selected f_p	Weighted f_p	Calculated C $_5$	Manual Input C	Selected C $_5$	Ae	ΣAe	I $_5$	Q $_5$
	ha	m	m/m				mins	mins	mins							ha	ha	mm/hr	m^3/s
S3	0.41	135.00	0.037	Range	0.013	26.15	7.00		7.00	Resi Medium Density	0.6		0.555		0.555	0.23	0.227	71.02	0.045
S4	0.13	82.00	0.061	Range	0.013	16.69	7.00		7.00	Road Zone Cat 2	0.6		0.555		0.555	0.07	0.072	71.02	0.014
S5	0.49	183.00	0.027	Range	0.013	34.50	7.00		7.00	Resi Medium Density	0.6		0.555		0.555	0.27	0.272	71.02	0.054
TOTAL	1.031								7.000		0						0.572	71.024	0.113

-0.83

Tc Calculated using :

$$t = 6.94 * \frac{(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.30}}$$

C10 Calculated using :

$$C^1_{10} = 0.1 + 0.0132(I_1^{10} - 25)$$

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

Q Calculated using :

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

Weighted Fraction Impervious using:

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

Go to Fraction Impervious Table

Directions:

1 Enter longest length of Catchment
2 Enter average slope of Catchment (Metre/Metre)
3 Choose surface type of catchment from drop down list (See n value table)
4 Enter Area of Catchment (Ha)
5 Choose Catchment category to determine fraction impervious
6 Sum effective areas of catchments to determine Q

Pre-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora		
Subject:	PRE-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	MA

Location : Nyora

ARI Year : 100

Coefficients						
a	b	c	d	e	f	g
3.72392	-0.64046	0.00137	0.00588	-0.00194	0.00024	-0.00003

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 100	Manual Input C	Selected C 100	Ae	ΣAe	I 100	Q 100
	ha			mins	mins	mins						ha	ha	mm/hr	m^3/s
Site Catchment	0.611	RURAL1	Rural - Environmental	6.57		6.57	0.1		0.245		0.245	0.15	0.150	151.60	0.063
TOTAL	0.611	RURAL1		6.57		6.57		0.000	0.143				0.150	151.60	0.063

Tc Calculated using :

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

Equation 5.4 AR&R

Weighted Frac Imperv using :

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

0.000

$$C_{10} = 0.1 + 0.0132 \left(I_{10} - 25 \right)$$

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

Equation 14.11 and 14.12 AR&R

Q Calculated using :

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

Rational Method

Post-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora		
Subject:	POST-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	LN

Location : Nyora

ARI Year : 100

Coefficients

ARI	a	b	c	d	e	f	g
100	3.72392	-0.6404646	0.001367	0.005876	-0.001942	0.000241	-2.595E-05

INPUT 1 2 3 4 4A 5 5A 6

Catchment	Area	Length (L)	Slope (S)	Surface	n (n*)	tI0.4	Calculated Tc	Manual Input Tc	Selected Tc	Catchment Category (For Fp)	Selected f_p	Weighted f_p	Calculated C 100	Manual Input C	Selected C 100	Ae	ΣAe	I 100	Q 100
	ha	m	m/m				mins	mins	mins							ha	ha	mm/hr	m^3/s
S1	0.23	87.00	0.040	Range	0.013	19.63	7.00		7.00	Resi Medium Density	0.6		0.701		0.701	0.16	0.163	147.38	0.067
S2	0.38	144.00	0.024	Range	0.013	30.95	7.00		7.00	Resi Medium Density	0.6		0.701		0.701	0.26	0.265	147.38	0.108
TOTAL	0.611								7.000			0					0.428	147.377	0.175

-1.25

Tc Calculated using :

$$t = 6.94 * \frac{(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.30}}$$

C10 Calculated using :

$$C_{10}^1 = 0.1 + 0.0132(I_{10} - 25)$$

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

Q Calculated using :

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

Weighted Fraction Impervious using:

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

Directions:

Go to Fraction Impervious Table

1 Enter longest length of Catchment
2 Enter average slope of Catchment (Metre/Metre)
3 Choose surface type of catchment from drop down list (See n value table)
4 Enter Area of Catchment (Ha)
5 Choose Catchment category to determine fraction impervious
6 Sum effective areas of catchments to determine Q

Pre-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Western Site)		
Subject:	PRE-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	MA

Location : Nyora

ARI Year : 10

Coefficients						
a	b	c	d	e	f	g
3.24768	-0.61613	-0.00907	0.00724	-0.00138	-0.00004	0.00000

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 10	Manual Input C	Selected C 10	Ae	ΣAe	I 10	Q 10
	ha			mins	mins	mins						ha	ha	mm/hr	m^3/s
Site Catchment	0.611	RURAL1	Rural - Environmental	6.57		6.57	0.1		0.189		0.189	0.12	0.115	86.23	0.028
TOTAL	0.611	RURAL1		6.57		6.57		0.000	0.110				0.115	86.23	0.028

Tc Calculated using :

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

Equation 5.4 AR&R

Weighted Frac Imperv using :

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

0.000

$$C_{10} = 0.1 + 0.0133 \left(I_{10} - 25 \right)$$

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

Equation 14.11 and 14.12 AR&R

Q Calculated using :

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

Rational Method

Post-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Western Site)		
Subject:	POST-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	LN

Location : Nyora

ARI Year : 10

Coefficients							
ARI	a	b	c	d	e	f	g
10	3.247683	-0.61612678	-0.009066	0.007236	-0.001382	-3.77E-05	2.97E-06

INPUT 1 2 3 4 4A 5 5A 6

Catchment	Area	Length (L)	Slope (S)	Surface	n (n*)	tI0.4	Calculated Tc	Manual Input Tc	Selected Tc	Catchment Category (For Fp)	Selected f_p	Weighted f_p	Calculated C $_{10}$	Manual Input C	Selected C $_{10}$	Ae	ΣAe	I $_{10}$	Q $_{10}$
	ha	m	m/m				mins	mins	mins							ha	ha	mm/hr	m^3/s
S1	0.23	87.00	0.040	Range	0.013	19.63	7.00		7.00	Resi Medium Density	0.6		0.584		0.584	0.14	0.136	83.96	0.032
S2	0.38	144.00	0.024	Range	0.013	30.95	7.00		7.00	Resi Medium Density	0.6		0.584		0.584	0.22	0.221	83.96	0.051
TOTAL	0.611								7.000			0					0.357	83.962	0.083

-1.25

Tc Calculated using :

$$t = 6.94 * \frac{(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.30}}$$

C10 Calculated using :

$$C^1_{10} = 0.1 + 0.0132(^{10}I_1 - 25)$$

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

Q Calculated using :

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

Weighted Fraction Impervious using:

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

Directions:

Go to Fraction Impervious Table

1 Enter longest length of Catchment
2 Enter average slope of Catchment (Metre/Metre)
3 Choose surface type of catchment from drop down list (See n value table)
4 Enter Area of Catchment (Ha)
5 Choose Catchment category to determine fraction impervious
6 Sum effective areas of catchments to determine Q

Detention Storage Calculator

SELECT LOCATION	Nyora
PRE-DEVELOPMENT ARI	10
POST-DEVELOPMENT ARI	10

Coefficients						
a	b	c	d	e	f	g
3.24768	-0.61613	-0.00907	0.00724	-0.00138	-0.00004	0.00000
3.24768	-0.61613	-0.00907	0.00724	-0.00138	-0.00004	0.00000

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Western Site)		
Subject:	RATIONAL / POERTNER METHOD DETENTION REQUIREMENT CALCULATIONS		
Job No:	1601444	**By:**	LN

PRE-DEVELOPMENT

Total Catchment Area	CA 10	Tc	I	Input Manual Restrictive Outflow	Calculated Restrictive Outflow
ha	ha	mins	mm/hr	m^3/s	m^3/s
0.6110	0.115	6.571	86.23	0.028	0.03

POST-DEVELOPMENT

Total Catchment Area	CA 10	Tc	I	Q 10
ha	ha	mins	mm/hr	m^3/s
0.611	0.357	7.000	83.962	0.083

Time Interval Start	7	(mins)
Storm Duration Time Interval (c)	2	(mins)
Pump / Outflow Outage Duration (to)	0	(mins)
Pump / Outflow Outage Duration (to)	0.00	(hrs)

Change only if required Default = Tc

Vary Time interval until maximum storage volume is achieved See graph below

Change only if required

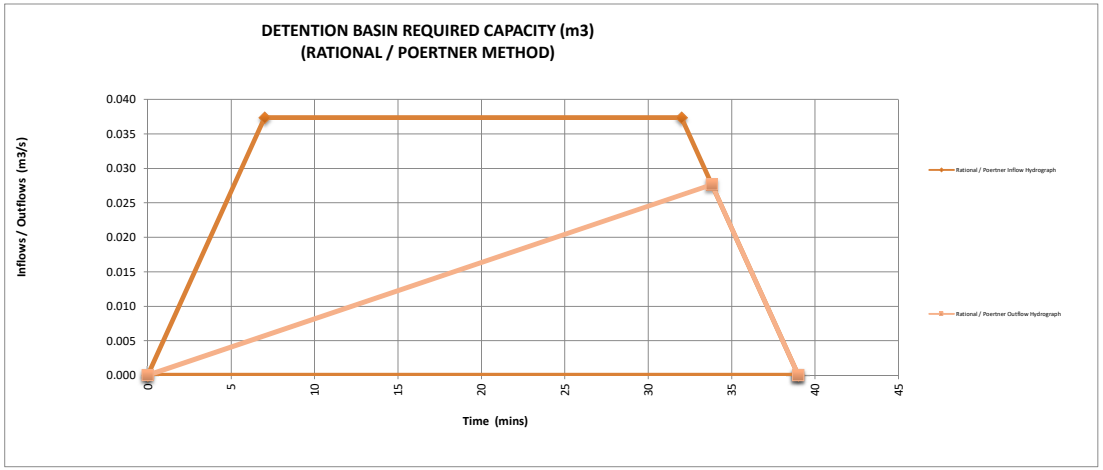
Change only if required

Formulas used

$$C^{1}_{10} = 0.1 + 0.0133 \times \left({}^{10}I_{1} - 25\right)$$

C Value

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



TOTAL DETENTION STORAGE REQUIRED (m^3)	Rational / Poertner Inflow Hydrograph			Rational / Poertner Outflow Hydrograph		
	Qi m^3/s	Time mins		Qo m^3/s	Time mins	
40	0.000	0.0		0.000	0.0	
40	0.034	7.0	(tc)	0.028	38.4	(tx2)
40	0.034	37.0	(ts)	0.000	44.0	(2tc+c)
40	0.000	44.0		0.000	44.0	
	0.000	0.0				

TOTAL STORAGE REQUIRED

Detain ARI of 1 in 10 Year Post to 1 in 10 Year Pre

RATIONAL / POERTNER METHOD

m^3

40

Pre-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Western Site)		
Subject:	PRE-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	MA

Location : Nyora

ARI Year : 5

Coefficients						
a	b	c	d	e	f	g
3.11307	-0.60649	-0.01285	0.00758	-0.00122	-0.00013	0.00001

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 5	Manual Input C	Selected C 5	Ae	ΣAe	I 5	Q 5
	ha			mins	mins	mins						ha	ha	mm/hr	m^3/s
Site Catchment	0.611	RURAL1	Rural - Environmental	6.57		6.57	0.1		0.170		0.170	0.10	0.104	72.89	0.021
TOTAL	0.611	RURAL1		6.57		6.57		0.000	0.099				0.104	72.89	0.021

Tc Calculated using :

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

Equation 5.4 AR&R

Weighted Frac Imperv using :

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

0.000

$$C_{10} = 0.1 + 0.0133 \times (I_{10} - 25)$$

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

Equation 14.11 and 14.12 AR&R

Q Calculated using :

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

Rational Method

Post-Developed Flow Calculations

Client:	Kufner Textiles (Australia) P/L	**Date:**	21/11/2018
Project:	32 Grundy Avenue, Nyora (Western Site)		
Subject:	POST-DEVELOPMENT FLOW CALCULATIONS		
Job No:	1601444	**By:**	LN

Location : Nyora

ARI Year : 5

Coefficients

ARI	a	b	c	d	e	f	g
5	3.11307	-0.60649079	-0.012849	0.007581	-0.001218	-0.00013	1.464E-05

INPUT 1 2 3 4 4A 5 5A 6

Catchment	Area	Length (L)	Slope (S)	Surface	n (n*)	tI0.4	Calculated Tc	Manual Input Tc	Selected Tc	Catchment Category (For Fp)	Selected f_p	Weighted f_p	Calculated C $_5$	Manual Input C	Selected C $_5$	Ae	ΣAe	I $_5$	Q $_5$
	ha	m	m/m				mins	mins	mins							ha	ha	mm/hr	m^3/s
S1	0.23	87.00	0.040	Range	0.013	19.63	7.00		7.00	Resi Medium Density	0.6		0.555		0.555	0.13	0.129	71.02	0.025
S2	0.38	144.00	0.024	Range	0.013	30.95	7.00		7.00	Resi Medium Density	0.6		0.555		0.555	0.21	0.210	71.02	0.041
TOTAL	0.611								7.000			0					0.339	71.024	0.067

-1.25

Tc Calculated using :

$$t = 6.94 * \frac{(L \times n^*)^{0.6}}{I^{0.4} \times S^{0.30}}$$

C10 Calculated using :

$$C^1_{10} = 0.1 + 0.0132(I_{10} - 25)$$

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

Q Calculated using :

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

Weighted Fraction Impervious using:

$$f = \sum \left(f_{area\ 1} \times \frac{A_{area\ 1}}{A_{total}} \right) + \left(f_{area\ 2} \times \frac{A_{area\ 2}}{A_{total}} \right)$$

Directions:

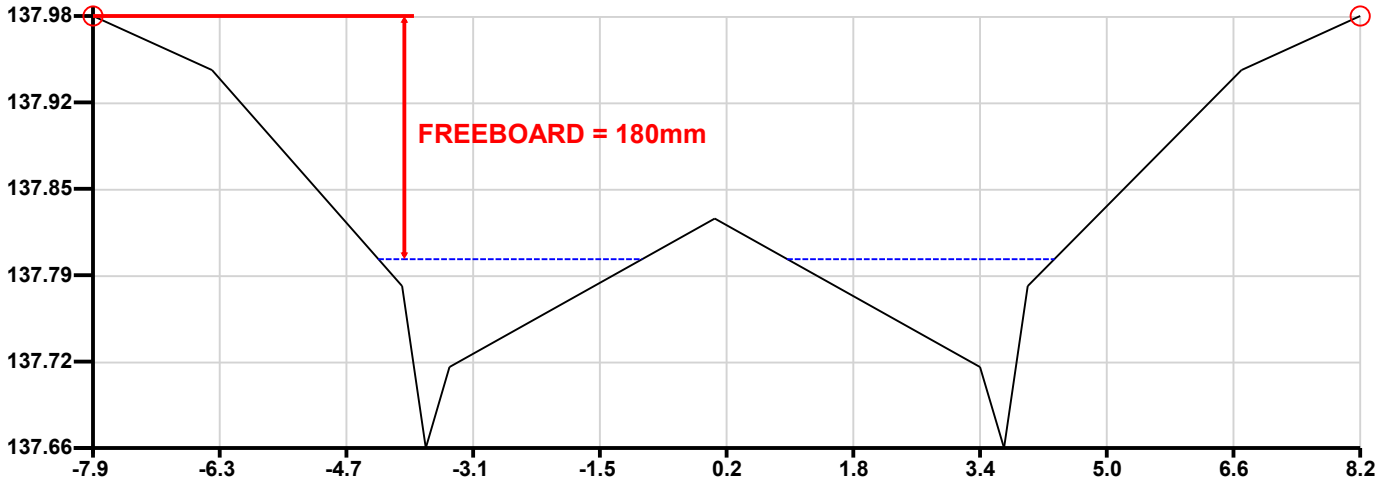
Go to Fraction Impervious Table

1 Enter longest length of Catchment
2 Enter average slope of Catchment (Metre/Metre)
3 Choose surface type of catchment from drop down list (See n value table)
4 Enter Area of Catchment (Ha)
5 Choose Catchment category to determine fraction impervious
6 Sum effective areas of catchments to determine Q

APPENDIX D
PC Convey Results

PROJECT: Road Reserve - Typical XS 16.0 m
Comment
Print-out date: 30/11/2018 - Time: 9:53
Data File: 1601444-32 Grundy Ave-16m Road XS.dat

1. CROSS-SECTION:



2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 0.183 cumecs

There is no pipe discharge
Overland / Channel / Watercourse discharge = 0.183 cumecs

3. RESULTS: Water surface elevation = 137.800m

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

	LEFT OVERBANK	MAIN CHANNEL	RIGHT OVERBANK	TOTAL CROSS-SECTION
Discharge (cumecs):	0.00	0.20	0.00	0.20
D(Max) = Max. Depth (m):	0.00	0.14	0.00	0.14
D(Ave) = Ave. Depth (m):	0.00	0.05	0.00	0.05
V = Ave. Velocity (m/s):	0.00	0.62	0.00	0.62
D(Max) x V (cumecs/m):	0.00	0.09	0.00	0.09
D(Ave) x V (cumecs/m):	0.00	0.03	0.00	0.03
Froude Number:	0.00	0.92	0.00	N/A
Area (m^2):	0.00	0.32	0.00	0.32
Wetted Perimeter (m):	0.00	6.77	0.00	6.77
Flow Width (m):	0.00	6.71	0.00	6.71
Hydraulic Radius (m):	0.00	0.05	0.00	0.05
Composite Manning's n:	0.000	0.015	0.000	N/A
Split Flow?	-	-	-	Yes

4. CROSS-SECTION DATA:

	LEFT HAND POINT		RIGHT HAND POINT		
SEGMENT NO.	CHAINAGE (m)	R.L. (m)	CHAINAGE (m)	R.L. (m)	MANNING'S N
1	-7.850	137.980	-6.350	137.940	0.035
2	-6.350	137.940	-3.950	137.780	0.035
3	-3.950	137.780	-3.650	137.660	0.013
4	-3.650	137.660	-3.350	137.720	0.013
5	-3.350	137.720	0.000	137.830	0.013
6	0.000	137.830	3.350	137.720	0.013
7	3.350	137.720	3.650	137.660	0.013
8	3.650	137.660	3.950	137.780	0.013
9	3.950	137.780	6.650	137.940	0.013
10	6.650	137.940	8.150	137.980	0.035