Beveridge Williams
development & environment consultants

18A Davis Street, Nyora

Stormwater Management Strategy

July 2018

DOCUMENT CONTROL DATA

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		Synopsis	*Stormwater discharge strategy for the proposed residential development located at 18A Davis Street, Nyora*

Reference: 1601444

Client: Kufner Textiles (Australia) P/L

Revision Table

Rev	Description	Date	Authorised
A	Initial Submission	26/07/2018	AB

Distribution Table

Date	Revision	Distribution
26/07/2018	A	*Council, Beveridge Williams, Client, Drainage Authority*

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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.
ARI	Average Recurrence Interval - *The average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration.*
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	Kufner Textiles (Australia) P/L
Council	South Gippsland Shire Council
IDM	Infrastructure Design Manual
NTWL	Normal Top Water Level
Q_5	Storm water flow generated from 5 year ARI storm event.
Q_{10}	Storm water flow generated from 10 year ARI storm event.
Q_{100}	Storm water flow generated from 100 year ARI 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 Kufner Textiles (Australia) P/L to prepare a preliminary Stormwater Management Strategy (SWMS) for a proposed residential development site located at 18A Davis Street, Nyora. The total site area is approximately 4.23 ha and it is proposed to develop the land into 42 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 currently vacant land. The site is irregular in shape with a total area of 4.23 hectares and fronts Davis Street and Cornishs Road (see Figure 1). The site is bounded by a low density residential area in east and west. There are also three separate "connections" to Davis Street comprising a width of 16 metres with corresponding 5m splays. These connections were left as future road access to the centre of the site under the subdivision development plan.

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

2 EXISTING CONDITIONS

2.1 Topography

The site is mostly cleared of vegetation. The topography is undulating and generally falls from the east to west.

There are one high points located on the east side of the site. Three low points are recognized located on the opposing west side. The survey conducted by Beveridge Williams is shown in Figure 2 below.

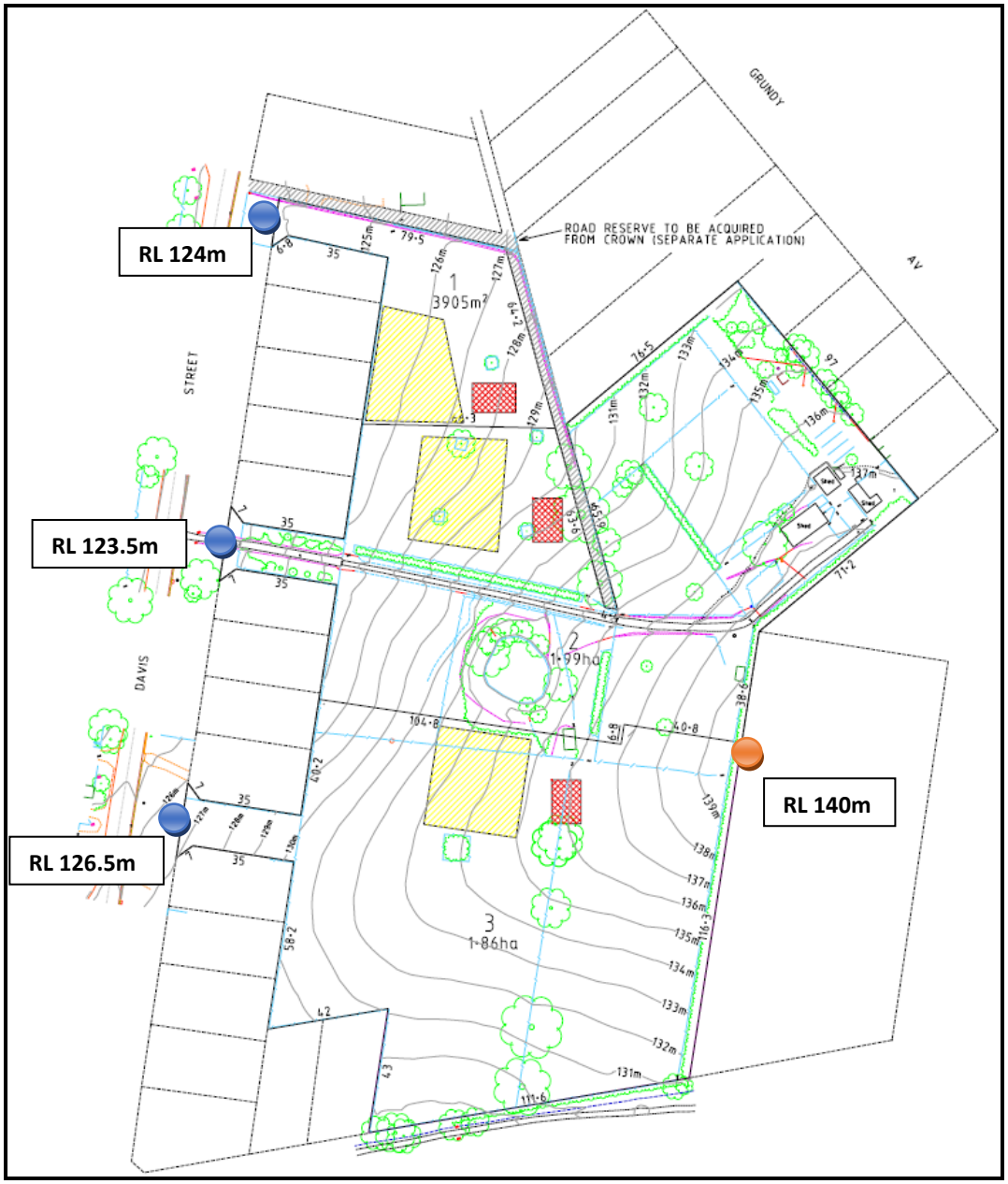

Figure 2: Site Topography Plan *(Not to Scale)*

2.2 Surface Water and Drainage

The site is relatively steep, with an approximate 1 in 15 grade that is relatively constant throughout the whole site. The site slopes in two directions, from east to north-west and south-west (Refer to Figure 3 below for the Site Analysis Plan).

Surface water from an external catchment (low density residential zone) of approximately 0.69 ha to the north-east of the site flows in to the site.

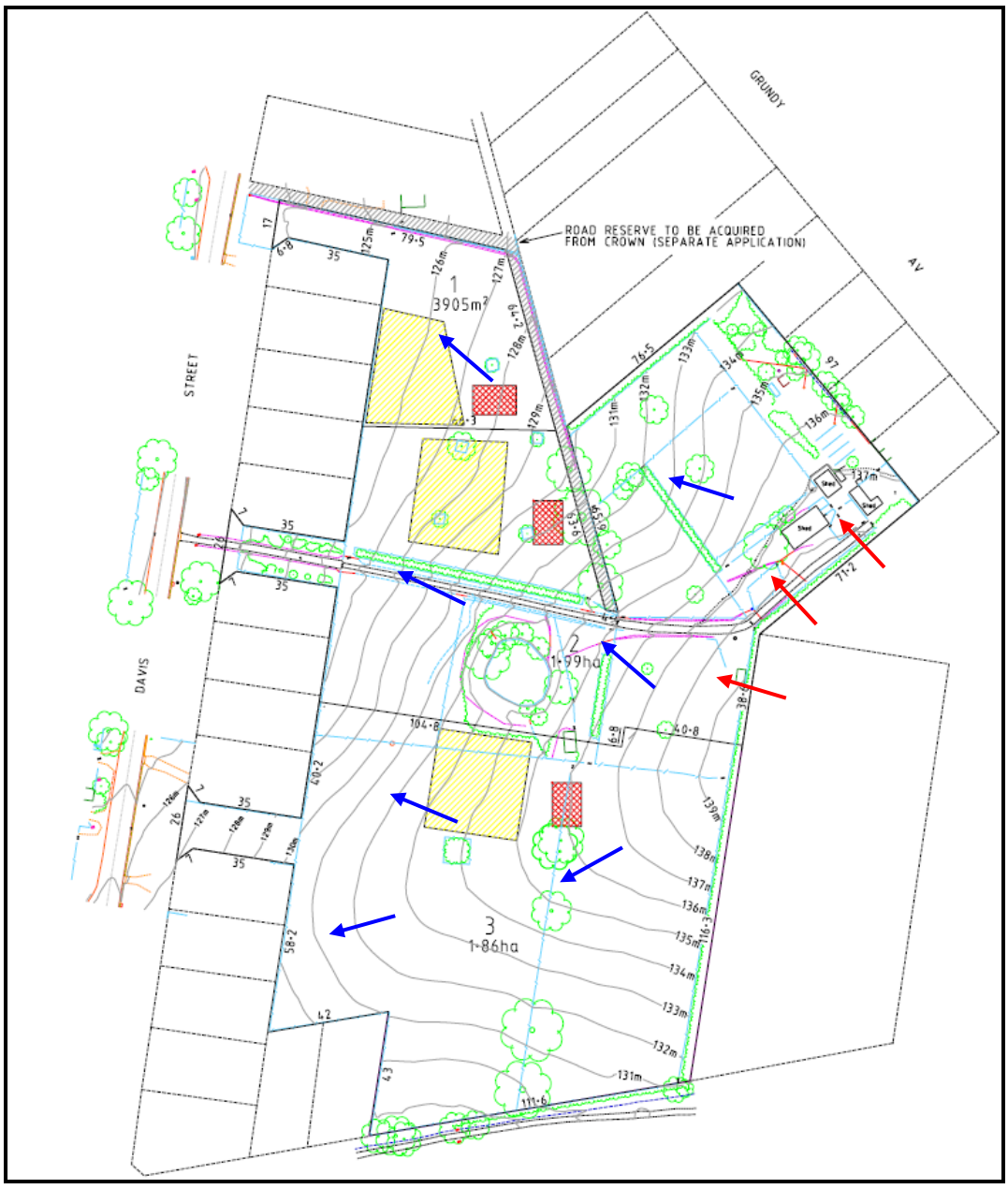

Figure 3: Site Analysis Plan *(Not to Scale)*

3 DESIGN INTENT

3.1 Proposed Development

The proposal of the subdivision site intends to form 42 residential lots with an average lot size of 758m^2. The site includes roads (0.882ha) as well as a super lot (0.391ha) (Refer to Figure 4 below and Appendix A).

The internal road layout provides a series of roads designed in accordance with their function. The cross sections are of sufficient width to facilitate the provision of on street parking, pedestrian paths, bicycle paths and public transport. The street network ensures safe movement and ease of access both internally and with surrounding uses.

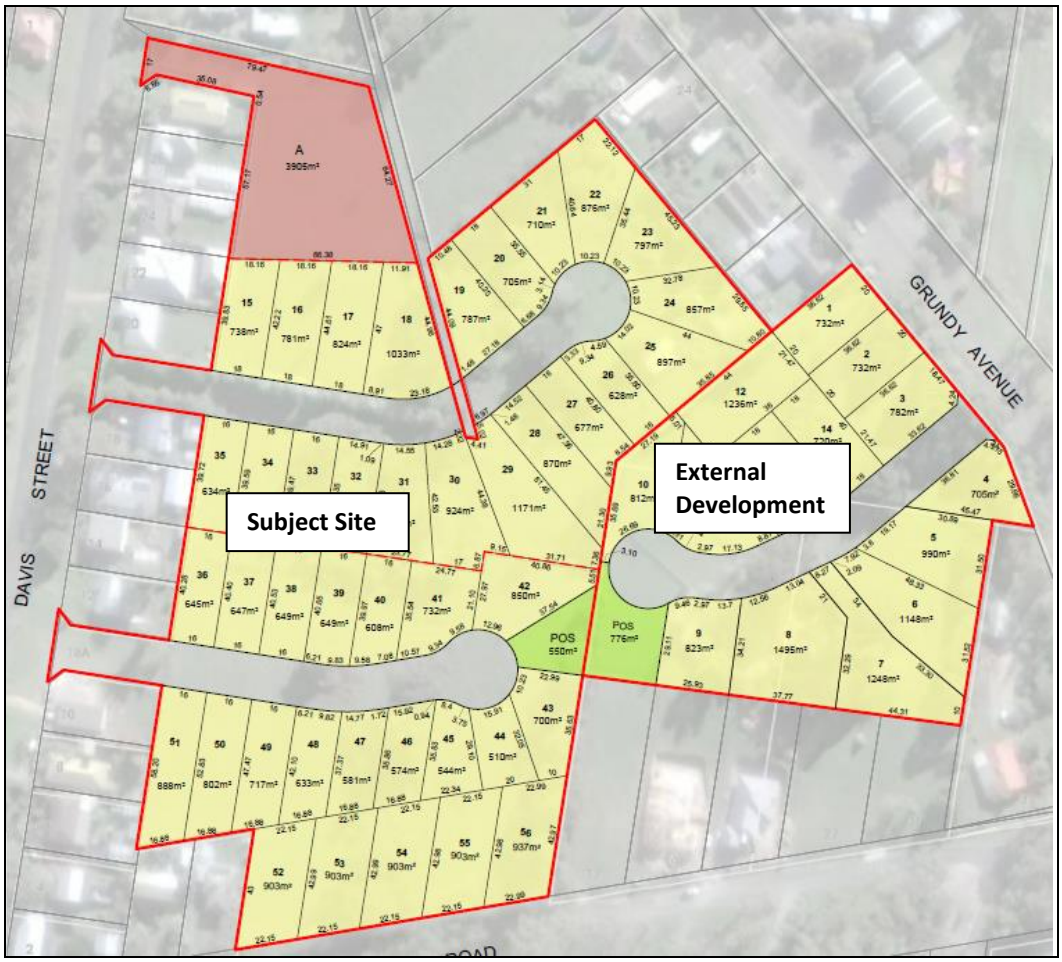

Figure 4: Indicative Subdivision Plan *(Not to Scale)*

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

Table 1: Details of Indicative Subdivision Plan of 18A Davis Street, Nyora

Details	**Area**
External Development	1.386 ha
Standard Density Lots (42 Lots)	3.184 ha
Roads (Includes External Development)	0.882 ha
Superlot A	0.391 ha
Passive open Space	0.133 ha
Total Area	**5.899 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 separate detention storage to cater for the flow from the development site. The strategy is to provide stormwater detention boxes under the main roads to detain the Q_{10} post development site flow to pre-development level. The flow from the Superlot will be managed by its future developer.

For stormwater quality management, it is proposed a Humeceptor unit within road reserve to provide the stormwater treatment for the development site. The treatment system consisting of rainwater tanks in each individual lot is also provided.

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

4 STORMWATER QUANTITY MANAGEMENT

As per Council's confirmation, stormwater runoff for the 1 in 10 year ARI 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 (10 year ARI)

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

The RORB model was developed and the parameters were calibrated based on Rational Method estimated flows. The kc parameter for the pre-development scenario was determined by calibrating the RORB result to match the result obtained from the Rational Method.

The calculations are included in Appendix B and the results is shown in Tables 2 and 3 below.

Table 2: RORB Results for the 100 year ARI Peak Pre-and Post-Development Flows

ARI Event	Pre-Development Flow	Post Development Flow without Detention
5 Year	0.079 m^3/s	0.523 m^3/s
100 Year	0.362 m^3/s	1.189 m^3/s

Table 3: RORB Results for the 10 year ARI Peak Pre-and Post-Development Flows

1 in 10 year ARI Peak Flows for 18A Davis Street, Nyora			Total Storage Volume Required for the Detention
Pre-Development Flow	Post Development Flow without Detention	Post Development Flow with Detention	
0.120 m^3/s	0.668 m^3/s	0.120 m^3/s	639 m^3

The above peak flows results indicate that the 1 in 10 year ARI post development peak flows can be detained to the pre-development level by providing detention storage of 639 m^3.

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

The Legal Points of Discharge for the proposed development will be to the existing drainage pipe in Davis Street on the external west of the 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 and detention basin located on the north of the site. The pipe network will be adequately sized to convey the 1 in 5-year ARI storm event flows through the proposed development drainage network.

4.3 Subject Site Overland Flow

Overland flows from the site will be directed via the road network to the proposed detention boxes, which is sized to cater for the Q_{10} post development flow for the post development site to pre-development level (Refer to the Overland Flow Path Plan in Figure 5).

The internal roads 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.

Gap Flow

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 using RORB modelling as above. The calculations are included in Appendix B and the results are shown in Table 4 below.

Table 4: RORB Results for the Gap Flow

Assessment Location	100 year ARI Flow	5 year ARI Flow	Gap Flow
Northern Road	0.403 m^3/s	0.151 m^3/s	0.252 m^3/s

A PC Convey assessment of the swale shows that the Q_{gap} flow can be contained within floodway safety criteria. A typical cross section is shown in Figure 6 and the calculation result is included in Appendix C.

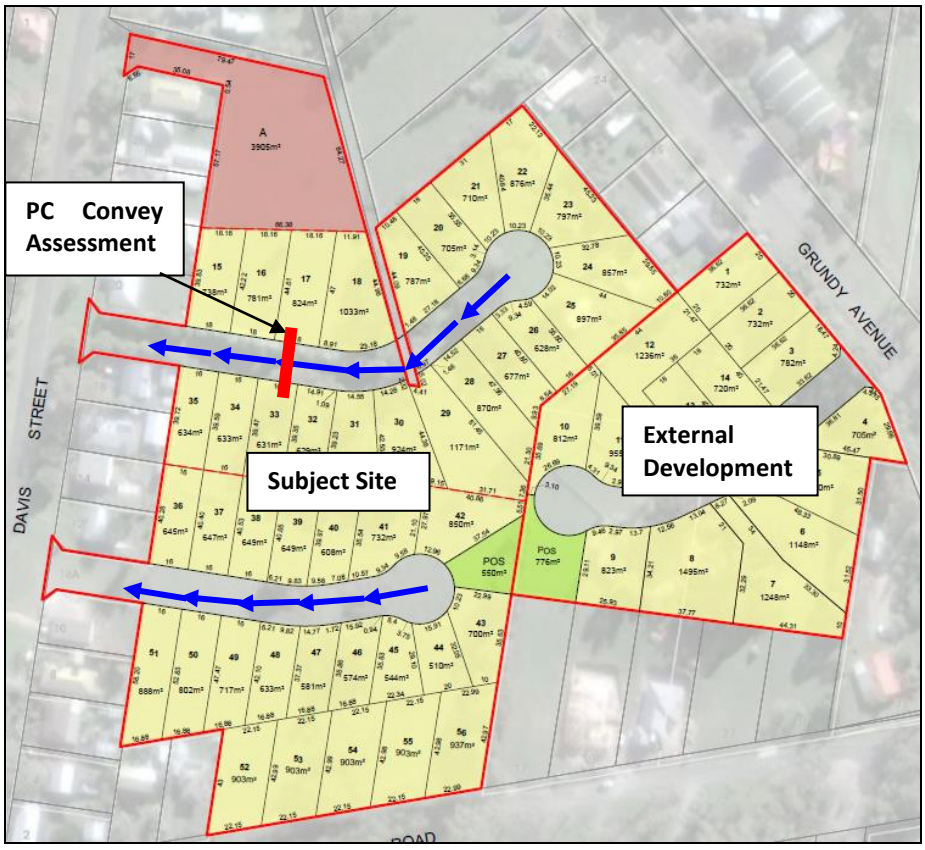

Figure 5: Indicative Overland Flow Path *(Not to Scale)*

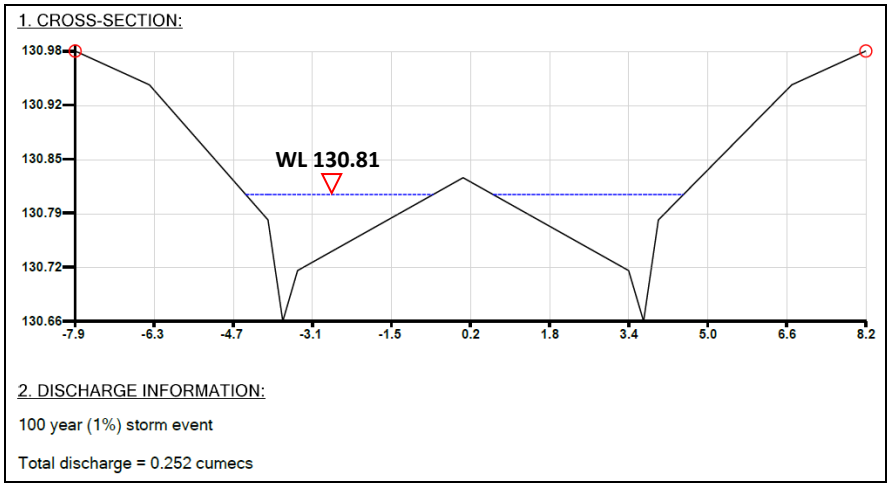

Figure 6: Typical Road Reserve Cross Section *(Not to Scale)*

4.4 Underground Detention Storage

As shown in Figure 7 (also in Appendix D), it is proposed to provide underground storage detentions within the road reserves in development site to detain the 1 in 10 year ARI post development peak flows to the pre-development level. The detail of the basin is provided in Table 5 below.

Table 5: Details of the Proposed Detentions

Details	Underground Detentions
Site Area	4.23 ha
Box Detention Sizes	45 (l) × 10 (w)
Box Detention (North) Capacity	326 m^3
Box Detention (South) Capacity	313 m^3
Outlet Control	100Ø Orifice (1 in 200 grade)

Figure 7: Concept SWMS Layout Plan *(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.

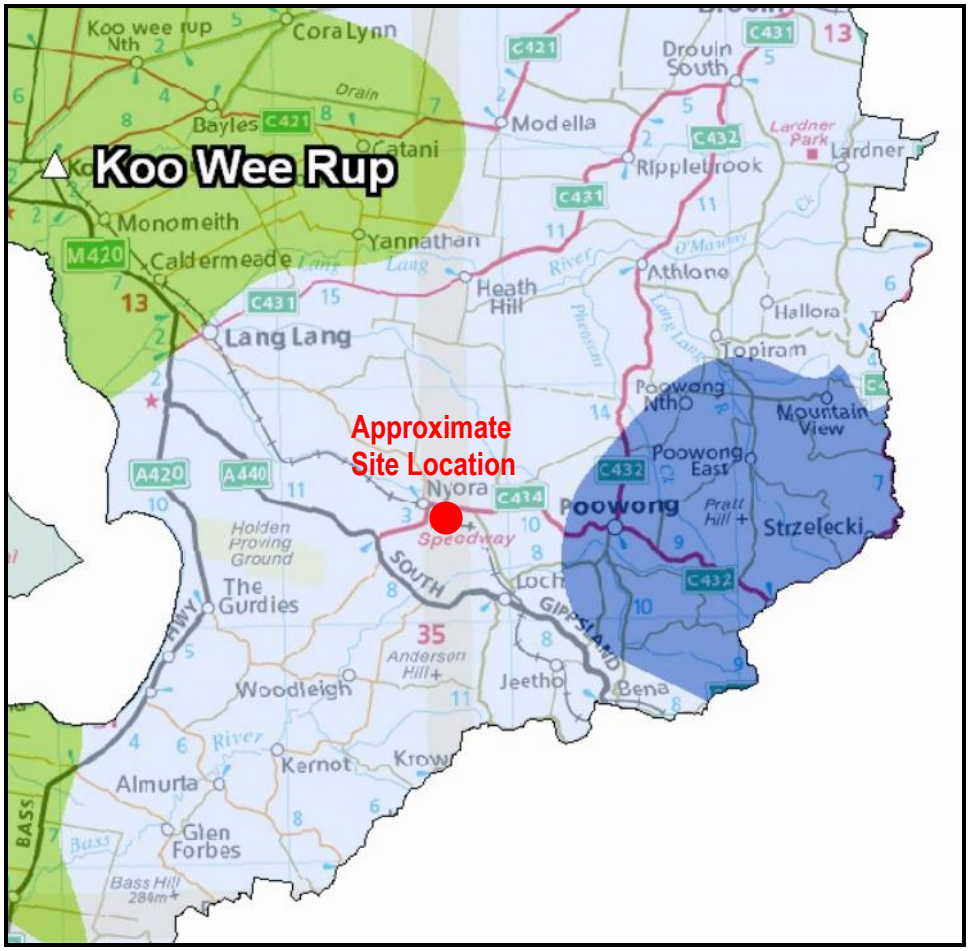

Figure 8: Greater Melbourne Rainfall Distribution *(Source: Melbourne Water Music Guidelines – Not to Scale)*

The layout of the MUSIC Model is shown in Figure 9 and results of the MUSIC model is shown in Table 6. The proposed stormwater treatment train will be a Humeceptor unit located in the road reserve of the site, and also using rainwater tanks within the residential lots. The stormwater treatment system will treat the subject site of 4.23 ha.

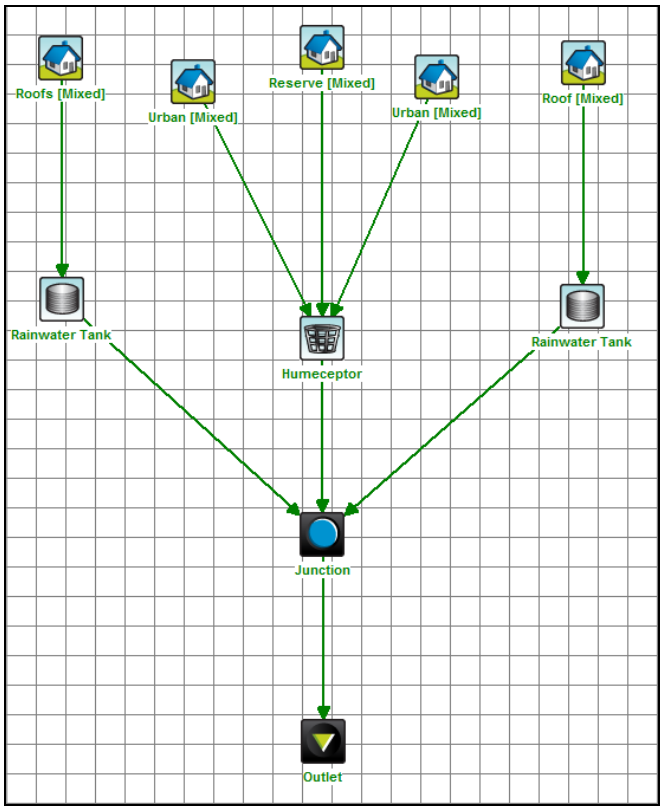

Figure 9: MUSIC Model Layout

Table 6: MUSIC Model Results

Site Treatment	% Removal	BPEMG Target % Removal
Total Suspended Solids (Kg/yr)	84.1	80
Total Phosphorus (Kg/yr)	51.3	45
Total Nitrogen (Kg/yr)	48.4	45
Gross Pollutants (Kg/yr)	36.5	70

As shown in Table 6, the results show that the best practice BPEMG target is achieved for all the pollutant types with the proposed treatment assets.

The detailed designs of the proposed stormwater treated have not been completed and will be submitted to South Gippsland Shire Council during the detail design phrase.

6 CONCLUSION

This report has identified an overall stormwater management strategy for the proposed residential development located at 18A Davis Street, Nyora. This strategy is preliminary only and subject to further changes on the size of the proposed lots and drainage reserve area.

The strategy provides a methodology for the management of stormwater on the subject site which would result in:

- Volumes of stormwater detention requirements of 639 m^3 for the development site will be required to detain 1 in 10-year peak post development flow to pre-development level. This volume will be catered by detention boxes located under the main road reserves of the development site; and
- Stormwater quality treatment system required to meet BPMEG standard will be a Humeceptor unit located in the road reserve of the site and rainwater tanks within residential lots.

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

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Project Manager

APPENDIX A
Indicative Subdivision Plan

LEGEND

- Title boundary (approx.)
- Internal title boundary (approx.)
- Lots
- Superlot A
- Unencumbered passive open space

DAVIS STREET

GRUNDY AVENUE

CORNISHS ROAD

A 3905m²

1 732m² | 2 732m² | 3 782m² | 4 705m² | 5 990m² | 6 1148m² | 7 1248m² | 8 1495m² | 9 823m² | POS 550m² | POS 776m² | 10 812m² | 11 955m² | 12 1236m² | 13 707m² | 14 720m² | 15 738m² | 16 781m² | 17 824m² | 18 1033m² | 19 787m² | 20 705m² | 21 710m² | 22 876m² | 23 797m² | 24 857m² | 25 897m² | 26 628m² | 27 677m² | 28 870m² | 29 1171m² | 30 924m² | 31 769m² | 32 629m² | 33 631m² | 34 633m² | 35 634m² | 36 645m² | 37 647m² | 38 649m² | 39 649m² | 40 608m² | 41 732m² | 42 850m² | 43 700m² | 44 510m² | 45 544m² | 46 574m² | 47 581m² | 48 633m² | 49 717m² | 50 802m² | 51 888m² | 52 903m² | 53 903m² | 54 903m² | 55 903m² | 56 937m²

DRAFT

FOR DISCUSSION PURPOSES ONLY

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.
- 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 (56 Lots)	4.493ha	
* Roads	0.882ha	
* Superlot A	0.391ha	
Unencumbered Passive Open Space	0.133ha	2.3%
Net Developable Area	5.766ha	
Lot Yield (Excludes superlot)	56 Lots @ 10.4 lots per ha 802m² 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

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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

Date: 01.03.18
Version No: 02
Job No: 1601444

Scale (A1): 1:750
(A3): 1:1500

N

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APPENDIX B
RORB Results and Detention Calculations

Post development_batch.out

RORBWin Batch Run Summary
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Program version 6.32 (last updated 3rd September 2017)
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Date run: 22 May 2018 10:19

Catchment file : K:\Jobs Data\1601444-18A Davis Street Nyora_Eng_General\Design\Drainage\RORB\Pos Dev - No RB\Post development.catg
Rainfall location: Nyora
Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
Spatial pattern : Uniform
Areal Red. Fact. : Based on ARR87 Bk II, Figs 1.6 and 1.7
Loss factors : Constant with ARI

Parameters: kc = 0.27 m = 0.80

Loss parameters	Initial loss (mm)	Runoff coeff.
	10.00	0.30

Peak	Description
01	Calculated hydrograph, SL
02	Calculated hydrograph, S4
03	Calculated hydrograph, S9
04	Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004
1	10m	5y	10.10	1.00	0.2926	0.0563	0.0318	0.3799
2	15m	5y	12.43	1.00	0.4008	0.0762	0.0464	0.5233
3	20m	5y	14.24	1.00	0.3103	0.0613	0.0299	0.4015
4	25m	5y	15.75	1.00	0.3245	0.0637	0.0369	0.4251
5	30m	5y	17.02	1.00	0.3189	0.0626	0.0361	0.4176
6	45m	5y	20.04	1.00	0.3046	0.0603	0.0284	0.3933
7	1h	5y	22.34	1.00	0.2611	0.0531	0.0296	0.3438
8	1.5h	5y	26.28	1.00	0.2759	0.0550	0.0326	0.3636
9	2h	5y	29.40	1.00	0.2949	0.0581	0.0280	0.3806
10	3h	5y	34.32	1.00	0.1755	0.0353	0.0183	0.2291
11	4.5h	5y	40.02	1.00	0.1442	0.0284	0.0157	0.1858
12	6h	5y	44.64	1.00	0.1145	0.0227	0.0117	0.1490
13	9h	5y	52.12	1.00	0.0976	0.0191	0.0102	0.1268
14	12h	5y	58.19	1.00	0.1037	0.0201	0.0105	0.1343
15	18h	5y	67.37	1.00	0.0674	0.0131	0.0068	0.0873
16	24h	5y	74.57	1.00	0.0675	0.0130	0.0067	0.0872
17	30h	5y	80.46	1.00	0.0494	0.0096	0.0048	0.0637
18	36h	5y	85.39	1.00	0.0459	0.0089	0.0045	0.0593
19	48h	5y	93.17	1.00	0.0504	0.0097	0.0048	0.0649
20	72h	5y	103.24	1.00	0.0361	0.0070	0.0036	0.0466

Elapsed Run Time (hh:mm:ss) = 00:00:03

Post development_batch.out

RORBWin Batch Run Summary
****

Program version 6.32 (last updated 3rd September 2017)
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Date run: 22 May 2018 10:18

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Spatial pattern : Uniform
Areal Red. Fact. : Based on ARR87 Bk II, Figs 1.6 and 1.7
Loss factors : Constant with ARI

Parameters: kc = 0.27 m = 0.80

Loss parameters	Initial loss (mm)	Runoff coeff.
	10.00	0.40

Peak	Description
01	Calculated hydrograph, SL
02	Calculated hydrograph, S4
03	Calculated hydrograph, S9
04	Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004
1	10m	10y	11.88	1.00	0.3784	0.0730	0.0414	0.4883
2	15m	10y	14.53	1.00	0.5137	0.0988	0.0554	0.6680
3	20m	10y	16.58	1.00	0.4102	0.0812	0.0382	0.5296
4	25m	10y	18.27	1.00	0.4323	0.0849	0.0471	0.5643
5	30m	10y	19.69	1.00	0.4247	0.0834	0.0460	0.5541
6	45m	10y	23.01	1.00	0.3746	0.0745	0.0351	0.4833
7	1h	10y	25.52	1.00	0.3184	0.0649	0.0359	0.4191
8	1.5h	10y	30.01	1.00	0.3455	0.0680	0.0406	0.4541
9	2h	10y	33.54	1.00	0.3615	0.0705	0.0348	0.4649
10	3h	10y	39.14	1.00	0.2183	0.0437	0.0223	0.2843
11	4.5h	10y	45.61	1.00	0.1785	0.0345	0.0189	0.2285
12	6h	10y	50.85	1.00	0.1393	0.0272	0.0141	0.1807
13	9h	10y	59.33	1.00	0.1190	0.0230	0.0123	0.1543
14	12h	10y	66.21	1.00	0.1269	0.0244	0.0127	0.1639
15	18h	10y	76.86	1.00	0.0824	0.0159	0.0082	0.1065
16	24h	10y	85.23	1.00	0.0821	0.0157	0.0080	0.1058
17	30h	10y	92.11	1.00	0.0606	0.0116	0.0058	0.0779
18	36h	10y	97.88	1.00	0.0522	0.0100	0.0051	0.0672
19	48h	10y	107.01	1.00	0.0620	0.0118	0.0059	0.0797
20	72h	10y	118.95	1.00	0.0444	0.0085	0.0043	0.0573

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RORBWin Batch Run Summary
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Program version 6.15 (last updated 30th March 2010)
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Date run: 19 Oct 2017 18:46

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Spatial pattern : Uniform
Areal Red. Fact. : Based on Siriwardena and Weinmann formulation
Loss factors : Constant with ARI

Parameters: kc = 0.25 m = 0.80

Loss parameters	Initial loss (mm)	Runoff coeff.
	10.00	0.60

Peak	Description
01	Calculated hydrograph, ML
02	Calculated hydrograph, NL
03	Calculated hydrograph, SL
04	Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004
1	10m	100y	20.54	0.99	0.0760	0.0192	0.0979	0.1929
2	15m	100y	24.76	1.00	0.1114	0.0240	0.1220	0.2532
3	20m	100y	27.93	1.00	0.1326	0.0273	0.1375	0.2894
4	25m	100y	30.48	1.00	0.1464	0.0277	0.1401	0.3084
5	30m	100y	32.59	1.00	0.1563	0.0268	0.1323	0.3147
6	45m	100y	37.40	1.00	0.1689	0.0277	0.1362	0.3251
7	1h	100y	40.91	1.00	0.1746	0.0296	0.1470	0.3420
8	1.5h	100y	48.03	1.00	0.1673	0.0306	0.1529	0.3349
9	2h	100y	53.63	1.00	0.1762	0.0320	0.1590	0.3617
10	3h	100y	62.47	1.00	0.1440	0.0234	0.1146	0.2772
11	4.5h	100y	72.67	1.00	0.1594	0.0263	0.1283	0.3140
12	6h	100y	80.93	1.00	0.1478	0.0213	0.1021	0.2712
13	9h	100y	94.26	1.00	0.1342	0.0198	0.0949	0.2489
14	12h	100y	105.07	1.00	0.1139	0.0175	0.0846	0.2160
15	18h	100y	122.81	1.00	0.0737	0.0112	0.0539	0.1371
16	24h	100y	136.87	1.00	0.0887	0.0123	0.0583	0.1594
17	30h	100y	148.48	1.00	0.0611	0.0092	0.0445	0.1148
18	36h	100y	158.30	1.00	0.0618	0.0086	0.0410	0.1103
19	48h	100y	174.00	1.00	0.0727	0.0105	0.0504	0.1337
20	72h	100y	194.97	1.00	0.0447	0.0067	0.0322	0.0835

Elapsed Run Time (hh:mm:ss) = 00:00:01

Post development_batch.out

RORBWin Batch Run Summary
****

Program version 6.32 (last updated 3rd September 2017)
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Date run: 22 May 2018 10:19

Catchment file : K:\Jobs Data\1601444-18A Davis Street Nyora_Eng_General\Design\Drainage\RORB\Pos Dev - No RB\Post development.catg
Rainfall location: Nyora
Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
Spatial pattern : Uniform
Areal Red. Fact. : Based on ARR87 Bk II, Figs 1.6 and 1.7
Loss factors : Constant with ARI

Parameters: kc = 0.27 m = 0.80

Loss parameters	Initial loss (mm)	Runoff coeff.
	10.00	0.30

Peak	Description
01	Calculated hydrograph, SL
02	Calculated hydrograph, S4
03	Calculated hydrograph, S9
04	Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004
1	10m	5y	10.10	1.00	0.2926	0.0563	0.0318	0.3799
2	15m	5y	12.43	1.00	0.4008	0.0762	0.0464	0.5233
3	20m	5y	14.24	1.00	0.3103	0.0613	0.0299	0.4015
4	25m	5y	15.75	1.00	0.3245	0.0637	0.0369	0.4251
5	30m	5y	17.02	1.00	0.3189	0.0626	0.0361	0.4176
6	45m	5y	20.04	1.00	0.3046	0.0603	0.0284	0.3933
7	1h	5y	22.34	1.00	0.2611	0.0531	0.0296	0.3438
8	1.5h	5y	26.28	1.00	0.2759	0.0550	0.0326	0.3636
9	2h	5y	29.40	1.00	0.2949	0.0581	0.0280	0.3806
10	3h	5y	34.32	1.00	0.1755	0.0353	0.0183	0.2291
11	4.5h	5y	40.02	1.00	0.1442	0.0284	0.0157	0.1858
12	6h	5y	44.64	1.00	0.1145	0.0227	0.0117	0.1490
13	9h	5y	52.12	1.00	0.0976	0.0191	0.0102	0.1268
14	12h	5y	58.19	1.00	0.1037	0.0201	0.0105	0.1343
15	18h	5y	67.37	1.00	0.0674	0.0131	0.0068	0.0873
16	24h	5y	74.57	1.00	0.0675	0.0130	0.0067	0.0872
17	30h	5y	80.46	1.00	0.0494	0.0096	0.0048	0.0637
18	36h	5y	85.39	1.00	0.0459	0.0089	0.0045	0.0593
19	48h	5y	93.17	1.00	0.0504	0.0097	0.0048	0.0649
20	72h	5y	103.24	1.00	0.0361	0.0070	0.0036	0.0466

Elapsed Run Time (hh:mm:ss) = 00:00:03

Post development_batch.out

RORBWin Batch Run Summary
****

Program version 6.32 (last updated 3rd September 2017)
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Date run: 22 May 2018 10:18

Catchment file : K:\Jobs Data\1601444-18A Davis Street Nyora_Eng_General\Design\Drainage\RORB\Pos Dev - No RB\Post development.catg
Rainfall location: Nyora
Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
Spatial pattern : Uniform
Areal Red. Fact. : Based on ARR87 Bk II, Figs 1.6 and 1.7
Loss factors : Constant with ARI

Parameters: kc = 0.27 m = 0.80

Loss parameters	Initial loss (mm)	Runoff coeff.
	10.00	0.40

Peak	Description
01	Calculated hydrograph, SL
02	Calculated hydrograph, S4
03	Calculated hydrograph, S9
04	Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004
1	10m	10y	11.88	1.00	0.3784	0.0730	0.0414	0.4883
2	15m	10y	14.53	1.00	0.5137	0.0988	0.0554	0.6680
3	20m	10y	16.58	1.00	0.4102	0.0812	0.0382	0.5296
4	25m	10y	18.27	1.00	0.4323	0.0849	0.0471	0.5643
5	30m	10y	19.69	1.00	0.4247	0.0834	0.0460	0.5541
6	45m	10y	23.01	1.00	0.3746	0.0745	0.0351	0.4833
7	1h	10y	25.52	1.00	0.3184	0.0649	0.0359	0.4191
8	1.5h	10y	30.01	1.00	0.3455	0.0680	0.0406	0.4541
9	2h	10y	33.54	1.00	0.3615	0.0705	0.0348	0.4649
10	3h	10y	39.14	1.00	0.2183	0.0437	0.0223	0.2843
11	4.5h	10y	45.61	1.00	0.1785	0.0345	0.0189	0.2285
12	6h	10y	50.85	1.00	0.1393	0.0272	0.0141	0.1807
13	9h	10y	59.33	1.00	0.1190	0.0230	0.0123	0.1543
14	12h	10y	66.21	1.00	0.1269	0.0244	0.0127	0.1639
15	18h	10y	76.86	1.00	0.0824	0.0159	0.0082	0.1065
16	24h	10y	85.23	1.00	0.0821	0.0157	0.0080	0.1058
17	30h	10y	92.11	1.00	0.0606	0.0116	0.0058	0.0779
18	36h	10y	97.88	1.00	0.0522	0.0100	0.0051	0.0672
19	48h	10y	107.01	1.00	0.0620	0.0118	0.0059	0.0797
20	72h	10y	118.95	1.00	0.0444	0.0085	0.0043	0.0573

Elapsed Run Time (hh:mm:ss) = 00:00:02

Post development_batch.out

RORBWin Batch Run Summary
****

Program version 6.15 (last updated 30th March 2010)
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Date run: 19 Oct 2017 19:04

Catchment file : K:\Jobs Data\1601444-18A Davis Street Nyora_Eng_General\Design\Drainage\RORB\Pos Dev - No RB\Post development.catg
Rainfall location: Nyora
Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
Spatial pattern : Uniform
Areal Red. Fact. : Based on Siriwardena and Weinmann formulation
Loss factors : Constant with ARI

Parameters: kc = 0.27 m = 0.80

Loss parameters	Initial loss (mm)	Runoff coeff.
	10.00	0.60

Peak	Description
01	Calculated hydrograph, SL
02	Calculated hydrograph, S4
03	Calculated hydrograph, Outlet

Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003
1	10m	100y	20.54	0.99	1.1648	0.1585	1.4142
2	15m	100y	24.76	1.00	1.2373	0.1820	1.5055
3	20m	100y	27.93	1.00	1.0796	0.1601	1.3113
4	25m	100y	30.48	1.00	1.1224	0.1646	1.3713
5	30m	100y	32.59	1.00	1.0606	0.1553	1.2945
6	45m	100y	37.40	1.00	0.8111	0.1222	0.9881
7	1h	100y	40.91	1.00	0.7262	0.1103	0.8981
8	1.5h	100y	48.03	1.00	0.8570	0.1226	1.0513
9	2h	100y	53.63	1.00	0.8371	0.1226	1.0169
10	3h	100y	62.47	1.00	0.5249	0.0786	0.6420
11	4.5h	100y	72.67	1.00	0.3911	0.0581	0.4809
12	6h	100y	80.93	1.00	0.3035	0.0451	0.3723
13	9h	100y	94.26	1.00	0.2585	0.0387	0.3177
14	12h	100y	105.07	1.00	0.2718	0.0406	0.3333
15	18h	100y	122.81	1.00	0.1832	0.0273	0.2245
16	24h	100y	136.87	1.00	0.1778	0.0265	0.2178
17	30h	100y	148.48	1.00	0.1294	0.0194	0.1584
18	36h	100y	158.30	1.00	0.1216	0.0182	0.1489
19	48h	100y	174.00	1.00	0.1301	0.0196	0.1593
20	72h	100y	194.97	1.00	0.0963	0.0144	0.1180

Elapsed Run Time (hh:mm:ss) = 00:00:00

RORBWin Batch Run Summary
****

Program version 6.32 (last updated 3rd September 2017)
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Date run: 22 May 2018 11:18

Catchment file   : K:\Jobs Data\1601444-18A Davis Street Nyora_Eng_General\Design\Drainage\RORB\2 Detention Basins\Post development.catg
Rainfall location: Nyora
Temporal pattern : AR&R87 Volume 2 for zone 1 (filtered)
Spatial pattern : Uniform
Areal Red. Fact. : Based on Siriwardena and Weinmann formulation
Loss factors   : Constant with ARI

Parameters: kc =   0.27   m = 0.80

Loss parameters	Initial loss (mm)	Runoff coeff.
	10.00	0.40

Peak	Description
01	Special storage : North Detention - Outflow
02	Special storage : North Detention - Inflow
03	Special storage : South Detention - Outflow
04	Special storage : South Detention - Inflow
05	Calculated hydrograph, Outlet

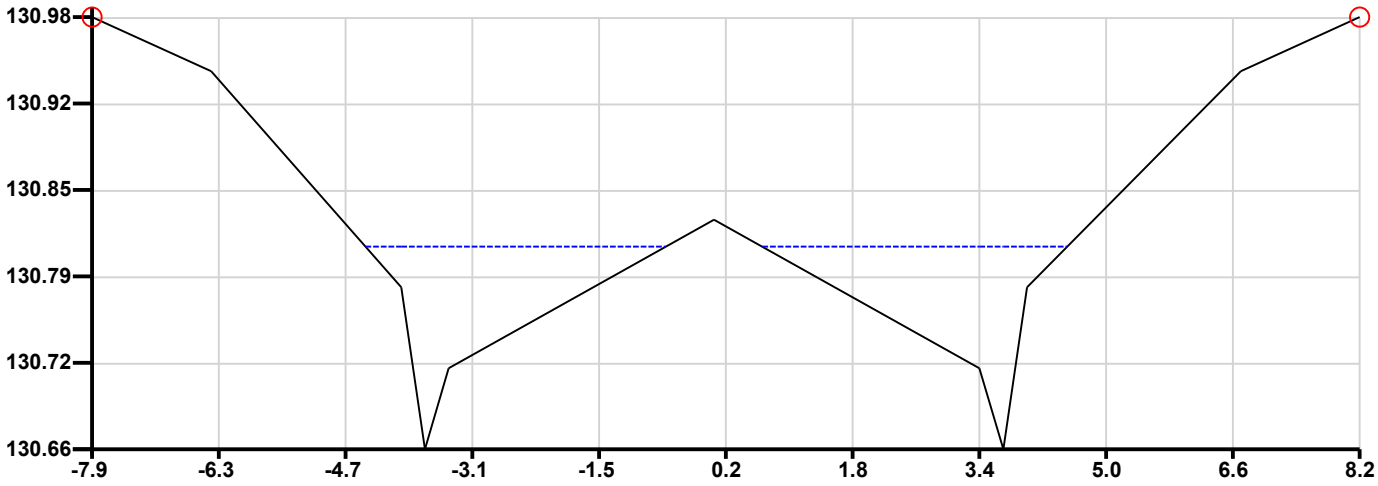
Run	Dur	ARI	Rain(mm)	ARF	Peak0001	Peak0002	Peak0003	Peak0004	Peak0005
1	10m	10y	11.88	1.00	0.0040	0.1567	0.0037	0.1557	0.0914
2	15m	10y	14.53	1.00	0.0052	0.2047	0.0049	0.2141	0.1208
3	20m	10y	16.58	1.00	0.0058	0.1775	0.0056	0.1665	0.0978
4	25m	10y	18.27	1.00	0.0063	0.1777	0.0061	0.1821	0.1032
5	30m	10y	19.69	1.00	0.0067	0.1752	0.0064	0.1787	0.1013
6	45m	10y	23.01	1.00	0.0074	0.1649	0.0072	0.1526	0.0938
7	1h	10y	25.52	1.00	0.0079	0.1374	0.0077	0.1420	0.0914
8	1.5h	10y	30.01	1.00	0.0086	0.1391	0.0084	0.1505	0.0963
9	2h	10y	33.54	1.00	0.0091	0.1545	0.0088	0.1477	0.1009
10	3h	10y	39.14	1.00	0.0096	0.0940	0.0093	0.0917	0.0612
11	4.5h	10y	45.61	1.00	0.0100	0.0764	0.0098	0.0741	0.0588
12	6h	10y	50.85	1.00	0.0102	0.0585	0.0100	0.0582	0.0479
13	9h	10y	59.33	1.00	0.0110	0.0489	0.0107	0.0491	0.0494
14	12h	10y	66.21	1.00	0.0112	0.0521	0.0110	0.0516	0.0507
15	18h	10y	76.86	1.00	0.0109	0.0339	0.0106	0.0337	0.0357
16	24h	10y	85.23	1.00	0.0105	0.0338	0.0102	0.0332	0.0385
17	30h	10y	92.11	1.00	0.0107	0.0252	0.0104	0.0243	0.0344
18	36h	10y	97.88	1.00	0.0102	0.0214	0.0099	0.0211	0.0300
19	48h	10y	107.01	1.00	0.0106	0.0256	0.0103	0.0247	0.0354
20	72h	10y	118.95	1.00	0.0084	0.0183	0.0082	0.0179	0.0251

Elapsed Run Time (hh:mm:ss) = 00:00:01

APPENDIX C
PC Convey Results

PROJECT: Road Reserve - Typical XS 16.0 m
Comment
Print-out date: 22/05/2018 - Time: 11:27
Data File: 1601444-Road Reserve- 16m Road XS.dat

1. CROSS-SECTION:



2. DISCHARGE INFORMATION:

100 year (1%) storm event

Total discharge = 0.252 cumecs

There is no pipe discharge
Overland / Channel / Watercourse discharge = 0.252 cumecs

3. RESULTS: Water surface elevation = 130.810m

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	0.25	0.00	0.25
D(Max) = Max. Depth (m):	0.00	0.15	0.00	0.15
D(Ave) = Ave. Depth (m):	0.00	0.05	0.00	0.05
V = Ave. Velocity (m/s):	0.00	0.63	0.00	0.63
D(Max) x V (cumecs/m):	0.00	0.10	0.00	0.10
D(Ave) x V (cumecs/m):	0.00	0.03	0.00	0.03
Froude Number:	0.00	0.90	0.00	N/A
Area (m^2):	0.00	0.39	0.00	0.39
Wetted Perimeter (m):	0.00	7.70	0.00	7.70
Flow Width (m):	0.00	7.64	0.00	7.64
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	130.980	-6.350	130.940	0.035
2	-6.350	130.940	-3.950	130.780	0.035
3	-3.950	130.780	-3.650	130.660	0.013
4	-3.650	130.660	-3.350	130.720	0.013
5	-3.350	130.720	0.000	130.830	0.013
6	0.000	130.830	3.350	130.720	0.013
7	3.350	130.720	3.650	130.660	0.013
8	3.650	130.660	3.950	130.780	0.013
9	3.950	130.780	6.650	130.940	0.013
10	6.650	130.940	8.150	130.980	0.035

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APPENDIX C
Detention Assets Concept Layout Plan

LEGEND

- Title boundary (approx.)
- Internal title boundary (approx.)
- Lots
- Superlot A
- Unencumbered passive open space

Detention Box (North)
45 (l) × 10 (w)

Detention Box (South)
45 (l) × 10 (w)

A
3905m²

STREET

DAVIS

GRUNDY AVENUE

CORNISHS ROAD

POS
776m²

POS
550m²

DRAFT

FOR DISCUSSION PURPOSES ONLY

15 0 15 30 45 60 75 90m

Detention Assets

18A Davis Street & 32 Grundy Avenue, Nyora

Kufner Textiles (Australia) P/L & Wayne Allen

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Version	Date	Description	Drafted	Approved
01	21.05.18	Initial Issue	MA	AM

Date: 21.05.18
Version No:
Job No: 1601444
Scale (A1): 1:750
(A3): 1:1500

K:\JOBS DATA\1601444-18A DAVIS STREET NYORA_ENG_GENERAL\DRAWINGS\DRAINAGE\4880FEAT-PRE_DEV.DWG