DIVERSI
CREATIVE ENGINEERING SOLUTIONS

Suite 102, 29-31 Solent Circuit
Norwest NSW 2153

PO Box 6662
Norwest NSW 2153

Diversi Consulting ABN 47 012 983 817

P 02 8883 1113
F 02 9659 1800
E mail@diversi.com.au
W diversi.com.au

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14 February 2019

Robert Moore & Associates Pty Ltd
27 Castle Hill Road
West Pennant Hills NSW 2125

Dear Ravonni,

RESIDENTIAL SUBDIVISION – 45 MAJOR ROBERTS AVENUE, TAHMOOR
STORMWATER MANAGEMENT STRATEGY

Diversi Consulting has been engaged by Robert Moore & Associates Pty Ltd, to prepare a Stormwater Management Strategy to support the Development Application (DA) submission for the proposed residential subdivision located at 45 Major Roberts Avenue, Tahmoor.

The following is a summary of the proposed Stormwater Management Strategy, which should be read in conjunction with the Robert Moore and Associates Pty Ltd engineering plan (ref: 100021 E5/B).

This report has been developed in accordance with Wollondilly Shire Council requirements, with regards to the analysis undertaken and to explain the concept behind the proposed Stormwater Management Strategy.

If you have any questions or require any clarifications please call me on 0421 484 152 or (02) 8883 1113.

Yours faithfully

Diversi Consulting

Phil Diversi
Director

1 BACKGROUND INFORMATION

1.1 Site

The subject development area, Lot 39 DP1215451, is located in the suburb of Tahmoor within the Wollondilly Shire Council Local Government Area (LGA). The site has an area of approximately 0.84 ha and is bounded by Major Roberts Avenue to the south, Myrtle Creek to the north, Wollondilly Pony Club to the west and the Macquarie Grove Retirement Village to the east. Refer to **Figure 1.1** below.

An existing Ø1050 pipeline is located on the site, which conveys runoff from the upstream street drainage network to a discharge headwall to Myrtle Creek. A splitter pit and GPT are also located on the site, which are understood to provide gross pollutant treatment for the upstream street drainage network.

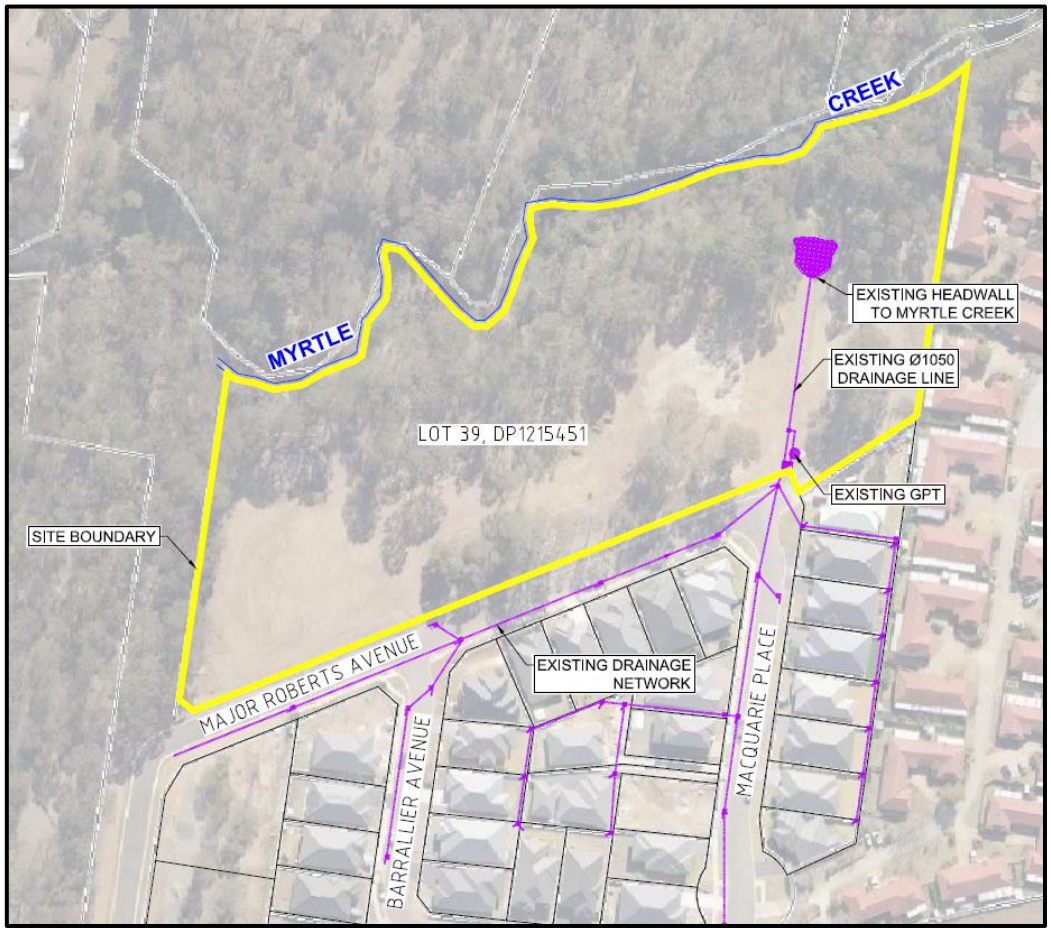

Figure 1.1: Locality Plan (NSW SIX Maps 2018)

1.2 Proposed Development

The proposed development includes 13 residential lots and associated drainage infrastructure. The development footprint is in close proximity to Myrtle Creek and includes both a 30 m riparian zone (to be rezoned as E2-Environmental Conservation) and an additional 30 m Asset Protection Zone (APZ). Refer to **Figure 1.2** below.

An inter-allotment drainage line (IAD) is proposed to convey runoff from the main developable area to the existing Ø1050 drainage line on the site. A junction pit will be added to the Ø1050 pipeline to connect the drainage network.

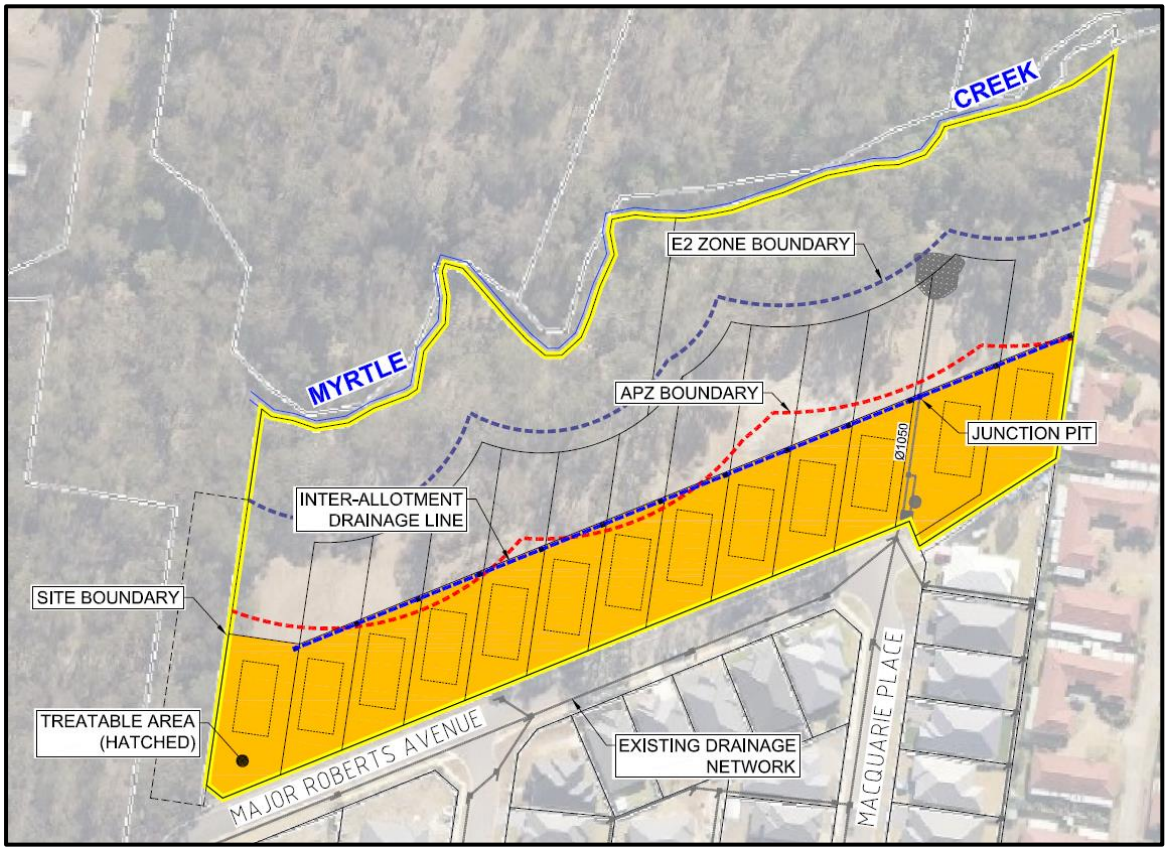

Figure 1.2: Proposed Development (NSW SIX Maps 2018)

All areas north of the IAD will drain overland into Myrtle Creek. Whilst, all developed areas will be collected and conveyed by the IAD.

1.3 Council and Authority Requirements

The Stormwater Management Strategy has been prepared in accordance with the following guidelines:

- Wollondilly Shire Council Development Control Plan (2016)
- Wollondilly Shire Council Design Specification (2016)
- NSW MUSIC Modelling Guidelines (Local Land Services, 2015)

2 STORMWATER CONCEPT DESIGN

2.1 General

The proposed Stormwater Management Strategy includes a water quality treatment system comprising of on-lot rainwater tanks (3 kL) and bio-retention raingardens. These devices will provide the necessary treatment of pollutants and nutrients generated on the site. The bio-retention raingardens have been designed to treat the pollutant loads from the 'first flush' storm water flows (3 month ARI), which typically include the excess nutrients generated from the development area.

Following consultation with Robert Moore and Associates Pty Ltd, it is understood that previous stages of the development have not required on-site detention. Based on this previous experience and the proximity of the site to Myrtle Creek, on-site detention has been deemed not required for the development.

2.2 Water Quality Treatment Objectives

The water quality pollutant removal objectives, as outlined in the Wollondilly Shire Council Design Specification (2016), are as follows:

Total Suspended Solids (TSS)	80%
Total Phosphorus (TP)	45%
Total Nitrogen (TN)	45%
Gross Pollutants (GP)	70%

2.3 Water Quality Modelling

The water quality modelling has been completed using MUSIC (Model for Urban Stormwater Improvement Conceptualisation), which has been developed by the Cooperative Research Centre for Catchment Hydrology (CRC) and Ewater. This computer model has been used to simulate the urban stormwater pollution levels to be expected from the development and demonstrate the performance of the proposed stormwater quality treatment system.

For the MUSIC modelling parameters adopted in this strategy, refer to Appendix A.

2.3.1 Sub-catchment Delineation

A large portion of the site, which includes the majority of land north of the IAD, will be located within the APZ and E2 zones. Due to these restrictions, it is unlikely that further development will occur in these areas. **As such, the treatable area (catchment) adopted for this WSUD strategy, is restricted to the area located south of the IAD.** This catchment has been split into "roof" and "urban" (remaining) areas based on the current development layout.

An overall percentage impervious of 60% has been adopted for the catchment. Refer to Appendix A for further details.

2.3.2 Water Quality Treatment Train

The proposed water quality treatment system, comprises of on-lot rainwater tanks (3 kL) and bio-retention treatment.

For modelling purposes, single combined "rainwater tank" and "bio-retention raingarden" nodes have been adopted to represent the overall treatment within the catchment. The sizing of the treatment devices has then been prorated between each lot.

Refer to **Figure 3.1** below for the MUSIC model layout.

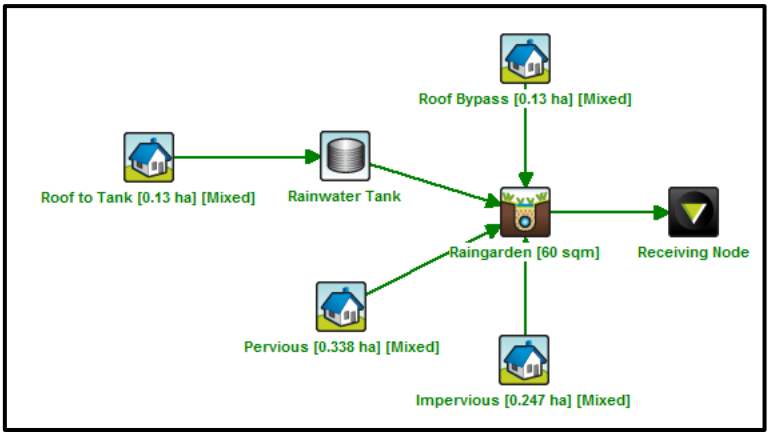

Figure 3.1: MUSIC Model Layout (Model ref: 19001-MU01-A1.sqz)

2.4 Results

The estimated pollutant loads and treatment train reductions have been determined from the MUSIC modelling and are summarised in **Table 3.1.**

Table 3.1: Proposed Treatment Train Effectiveness

POLLUTANT	SOURCE LOAD (KG/YR)	RESIDUAL LOAD (KG/YR)	TARGET % REDUCTION	% REDUCTION
TSS	431	80.7	80.0%	81.3%
TP	0.957	0.356	45.0%	62.8%
TN	9.46	4.05	45.0%	57.2%
GP	107	0.851	70.0%	99.2%

Results demonstrates that, with a 60 m^2 bio-retention raingarden system, Council's pollutant removal objectives for TSS, TP, TN and GP are achieved for the site.

To ensure each lot provides the necessary level of treatment, a breakdown of the individual raingarden areas required for each lot is provided in **Table 3.2**. Importantly, for the WSUD strategy to operate effectively, all stormwater from the lots, including surface and roof/rainwater tank runoff, shall be directed to the surface of the respective bio-retention raingarden.

Table 3.2: Individual Raingarden Areas

LOT	TREATABLE AREA (m^2)	RAINGARDEN AREA (m^2)
130	841.0	6.0
131	591.6	4.2
132	591.6	4.2
133	591.6	4.2
134	591.6	4.2
135	591.6	4.2
136	558.5	4.0
137	624.8	4.4
138	591.6	4.2
139	591.6	4.2
140	592.5	4.2
141	875.8	6.2
142	807.9	5.7
TOTAL:	**8442.0**	**60.0**

3 CONCLUSION

This report is submitted for Council's review and approval and should be read in conjunction with the engineering plans submitted for the Development Application (DA) for the proposed development.

Based on the MUSIC modelling completed of the site, provision of on-lot rainwater tanks and bio-retention treatment of first flush flows, to a total filter area of 60 m^2, will achieve the required pollutant removal objectives for the proposed development.

It is therefore concluded that this Stormwater Management Strategy for the site, if fully implemented, will meet the Council's stormwater management requirements.

APPENDIX A - MUSIC MODELLING PARAMETERS

Rainfall Data

The MUSIC model has adopted 6 minute rainfall data observed at Liverpool (Station no: 67035) between the years 1967-1973. For the rainfall and evapo-transpiration data adopted in the MUSIC model, refer to Figure A1 below.

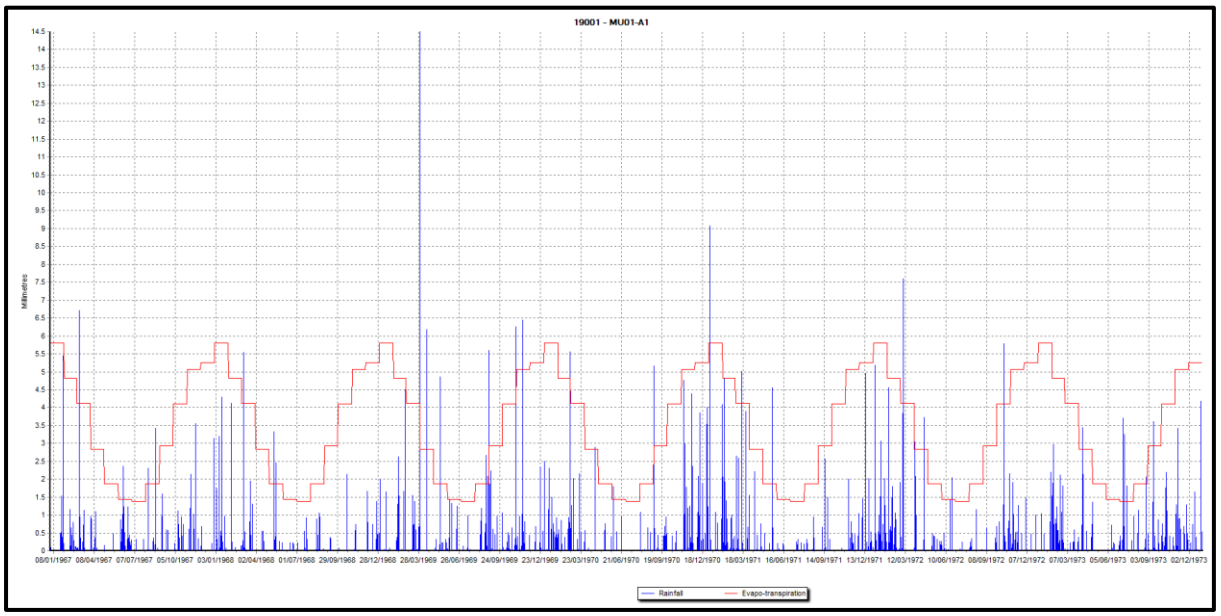

Figure A1: MUSIC Model Rainfall Data

In the absence of site specific data regarding the soil and groundwater parameters of the site, the rainfall – runoff parameters within the MUSIC model have been generally adopted from the NSW MUSIC Modelling Guidelines (LLS, 2015) and are provided in **Table A1**.

Table A1: Rainfall – Runoff Parameters

PARAMETER	VALUE	
	General	Roof
Impervious Area Properties		
Rainfall Threshold (mm/day)	1.0	0.3
Pervious Area Properties		
Soil Storage Capacity (mm)	170	170
Initial Storage (% of Capacity)	30	30
Field Capacity (mm)	70	70
Infiltration Capacity Coefficient - a	210	210
Infiltration Capacity Exponent - b	4.7	4.7
Groundwater Properties		
Initial Depth (mm)	10	10
Daily Recharge Rate (%)	50	50
Daily Baseflow Rate (%)	4	4
Daily Deep Seepage Rate (%)	0	0

Source Node Data

As discussed in Section 2.3.1, the catchment has been split into "roof" and "urbans" areas based on the current development layout. For input into the MUSIC model, these areas have been further divided to represent the following:

- Roof to Tank: 50% of total roof area that will drain into the rainwater tank.
- Roof Bypass: 50% of total roof area that is assumed to bypass rainwater tank.
- Impervious Area: remaining area to ensure 60% total imperviousness across the catchment.
- Pervious Area: 40% of catchment area.

Refer to **Table A2** for the area breakup adopted in the MUSIC model.

Table A2: Source Node Areas

TREATABLE AREA (ha)	ROOF AREA (ha)	URBAN AREA (ha)	MUSIC NODE INPUTS (ha)			
			Roof to Tank	Roof Bypass	Impervious Area	Pervious Area
0.844	0.260	0.584	0.130	0.130	0.247	0.338

Source node pollutant load parameters have been adopted from the NSW MUSIC Modelling Guidelines (LLS, 2015) and are provided in **Table A3**.

Table A3: Pollutant Parameters

	TSS		TP		TN	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Base Flow						
Roof*	1.2	0.17	-0.85	0.19	0.11	0.12
Impervious*	1.2	0.17	-0.85	0.19	0.11	0.12
Pervious	1.2	0.17	-0.85	0.19	0.11	0.12
Storm Flow						
Roof	1.3	0.32	-0.89	0.25	0.3	0.19
Impervious	2.43	0.32	-0.3	0.25	0.34	0.19
Pervious	2.15	0.32	-0.6	0.25	0.3	0.19

*Base Flow for impervious areas is not applicable

Treatment Node Data

For the assumptions and inputs adopted for the rainwater tank and bio-retention raingarden nodes, refer to **Tables A4** and **A5**.

Table A4: Rainwater Tank Parameters

PROPERTY	VALUE
Assumptions	
Number of Dwellings	13
Total Roof Area to Tank (ha)	0.13
10 yr ARI 5 min. rainfall intensity (mm/hr)*	146
Assumed Daily demand (kL/house/day)^	173
Overflow Pipe diameter (mm)	50
Area overflow pipe (m^2)	0.002
Equivalent overflow pipe area (m^2)	0.026
Assumed tank volume (kL)	3
Assumed useable tank volume (kL)~	2.4
Assumed tank height (m)	1.5
MUSIC Modelling Parameters	
High Flow Bypass (m^3/s)	0.05
Total Tank Volume (m^3)	31.2
Total Tank Area (m^2)	20.8
Overflow Pipe diameter (mm)	180.3
Daily Demand	2.249

*Based on Wollondilly Design Specifications IFD Data.
^Adopted from NSW MUSIC Modelling Guidelines (LLS, 2015) for a 3 person single dwelling with toilet and laundry reuse.
~Assumed 80% of overall tank volume.

Table A5: Bio-retention Raingarden Parameters

PROPERTY	VALUE
Low Flow Bypass (m^3/s)	0
High Flow Bypass (m^3/s)	0.05
Extended Detention Depth (m)	0.3
Surface Area (m^2)	**60**
Filter Area (m^2)	**60**
Unlined Filter Media Perimeter (m)	0.01
Saturated Hydraulic Conductivity (mm/hr)	100
Filter Depth (mm)	0.4
TN Content of Filter Media (mg/kg)	400
Orthophosphate Content of filter Media (mg/kg)	40
Exfiltration Rate (mm/hr)	0
Base Lined? (Y/N)	Y
Overflow Weir Width (m)	6
Underdrain Present? (Y/N)	Y
Submerged Zone with Carbon Present? (Y/N)	N

Note: The filter media used for the construction of the bio-retention raingardens is to comply with the specifications available from the Facility for Advancing Water Bio-Filtration (FAWB) published by Monash university.