

REPORT



467 FEDERAL DRIVE, FEDERAL
NSW

STORMWATER MANAGEMENT PLAN

AMITRAN

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the sustainable
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Executive Summary

FloodWorks has been engaged by Amitran to prepare a Stormwater Management Plan (SMP) for the proposed development over 467 Federal Drive, Federal, NSW (Lot 10 DP790360), known here in as the subject site. The subject site is located within the Byron Shire Council Local Government Area (LGA).

Specifically, the development will incorporate:

- Stormwater quality objectives will be achieved through the Rainwater Reuse connected to toilet and gardens, and Raingarden
- Stormwater quantity objectives will be achieved through On Site Detention being located within Raingarden system

The above design complies with *Byron Shire Council DCP Chapter B3* and *Byron Shire Council Comprehensive Guidelines for Stormwater Management*, for stormwater water quantity, quality controls.

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Appendix A – Stormwater Management Plans

1. Introduction

1.1. Background

FloodWorks has been engaged by Amitran to prepare a Stormwater Management Plan (SMP) for the proposed development over 467 Federal Drive, Federal, NSW (Lot 10 DP790360), known here in as the subject site.

1.2. Scope

Specifically, this report details the following:

1. Conceptual Stormwater Management Plan (SMP);
 - a. Stormwater quality assessment (MUSIC);
 - b. Pre and post developed hydrology and hydraulics of the site (XP-SWMM);
 - c. Rainwater reuse; and
 - d. Water sensitive urban concept design.

To minimise the impact of the proposed development on the external sensitive environment the proponent shall implement this SMP. To avoid significant and/or sustained deterioration in downstream water quality, this SMP may be amended as required.

1.3. Objectives

The objective of this SMP is to ensure that there is no worsening of stormwater quantity and quality nor any reduction in the environmental values of the downstream receiving waters as a result of activities on the subject site in compliance with the Byron Shire Council Development Control Plan (DCP) 2014.

This objective will be achieved through the implementation of:

- Management strategies designed to minimise water pollution from the development of the subject site;
- Specific construction phase controls to minimise erosion and control sediment loss;
- A monitoring and maintenance program for the construction phase; and
- Defined performance criteria and actions to be taken if the criteria are not met.

1.4. Description of Subject Site

The subject site is located on 467 Federal Drive, Federal, within Byron Shire Council, NSW, properly described Lot 10 DP790360 (the Subject Site). The total site area occupies approximately 0.4 ha, with a developable area of 0.4 ha.

The site is bounded by Federal Drive to the east and Coachwood Court to the north, residential lots to the west and southern boundary. The site is mostly vacant with an existing dwelling located in the middle of the site. The site is mainly covered by grass.

Refer to Figure 1.1 for the location and aerial imagery of the subject site.



Figure 1.1 Aerial Imagery of Subject Site

1.5. Topography and Stormwater Conveyance

The subject site slopes from the north to the south with an average grade of approximate 6.5%.

The site's highest elevation of 176 m AHD is located in the north of the site. The site's northern area grade towards the southern corner abutting lot 17 DP814436.

1.6. Rainfall

Intensity Frequency Duration (IFD) data has been derived using the Bureau of Meteorology (BOM) IFD generator. The IFD data is derived in accordance with Australian Rainfall and Runoff 2019 (ARR, 2019) and has been used in determining the peak flow rates from the site.

An additional 10-years of 6-minute interval data was obtained for Alstonville and applied to the water quality modelling undertaken as part of this assessment. The data indicates the mean annual rainfall and evapotranspiration between 1996 and 2006 was 1,563 mm/year and 1,516 mm/year respectively.

1.7. Description of Development

The proposed development will be light industrial development with 8 units, carparks & landscaped area. The site entry is from Federal Drive to the east through the proposed internal Road. The total developed area is approximately 0.4 ha.

The proposed development will result in an increase in impervious area from the proposed roof and road areas over the pre-developed case.



The development proposes to use Water Sensitive Urban Design (WSUD) measures to control and treat stormwater as per Councils planning guidelines. The proposed development layout is illustrated in Figure 1.2 below.

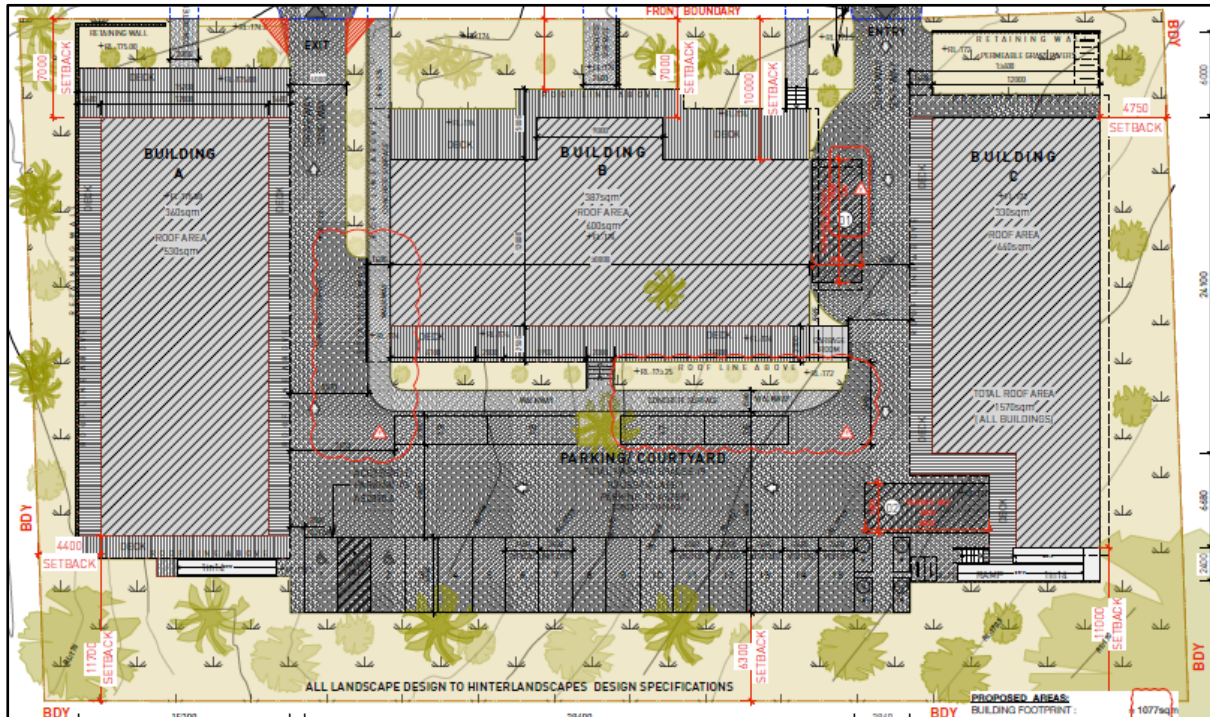


Figure 1.2 Proposed Plan of Development

2. Stormwater Quality

To minimise the potential adverse impacts, the proposed development will reduce contamination in stormwater runoff through the incorporation of Water Sensitive Urban Design (WSUD) measures.

2.1. Water Quality Objectives

As indicated in the Byron Shire Council DCP, all stormwater drainage systems shall be designed to achieve the following Water Quality Objectives (WQO's) as detailed in Figure 2.1.

Pollutant / Issue	Retention Criteria
Litter	70% of average annual load greater than 5mm.
Coarse Sediment	80% of average annual load for particles 0.5mm or less.
Fine Particles	50% of average annual load for particles 0.1mm or less.
Total Phosphorous	45% of average annual load.
Total Nitrogen	45% of average annual load.
Hydrocarbons, motor fuels, oils & grease	90% of average annual load.

Figure 2.1 Byron Shire Council Stormwater Quality Objectives

2.2. Water Quality Concept

The MUSIC water quality assessment has been completed as per the Using-MUSIC-in-the-Sydney-Drinking-Water-Catchment, *NSW Music Modelling Guidelines* (August 2019), and the *Music Modelling Guidelines for South East Queensland* (Music by Design, 2006).

To achieve the above water quality objectives, it is proposed to have water reuse via 440KL rainwater tank.

All carparking area and water in excess of the reuse tank capacity will be directed via surface flow to the proposed Raingarden for treatment.

2.3. MUSIC Source Node Parameters

The MUSIC modelling algorithm used to generate urban runoff is based from the following sources. In accordance with best modelling practice the developed sub-catchments were further separated into the effective contributing impervious areas of Road, Ground and Roof. Source node pollutant values are listed in Table 2.1.

Table 2.1 Source Node Pollutant Values

Industrial	Total Suspended Solids (log mg/L)		Total Phosphorous (log mg/L)		Total Nitrogen (log mg/L)	
	Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Storm Flow Concentration	1.30 ⁽¹⁾		-0.89 ⁽¹⁾		0.30 ⁽¹⁾	
	2.43 ⁽²⁾	0.32	-0.30 ⁽²⁾	0.25	0.34 ⁽²⁾	0.19
	2.15 ⁽³⁾		-0.60 ⁽³⁾		0.30 ⁽³⁾	
Base Flow Concentration	0 ⁽¹⁾	0 ⁽¹⁾	0 ⁽¹⁾	0 ⁽¹⁾	0 ⁽¹⁾	0 ⁽¹⁾
	1.2 ⁽²⁾	0.17 ⁽²⁾	-0.85 ⁽²⁾	0.19 ⁽²⁾	0.11 ⁽²⁾	0.12 ⁽²⁾
	1.2 ⁽³⁾	0.17 ⁽³⁾	-0.85 ⁽³⁾	0.19 ⁽³⁾	0.11 ⁽³⁾	0.12 ⁽³⁾

NOTE: (1) Values applied to "Roof" areas
 (2) Values applied to "Road" areas

(3) Values applied to "Ground" areas

2.4. Water Reuse Parameters

Water Reuse is an important component of Water Sensitive urban design and has been included as per Table 2.2 below (WaterNSW Standard, 2019). Proposed Rainwater Tanks are to be 440kL.

Table 2.2 Water Reuse

End Use	Demand
Daily demand	0.9 kL/day
Annual demand	516.2 kL/yr

2.5. Rainfall Threshold

The rainfall threshold is defined as per Table 2.3.

Table 2.3 Rainfall Threshold

Land Use Type	Rainfall Threshold (mm)
Land Use Zoning	
For all Land Use (Residential, rural res, etc)	1.0
Surface Type	
Roofs	0.3
Sealed Roads, driveways Paths, paving	1.5
Permeable pavement	1.2

2.6. Surface Types

In accordance with best modelling practice the developed sub-catchments were further separated into the effective contributing impervious areas of Road, Ground and Roof.

2.6.1. Effective Impervious Areas (EIA)

Effective Impervious Area (EIA) is the area that will directly contribute flow to the drainage network. These areas will be “effective” in generating runoff which will be delivered rapidly at the catchment outlet during a rainfall event, as per Table 2.4.

Table 2.4 Surface Type EIA Node Factors (for Source Nodes <10Ha)

Surface Types	EIA Factor
Roofs	1.0 x TA
Sealed Roads	1.0 x TA
Vegetated Landscaping	0.05 x TA
Paved landscaping	1.0 x TA

TA = Total site/Catchment/surface area; TIA = Total Impervious Area;

Table 2.5 below lists the post developed effective impervious areas for each sub-catchment.

Table 2.5 Effective Impervious Areas

Sub catchment	Sub Catchment Area (ha)	EIA Factor	Effective Impervious Area (ha)
Roof	0.158	1	0.158
Road	0.096	1	0.096
Vegetated Landscaping	0.135	0.05	0.007
Paved landscaping	0.011	1	0.011
<i>TOTAL</i>	<i>0.400</i>		<i>0.272</i>

2.7. Treatment Train

To ensure the above WQO's can be met at the site's Lawful Point of Discharge (LPD), a treatment train was proposed for the developed site and modelled using the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software. The proposed treatment train for operational phase of the development is presented schematically in Figure 2.2.

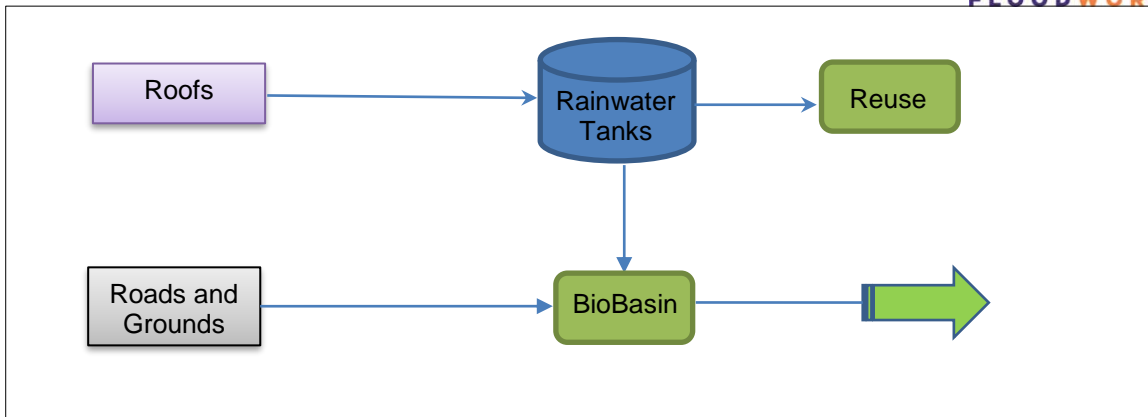


Figure 2.2 Proposed Stormwater Treatment Train

2.8. MUSIC Schematic

Figure 2.3 below shows the arrangement of the water quality treatment measures for the subject site to be used in satisfaction of the Byron Shire Council DCP.

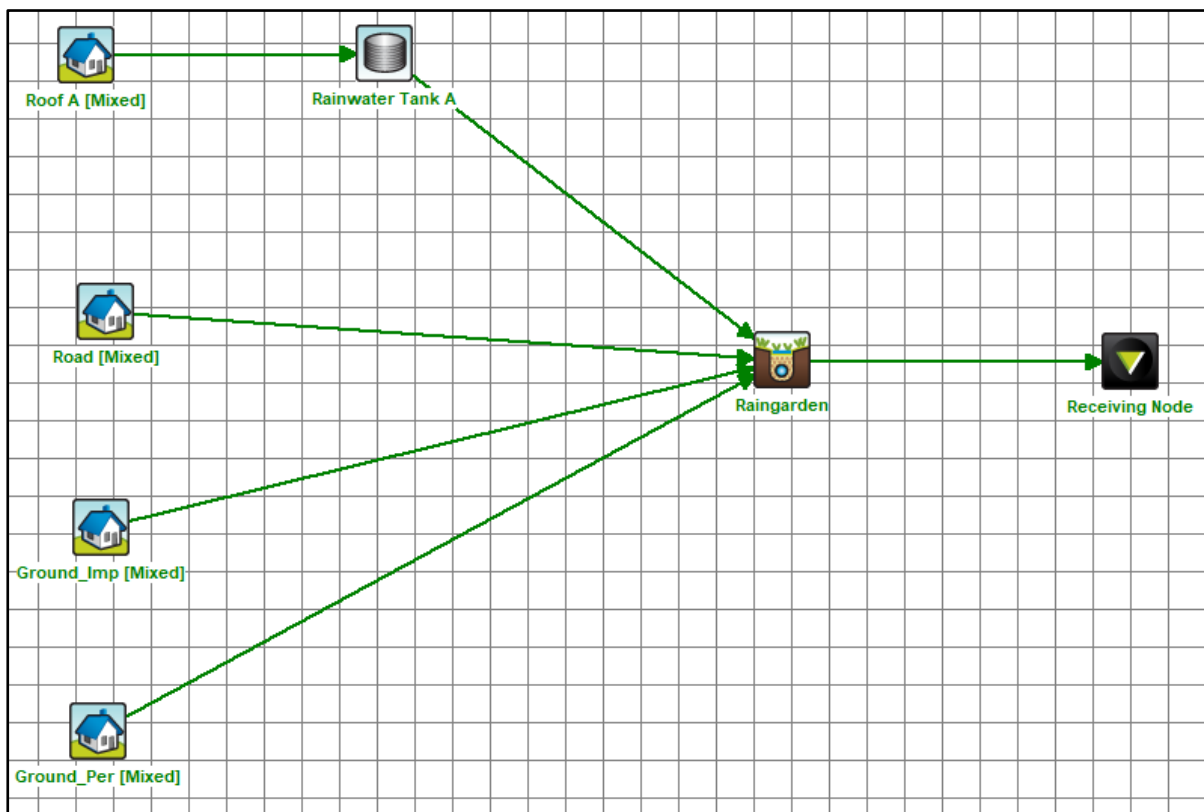
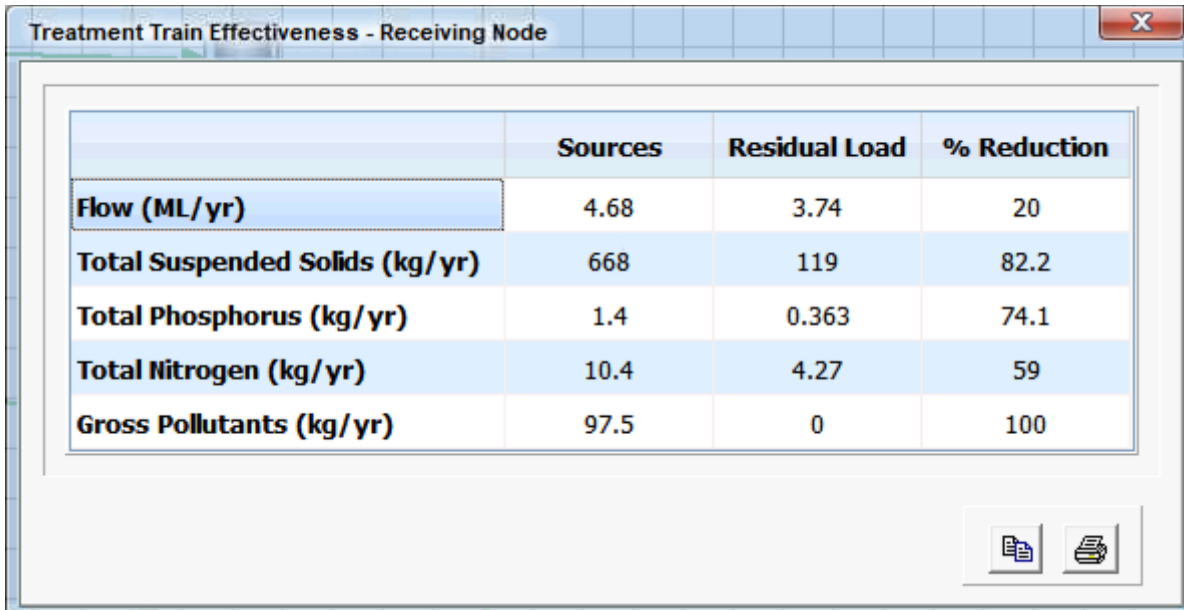


Figure 2.3 Subject Site Music Schematic and Treatment Train

The results for the treatment train area are as per Figure 2.4



	Sources	Residual Load	% Reduction
Flow (ML/yr)	4.68	3.74	20
Total Suspended Solids (kg/yr)	668	119	82.2
Total Phosphorus (kg/yr)	1.4	0.363	74.1
Total Nitrogen (kg/yr)	10.4	4.27	59
Gross Pollutants (kg/yr)	97.5	0	100

Figure 2.4 MUSIC Results for Raingarden

2.9. MUSIC Results

Results of the MUSIC modelling for the subject site are summarised in Table 2.6 for flow based sub-samples and treatment train effectiveness respectively.

Table 2.6 Treatment Train Effectiveness

Pollutant	% Reduction	Target	Target Met?
TSS (kg/yr)	82.2	80%	Yes
TP (kg/yr)	74.1	45%	Yes
TN (kg/yr)	59	45%	Yes
Gross Pollutants (kg/yr)	100	90%	Yes

NOTE: All simulations have been run with pollutant export estimation set to "stochastic generation".

The water quality management plan proposed will achieve the water quality objectives of the Byron Shire Council. For further details of the treatment train properties, refer to Table 2.7 below.

Table 2.7 Proposed System Parameters used in Stormwater Quantity Assessment

Basin ID	Parameter	Value
Raingarden	Base Area	36m ²
	Extended Detention Depth	0.3m
Rainwater Tank	Volume below overflow pipe	440kL
	Depth above overflow pipe	0.2m

NOTES

Please note the following assumptions within the design:

- Biobasins to be designed generally in accordance with Figure 2.5 below.

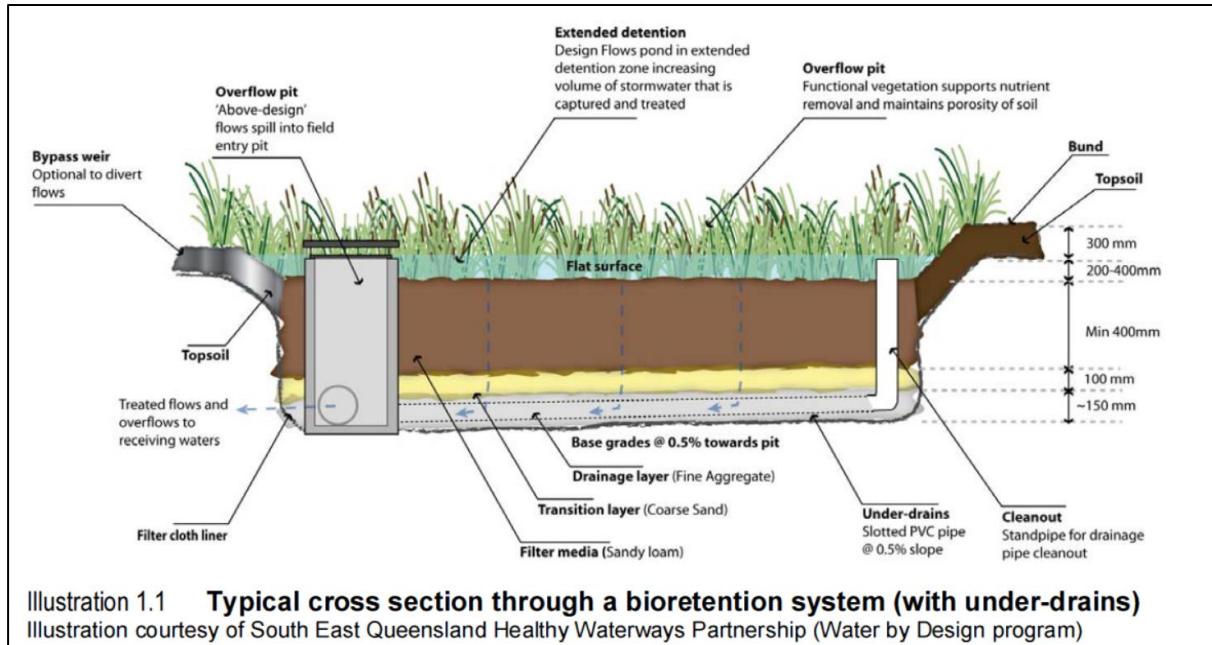


Figure 2.5 Typical Bio Basin Cross Section

It should be noted that the above calculated volumetric requirements are conceptual and are to be confirmed during detailed Civil design phase of the development (Construction Certificate).

3. Stormwater Quantity Assessment

3.1. Hydrological and Water Quantity Objectives

The following section of this report outlines the measures required to meet the water quantity objectives as per the Chapter B3 of the DCP. In order to meet these objectives, it is necessary to ensure that post development discharge from the site will not create a worse situation for downstream property owners than that which existed prior to the development (i.e. non-worsening) (DEWS; BCC; IPWEA, 2013).

Due to the increase in impervious areas within the proposed development, peak stormwater flow rates will increase. In order to mitigate these increased flow rates from the developed site it is proposed to implement an On-Site Detention (OSD) system. OSD systems temporarily store stormwater runoff and release flows at a controlled rate that is no greater than the pre-developed peak rate.

3.2. Conveyance of Site Flows

The proposed roof flow is to be captured by the rainwater tanks and then overflow from the tanks and roof is to be discharged to the Proposed Raingarden and ultimately the Inter Allotment Drainage (IAD) system.

The proposed carpark flow will be conveyed overland to the designated Raingarden. All site flow ultimately discharges to LPD A via the proposed 375mm stormwater system in existing easement up to and including the 1%AEP design event. All events in excess of this will be conveyed by a design weir to the south east.

Refer to drawing Stormwater Drawings within Appendix A of this report.

3.3. XP-SWMM Analysis

XP-SWMM (version 2017.2) software was utilised to model the performance of the proposed stormwater quantity control measures. This modelling software is a link-node model capable of performing hydrology and hydraulics of stormwater drainage systems simultaneously.

Laurenson's Hydrology has been adopted as the runoff routing method within XP-SWMM. Sub-catchment routing in this method is carried out using the Muskingum procedure, which is a storage routing method based on the storage equation

3.4. XP-SWMM Results

To confirm the performance of the proposed OSD system, a pre- and post-development model was constructed. These models compare the discharge hydrographs for a range of storm durations at the existing Lawful Points of Discharge. All design events (20%AEP to 1% AEP) have been simulated for using critical events.

A summary of the modelling results for the different ARI events is contained in Table 3.1. Results of the modelling indicate the proposed system is capable of maintaining the pre-development peak discharges for all design events from the 20%AEP to 1%AEP at the sites LPD's.

Table 3.1 Pre-Development vs Post-Development (Mitigated) Peak Discharges at LPDs

Catchment	AEP Event	Pre-Development (m ³ /s)	Post-Development (Un-mitigated) (m ³ /s)	Post-Development (Mitigated) (m ³ /s)	Comply?
A	1%	0.191	0.268	0.177	Yes
	2%	0.171	0.238	0.159	Yes
	5%	0.146	0.205	0.139	Yes
	10%	0.125	0.176	0.116	Yes
	20%	0.107	0.150	0.106	Yes

3.5. On-Site Detention Details

The proposed OSD systems are to be implemented to ensure a non-worsening of peak discharges at the LPD. Table 3.2 below contains the details of the proposed OSD systems within the subject site.

Table 3.2 OSD Details

Detention ID	Outlet Structures			100yr ARI Detention Volume (m3)
	Orifices	Riser	Outlet Pipe (s)	
Basin	2x200x200mm @ EDD	0.6x0.6m @ 0.3m above EDD	1x375mm \varnothing	39

See Stormwater Management Plan Addendum A for detail

4. Summary

This Stormwater Management Plan (SMP) has been designed in accordance with Byron Shire Council Comprehensive Guidelines for Stormwater Management, and complies with Chapter 22 of the DCP.

Specifically, the development will incorporate:

- Stormwater quality objectives will be achieved through the use of 440kL of rainwater reuse, and biological treatment through the proposed Raingarden
- Stormwater quantity objectives will be achieved through on-site detention basin of 39m³

In conclusion, the above design complies with Byron Shire Councils DCP Chapter B3, and the BSC *Comprehensive Guidelines for Stormwater Management* for stormwater quantity and quality management. Stormwater quality can be achieved on all key indicators TN, TP, TSS and Gross Pollutants, and stormwater can be effectively detained to predevelopment levels for all design events up to and including the 1%AEP design event.

Final location and arrangement of stormwater infrastructure to be confirmed during detail design/construction certificate approval.

5. References

Using MUSIC in Sydney Drinking Water Catchment WaterNSW Standard, WaterNSW 2019

Music by Design 2006, *Music modelling Guidelines for South East Queensland*

Byron Shire Council Development Control Plan - Part B3, 2014

Comprehensive Guidelines for Stormwater Management, BSC

Aus-Spec 2005 *Handbook Of Stormwater Drainage Design Reference D5 – Stormwater Drainage Design*

Appendix A Stormwater Management Plans