infrastructure & development consulting

Tuggerah Gateway

Stormwater Management Report

February 2024

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Project Number	21-008	Date	16.02.24
Project Name	Scentre Group Tuggerah	Status	Final
Client	Scentre Group	Revision	H
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1 Executive Summary

This Stormwater Management Report has been updated with consideration of numerous discussions held with Council and DPE (BCD Division) on biodiversity and flooding matters post Gateway Determination.

The submitted documents achieve the following outcomes and confirm:

- that the spatial planning of Mardi Creek and the north/south WSUD drainage corridor has reasonably avoided the impacts to high biodiversity values
- that the design of the Gateway site is capable of avoiding adverse impact on the Melaleuca Bioconvexa on the northern boundary of the site. This has been confirmed through detailed civil, landscape and flooding reviews.
- that the riparian corridor meets Council's minimum design requirements and objectives for proper riparian corridor management
- that the riparian corridor and WSUD corridor provide an amenity outcome that balances flood and ecological management including re-creating wildlife corridors with consideration given to strategy 6.1-6.5 of the Central Coast Regional Plan 2041, as well as supporting open space and recreation values
- that the flood study, civil/stormwater drawings, BCAR/ecological report, landscape concepts are all in alignment.

Given the importance of the raised matters and to enable greater certainty in the development outcome, detailed design testing and documentation has been prepared which should provide added comfort and certainty to Council and BCD. We have tested the design to a level that would ordinarily be expected in a Development Application submission.

This report should be read in association with the following documentation:

- *Biodiversity Certification Assessment Report*, prepared by Ecological;
- *Flood report*, prepared by Stantec; and
- Indicative landscape concept sketches and cross sections within the *Urban Design Report*, prepared by Urbis

2 Introduction

On behalf of Scentre Group, this stormwater management report supports a Planning Proposal and Structure Plan prepared by Urbis. The Planning Proposal facilitates the proposed amendment to the Local Environment Plan at the Tuggerah Gateway Site, known as Lot 2 DP1056960 and Lot 3 DP1084221, which will enable residential, mixed-use and recreational land uses.

This report will be lodged with Central Coast Council to support the Planning Proposal and summarises the modelling procedures and results obtained in preparing the proposed stormwater management strategy for the site.

The following scope of works has been undertaken in the preparation of this Stormwater Management Report:

- Review the existing stormwater flow conditions for the site and establish requirements for the post-development flows from Council guidelines
- Design a suitably sized stormwater pipe network to convey flows throughout the site to appropriate discharge points
- Assess the safety of overland flows throughout the development
- Identify appropriate measures to meet Council's water quality and quantity requirements and determine the location and land area required to implement the measures

The following study has taken into consideration the economical, engineering, environmental and social aspects of the works through the implementation of appropriate stormwater controls and best management practices.

We note that the proposed stormwater measures are strategic in nature and further refinement may be required during the subsequent design phases of the proposal, however, the underlying principles and objectives of this Report are to be maintained.

3 Site Description & Proposed Works

The site is located within the Central Coast Council LGA, to the south-east of the intersection of the Pacific Motorway and Wyong Road. It lies directly to the west of the existing Westfield Tuggerah site, with heavily vegetated bushland to the south.

The site, which is currently undeveloped, covers an area of approximately 41.6Ha and falls steeply south-north towards Wyong Road. A First Order watercourse (Mardi Creek) currently enters the site at the western boundary with the Pacific Motorway and drains west-east before discharging to an existing culvert outlet located near the intersection of Wyong Road and Tonkiss Street. This watercourse is to be integrated as part of the Masterplan Landscape strategy for the site and will be the proposed discharge point for stormwater flows generated by the proposed development.

Figure 1 – Existing Site

The site is currently zoned RU6 Transition, B4 Mixed Use and E2 Environmental Conservation. The Planning Proposal seeks to rezone land comprising (part) Lot 2 in DP1056960 and Lot 3 in DP1084221 from RU6 Transition to R1 General Residential. The B4 Mixed Use zone in the north-east of the site and E2 Environmental Conservation zone in the south-east is to be retained.

The long-term development yield capable of being accommodated on the site comprises of 2,112 dwellings including a mix of detached housing lots, medium density townhouses/terraces, apartments and seniors living. Consistent with the Structure Plan, the future development of the site is to be staged in accordance with market demand and infrastructure requirements. In the short-term employment uses in the form of bulky goods/large format retailing will be prioritised in part of the B4 Mixed Use zone. In the longer term this area is envisaged as a mixed-use precinct. The proposed indicative layout plan for the site is shown in Figure 2 below.

Figure 2 - Proposed Development (Indicative)

A breakdown of the expected development typologies is provided in Table 1.

Table 1 - Proposed Development

Land Use	Land Area (Ha)	Dwellings
Low Density (Standard & Large Lots)	5.2	86
Medium Density (Townhouse, Duplex & Terraces)	5.6	298
High Density (Low – Medium Rise Apartments)	3.2	661
Independent Living Unit (Medium Rise Apartment)	1.2	261
Mixed Use	4.1	806
Total	**19.6**	**2,112**

4 Data

4.1 Topography

Topographic information for the site was obtained from a combination of detail site survey prepared by Urbanex Surveyors and aerial Lidar data.

4.2 Rainfall Data

4.2.1 DRAINS Model

In accordance with Council's Design Guidelines, rainfall data derived using ARR2019 method was utilised for the subject site.

4.2.2 Pluviograph Data

Pluviography data from Sydney Observatory Hill 6-minute interval was utilised within the proposed MUSIC model.

5 Design Controls & Guidelines

The stormwater network for the site has been designed to comply with the following guidelines:

- Central Coast Council *Civil Works Specification Design Guideline* (2020)
- Australian Rainfall and Runoff
- Managing Urban Stormwater: Soils and Construction

6 Stormwater Management Strategy

The following sections provide a breakdown of the key technical aspects split into the various stages of the water cycle which have been used to inform the concept masterplan strategy for the proposed development.

6.1 Sediment & Erosion Control

Prior to any works commencing on site, erosion and sediment control measures will be put in place generally in accordance with Managing Urban Stormwater: Soils and Construction 4th Edition, March 2004. These measures include:

- Installation of a 1.8m high chain wire fence covered with geotextile fabric to the perimeter of the work site area;
- A sediment basin situated towards the low point of the site for the collection of stormwater runoff during construction;
- The use of appropriate sediment diverting methods to minimise sediment in Council's stormwater drainage network;
- Locations for temporary stockpiling; and
- Provision of a temporary truck wash down facility for vehicles exiting the site during construction.

6.2 Water Quantity Management

6.2.1 Major/Minor System Drainage

The major / minor approach to stormwater drainage is the recognised drainage concept for urban catchments within the Central Coast Council local government area.

The minor drainage system is comprised of the below ground pit and pipe network within the new local roads and is designed to control nuisance flooding and enable effective stormwater management for the site. In accordance with Central Coast Council requirements, the minor (pit and pipe network) for the new road drainage system has been designed for a minimum 20% AEP storm.

The major drainage system incorporates overland flow routes through proposed road and open space areas and is assessed against the 1% AEP storm event. The major system also exists to cater for minor system failures. In accordance with Council requirements, the major drainage system is to be designed in a manner that ensures that personal safety is not compromised. As such, all overland flow routes for the site are to be designed so that the maximum velocity-depth product does not exceed $0.4m^2/s$ in accordance with standard engineering practice.

For the purpose of this study, DRAINS software has been used to size the below ground pipe network to adequately convey the 20% AEP storm with provision for safe overland flows during the 1% AEP storm event.

6.2.2 Detention Strategy

Medium and high density developments can lead to more intensive site usage and less efficient stormwater drainage systems. Without appropriate compensatory measures, the cumulative impacts of the increased stormwater runoff across development sites can potentially increase the risk of flooding to downstream properties.

In order to manage the intensified land use for the proposed development, provision of detention basins will be required to restrict the peak post-developed flows to pre-development levels for all storm events up to and including the 1% AEP event in accordance with Central Coast Council requirements. As such, a number of stormwater detention basins are to be incorporated as part of the proposed landscape design for the proposal to control flows from the site prior to discharge (refer to Sections 6.2 and 6.3 of this Report for details of proposed basins).

For the purposes of this study, DRAINS software has been used to calculate stormwater flows generated within the site for the proposed development and subsequently determine appropriately sized detention facilities to manage the increase in site runoff in accordance with Council requirements.

6.3 Water Quality Management

The proposed development is situated within the Tuggerah Lake catchment and, similar with many other urbanised areas in the Central Coast, the study area at times can result in poor water quality from roads and development areas, particularly after heavy rain. This untreated runoff in the localised catchment also contributes to the overall water quality in the Wyong River and Tuggerah Lake. As part of the proposal, Water Sensitive Urban Design (WSUD) procedures have been incorporated to improve water quality in the local waterways.

Due to the proposals emphasis on active and passive open space, it is proposed that WSUD treatments be integrated and incorporated as part of the landscape strategy for the site to ensure that downstream water quality targets are achieved for the site.

In accordance with Council's Design Guidelines, we note that Council have set the following targets in relation to stormwater quality in accordance with general engineering practice:

- 90% reduction in the post development mean annual load for Gross Pollutants (GP);
- 80% reduction in the post development mean annual load of Total Suspended Solids (TSS);
- 45% reduction in the post development mean annual load of Total Phosphorus (TP); and
- 45% reduction in the post development mean annual load of Total Nitrogen (TN)

The removal and treatment of the above pollutants is to be achieved through the implementation of appropriate water sensitive urban design principles on site in accordance with Council requirements. As such, for the purposes of this Report, a treatment train of the proposed works has been assessed using MUSIC (refer to Section 7.4 of this Report for details).

6.4 Flooding

We note that the subject site is affected by overland flooding from Mardi Creek in large storm events. As such, a site specific flood assessment has been undertaken for the development by Stantec to support the rezoning and determine an appropriate flood management strategy for the site in line with Council's statutory requirements.

As outlined in the Stantec study, it is understood that the proposed filling and creek realignment works associated with the development will not adversely impact on flood conveyance in Mardi Creek and that the proposed building pads for the residential lots are located a minimum of 500mm above the peak 1% AEP flood levels to ensure that sufficient freeboard is maintained to the future dwellings in accordance with Council requirements.

7 Stormwater Modelling

7.1 Existing System

Upstream Flows

The subject site is currently bisected by two (2) primary overland flow routes as follows:

- Mardi Creek which flows west-east across the northern portion of the site before discharging to an existing downstream culvert outlet situated at the intersection of Wyong Road and Tonkiss Street;
- An informal tributary which enters the site at the south-west corner of the development area. From here, flows drain south-north through the site before joining Mardi Creek further downstream.

Local Site flows

Based on a review of detailed site survey and visual site inspections, we note that local stormwater runoff generated within the subject site boundary is currently conveyed overland via informal flow paths to Mardi Creek. From here, flows drain west-east through the site before discharging to the existing authority owned stormwater infrastructure situated downstream of the development area.

Figure 3 – Existing Site

7.2 Proposed System

The proposed stormwater strategy for the site is to consist of the following:

- Mardi Creek is to be realigned as part of the proposal. Here, upstream flows will be captured and conveyed through the site via a new watercourse which is to drain along the northern boundary before discharging to the downstream culvert as per the existing flow regime. We note that the realigned watercourse for Mardi Creek is to be integrated as part of the proposed landscape design for the masterplan with appropriate dedicated riparian offsets to suit;
- Flows relating to the informal tributary that enters the site at the south-west boundary are to be intercepted within a new WSUD corridor which is to drain along a similar alignment south-north through the new urban areas before joining Mardi Creek further downstream;
- Stormwater detention basins and associated treatment facilities are to be incorporated within the new WSUD corridor to manage site flows prior to discharge; and
- A below ground trunk pit and pipe system is to be created within the new local road network to capture and convey runoff from the proposed road, lot, and building areas before discharging to the stormwater basins within the WSUD corridor. From here, flows are than directed to Mardi Creek as per the existing flow regime.

We note that flows associated with both the realigned Mardi Creek and south-north tributary have been assessed as part of the separate flooding and overland flow study undertaken by Stantec for the proposal (refer to Stantec Report for details).

As such, the DRAINS model for the proposed site was created to assess the performance of the new street pit and pipe network to adequately convey stormwater flows to the downstream watercourses and was developed based on the following methodology:

- Stormwater flows from the site are to discharge via a new below ground pipe network to Mardi Creek as per the existing flow regime;
- An indicative pit and pipe network was developed for the proposed siteworks (refer to IDC Drawings for details);
- Three (3) above ground detention basins were incorporated into the model to control flows from the site to the discharge point in accordance with Council requirements. The location of the basins has been proposed to maximise efficiency and allow safe access for maintenance;
- Tailwater conditions at the outlets from the basins to the watercourses have been set as follows:
    - Top of pipe obvert in accordance with general engineering practice.

  These levels have been specified based on the assumption that the peak site catchment occurs prior to the peak downstream 1% AEP flood event in Mardi Creek. We also note

that a separate sensitivity analysis was undertaken for the site to assess the event that the peak site discharge occurs at the same time as the downstream flood event;

- In accordance with Council's guidelines, the following impervious percentages were adopted for each land use type:
    - 85% for townhouse/duplex homes and terraces
    - 80% for low density lots
    - 90% for medium and high density lots
    - 95% for commercial lots
- Contributing flows from the heavily vegetated bushland to the south of the site have also been considered in the modelling process to verify the capacity of the proposed stormwater network. The catchment division for the upstream areas was based on aerial lidar data, with a Manning's roughness factor of 0.15 adopted in accordance with general engineering practice; and
- 20% AEP, 5%AEP and 1% AEP events were considered for all standard durations.

Figure 4 – DRAINS Model

7.3 Drains Results

The proposed piped drainage system has been designed to cater for the 20% AEP event with provision for overland flows in larger storm events. Results of the DRAINS analysis indicate that major/minor system requirements are satisfied at all pits within the development area and that the piped system sufficiently conveys minor storm flows with safe provision for major system flows.

7.3.1 Detention Results

Iterations were performed in the DRAINS model to determine the size of the proposed stormwater basins to satisfy Council's pre-post requirements.

The proposed basins have the following parameters:

- The stormwater basins are situated within the WSUD corridor and have been sized to capture runoff from the new local roads and residential lots;
- Total storage volume provided is approximately 5,470m^3 which is contained within the above ground systems;

Table 2 – Basin Summary

Basin	Storage Volume (m^3)
M1	2,090
M2	1,800
M3	1,580
Total	**5,470**

- Discharge is controlled via choke pipes installed as the outlet of the discharge control pit in order to satisfy pre-post conditions; and
- Overflow weirs within the basin embankments are also proposed as a secondary stage outlet in major storm events.

Results of the DRAINS analysis are summarised in Table 3.

Table 3 – DRAINS Pre-Post Comparison

Storm	Downstream Pre-Developed Peak Discharge (m^3/s)	Downstream Post-Developed Peak Discharge (m^3/s)
20% AEP	6.66	6.44
5% AEP	13.28	12.89
1% AEP	23.12	22.76

Results of the DRAINS analysis indicate that the proposed stormwater basins provide sufficient flow retardation and attenuation to ensure that the downstream peak post-developed discharges do not exceed those of the pre-developed scenario for the worst-case storm duration. It should be noted that the proposed stormwater detention measures are strategic in nature and further refinement to confirm the exact location and configuration of the basins will be required during the subsequent detailed design phases of the proposal, however, the underlying principles and objectives identified above are to be maintained.

7.3.2 Sensitivity Analysis

A sensitivity analysis was also performed within the DRAINS model to assess the event that the peak site discharge occurs at the same time as the peak mainstream flood event in the downstream watercourses.

The DRAINS model for the sensitivity analysis was developed based on the same methodology as the proposed scenario model, however, the tailwater level at the outlets to the watercourses were set as the peak downstream 1% AEP water level for the worst-case flood event as calculated in the Stantec study.

Results of the DRAINS analysis indicates that the developments internal piped network sufficiently conveys minor storm flows with safe provision for major system flows.

7.4 MUSIC Modelling

The MUSIC model for the site was developed based on the following methodology:

- In accordance with Council requirements, rainfall pluviography and catchment data was implemented using the Central Coast Council MUSIC-link within the model;
- The post-developed site was consolidated into four (4) main sub-catchments based on the proposed drainage and lot layout as follows:

Table 4 - MUSIC Catchment Summary

MUSIC Catchment	Area (Ha)
M1	13.14
M2	6.42
M3	5.70
M4	4.50
Total	**29.76**

- Each sub-catchment was than broken down into 'Open Space', 'Road', 'Laneway', and 'Lot' areas as per the latest masterplan for the site:

Table 5 - MUSIC Catchment Breakdown

Land Use	M1	M2	M3	M4	Total (Ha)
Open Space	0.634	-	1.072	-	**1.659**
Road	3.688	2.283	1.228	0.351	**7.550**
Laneway	0.530	0.256	-	-	**0.786**
Lot	8.286	3.881	3.400	4.149	**19.958**
Sub-Total	**13.138**	**6.420**	**5.700**	**4.500**	**29.758**
Bypass (Open Space)	**-**	**-**	**0.294**	**-**	**0.294**
Total					**30.052**

- The pollutant concentration parameters used within the model were based on the recommended model defaults for different land use categories as specified in Council's Design Guidelines. These are summarized in the following table:

Table 6 - MUSIC Node Classification

MUSIC Node	Classification
Open Space	Residential
Road	Road Areas
Laneway	Road Areas
Lot	Residential

- As per Council's Design Guidelines, we note that the subject site is situated within an "upland" area (slopes > 5%). As such, the soil properties for the pervious areas of the catchment were defined based on the recommended default parameters as summarised below:

Table 7 - MUSIC Soil Parameters

Soil Properties	Upland (>5%)
Impervious Threshold (mm)	1
Soil Storage Capacity (mm)	200
Initial Storage (% of capacity)	30
Field Capacity (mm)	80
Infiltration coefficient 'a'	200
Infiltration coefficient 'b'	1
Initial groundwater depth (mm)	10
Daily recharge rate (%)	0.5
Daily base flow rate (%)	0.16
Daily deep seepage rate (%)	2

7.4.1 Water Quality Treatment Train

The following treatment train has been proposed for the site:

- Rainwater Tanks have been assumed to be provided within each new lot to collect roof water for re-use on-site within the new dwellings and for irrigation of garden areas. Overflows from the rainwater tanks are to be directed to the new street drainage system. It should be noted that for the purposes of this study that Rainwater Tank treatments have been excluded form the proposed MUSIC model. This is considered appropriate as it assumes the worst-case scenario for the site. Moving forward, the exact type, size and location of the proposed tanks are to be confirmed via detailed modelling during the subsequent Development Applications for each building within the proposal area. Similarly, this will allow for different options to be explored to achieve higher standards (including BASIX requirements) where feasible;
- Runoff from the new road reserve areas within Catchments M1, M2 and M3 are to be collected within the below-ground pit and pipe network before being conveyed to a bioretention "raingarden" located within each of the stormwater basins. For Catchment M4, it has been assumed that lot-based treatments are to be provided to treat water from the new building areas for pre-treatment prior to discharge to Mardi Creek. For the purposes of this study, it has been assumed that Gross Pollutant Traps are to be provided within each new lot to target larger sediments and gross pollutants;
- Gross Pollutant Traps (GPT) are proposed immediately upstream of each bioretention system within Catchments M1-M3 to provide pre-treatment of larger pollutants and sediments prior to discharge to the basins; and

- A Bioretention "Raingarden" is proposed as an end-of-line treatment prior to discharge to Mardi Creek.

Bioretention

In developing the MUSIC model for the post-developed site, the following assumptions have been made regarding the bioretention system:

- Treatable Flow Rate = 3-month ARI
- Filter area = see Table 8
- Extended detention depth = 0.3m
- Filter depth = 0.5m
- Saturated hydraulic conductivity = 150mm/hr

We note that the remaining bioretention parameters are as per the recommended model defaults.

Table 8 – Bioretention Summary

Basin	Filter Area (m^2)
M1	1,500
M2	1,200
M3	750
Total	**3,450**

Gross Pollutant Trap

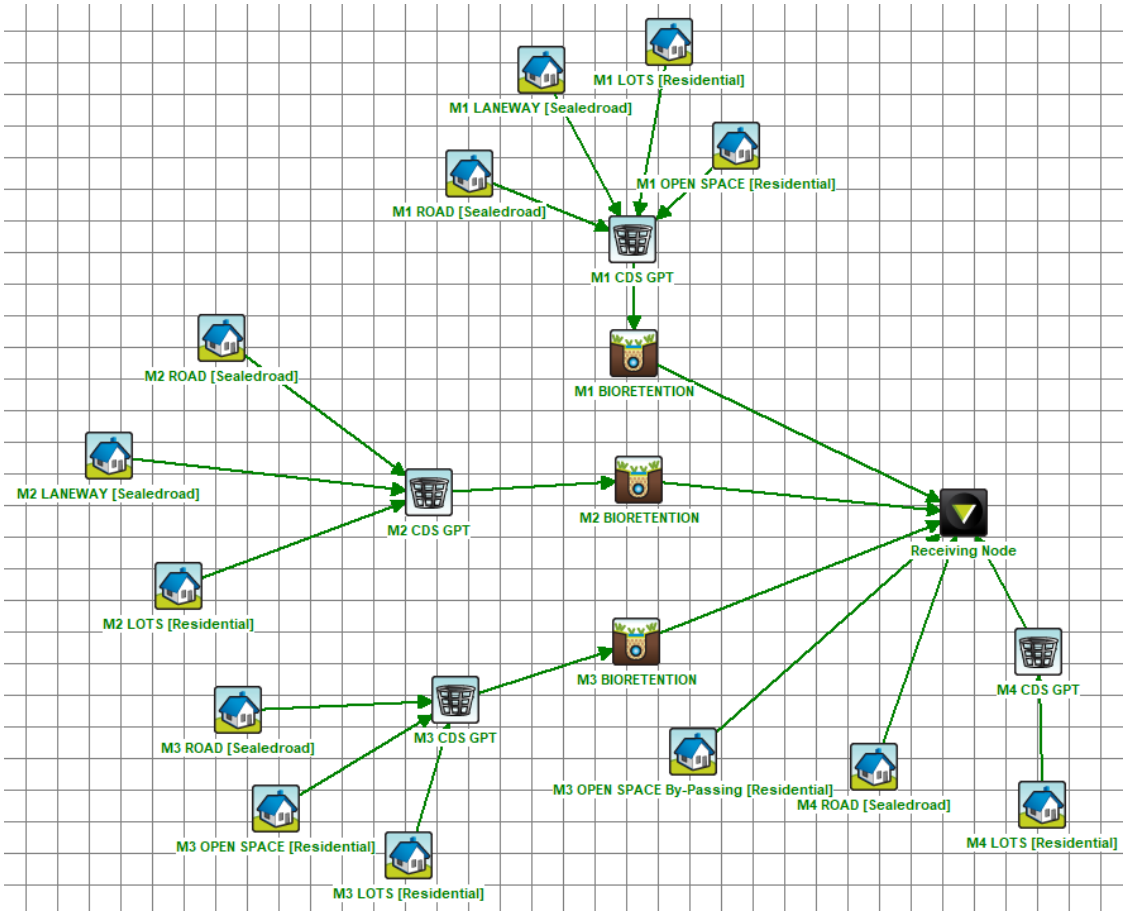
Pollutant removal rates utilised in the MUSIC model for the GPT have been based on a generic CDS style system and have been summarised in Table 9.

- Treatable Flow Rate = 3-month ARI

Table 9 - GPT MUSIC Parameters

Pollutant	Input	Output	Reduction
Total Suspended Solids	100	30	70%
Total Phosphorus	100	70	30%
Total Nitrogen	50	50	0%
Gross Pollutants	100	2	98%

Figure 5 – MUSIC Model



7.4.2 MUSIC Results

The results of the MUSIC analysis are summarised in Table 10 below.

Table 10 - Music Results

Pollutant	Generation (kg/yr)	Output (kg/yr)	Removal Rate (%)	Target Removal Rate (%)
Total Suspended Solids	69,800	8,530	87.8	80
Total Phosphorus	114	37.1	67.5	45
Total Nitrogen	690	366	46.9	45
Gross Pollutants	7,830	206	97.4	90

Based on the results of the assessment detailed above, we note that the proposed treatment train will provide adequate improvements to satisfy the water quality improvement objectives set out in Council's Design Guidelines. As such, the water quality objectives have been achieved for the proposed development (see Appendix A for a copy of the MUSIC-link Report).

Appendix A – MUSIC-Link

MUSIC-*link* Report

Project Details		Company Details	
Project:	Tuggerah Gateway	**Company:**	
Report Export Date:	10/11/2023	**Contact:**	
Catchment Name:	21-008 210803 Proposed MUSIC Model	**Address:**	
Catchment Area:	30.052ha	**Phone:**	
Impervious Area*:	82.23%	**Email:**	
Rainfall Station:	66062 SYDNEY		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1974 - 31/12/1993 11:54:00 PM		
Mean Annual Rainfall:	1297mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.34		
Study Area:	Upland		
Scenario:	Central Coast Development		

* takes into account area fromall source nodes that link to the chosen reporting node, excluding Import Data Nodes

Treatment Train Effectiveness		Treatment Nodes		Source Nodes	
Node: Receiving Node	**Reduction**	**Node Type**	**Number**	**Node Type**	**Number**
Flow	2.57%	Bio Retention Node	3	Urban Source Node	13
TSS	87.8%	GPT Node	4		
TP	67.5%				
TN	46.9%				
GP	97.4%				

Comments

TN Content for Filter Media set to 400mg/kg as per Table 11.8 of Council's Design Guidelines

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Bio	M1 BIORETENTION	Exfiltration Rate (mm/hr)	0	0	0
Bio	M1 BIORETENTION	Extended detention depth (m)	0.1	0.3	0.2
Bio	M1 BIORETENTION	Filter depth (m)	0.5	1	0.5
Bio	M1 BIORETENTION	Orthophosphate Content in Filter (mg/kg)	40	50	40
Bio	M1 BIORETENTION	PET Scaling Factor	2.1	2.1	2.1
Bio	M1 BIORETENTION	Saturated Hydraulic Conductivity (mm/hr)	100	180	150
Bio	M2 BIORETENTION	Exfiltration Rate (mm/hr)	0	0	0
Bio	M2 BIORETENTION	Extended detention depth (m)	0.1	0.3	0.2
Bio	M2 BIORETENTION	Filter depth (m)	0.5	1	0.5
Bio	M2 BIORETENTION	Orthophosphate Content in Filter (mg/kg)	40	50	40
Bio	M2 BIORETENTION	PET Scaling Factor	2.1	2.1	2.1
Bio	M2 BIORETENTION	Saturated Hydraulic Conductivity (mm/hr)	100	180	150
Bio	M3 BIORETENTION	Exfiltration Rate (mm/hr)	0	0	0
Bio	M3 BIORETENTION	Extended detention depth (m)	0.1	0.3	0.2
Bio	M3 BIORETENTION	Filter depth (m)	0.5	1	0.5
Bio	M3 BIORETENTION	Orthophosphate Content in Filter (mg/kg)	40	50	40
Bio	M3 BIORETENTION	PET Scaling Factor	2.1	2.1	2.1
Bio	M3 BIORETENTION	Saturated Hydraulic Conductivity (mm/hr)	100	180	150
GPT	M1 CDS GPT	Hi-flow bypass rate (cum/sec)	None	99	1.19
GPT	M2 CDS GPT	Hi-flow bypass rate (cum/sec)	None	99	0.89
GPT	M3 CDS GPT	Hi-flow bypass rate (cum/sec)	None	99	0.36
GPT	M4 CDS GPT	Hi-flow bypass rate (cum/sec)	None	99	0.46
Receiving	Receiving Node	% Load Reduction	None	None	2.57
Receiving	Receiving Node	GP % Load Reduction	90	None	97.4
Receiving	Receiving Node	TN % Load Reduction	45	None	46.9
Receiving	Receiving Node	TP % Load Reduction	45	None	67.5
Receiving	Receiving Node	TSS % Load Reduction	80	None	87.8
Urban	M1 LANEWAY	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M1 LANEWAY	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M1 LANEWAY	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M1 LANEWAY	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	M1 LANEWAY	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	M1 LANEWAY	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	M1 LOTS	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M1 LOTS	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M1 LOTS	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M1 LOTS	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	M1 LOTS	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	M1 LOTS	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	M1 OPEN SPACE	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11

Only certain parameters are reported when they pass validation

Node Type	Node Name	Parameter	Min	Max	Actual
Urban	M1 OPEN SPACE	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M1 OPEN SPACE	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M1 OPEN SPACE	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	M1 OPEN SPACE	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	M1 OPEN SPACE	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	M1 ROAD	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M1 ROAD	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M1 ROAD	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M1 ROAD	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	M1 ROAD	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	M1 ROAD	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	M2 LANEWAY	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M2 LANEWAY	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M2 LANEWAY	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M2 LANEWAY	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	M2 LANEWAY	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	M2 LANEWAY	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	M2 LOTS	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M2 LOTS	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M2 LOTS	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M2 LOTS	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	M2 LOTS	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	M2 LOTS	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	M2 ROAD	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M2 ROAD	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M2 ROAD	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M2 ROAD	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	M2 ROAD	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	M2 ROAD	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	M3 LOTS	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M3 LOTS	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M3 LOTS	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M3 LOTS	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	M3 LOTS	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	M3 LOTS	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	M3 OPEN SPACE	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M3 OPEN SPACE	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M3 OPEN SPACE	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M3 OPEN SPACE	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	M3 OPEN SPACE	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6

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Node Type	Node Name	Parameter	Min	Max	Actual
Urban	M3 OPEN SPACE	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	M3 OPEN SPACE By-Passing	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M3 OPEN SPACE By-Passing	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M3 OPEN SPACE By-Passing	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M3 OPEN SPACE By-Passing	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	M3 OPEN SPACE By-Passing	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	M3 OPEN SPACE By-Passing	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	M3 ROAD	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M3 ROAD	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M3 ROAD	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M3 ROAD	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	M3 ROAD	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	M3 ROAD	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43
Urban	M4 LOTS	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M4 LOTS	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M4 LOTS	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M4 LOTS	Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3
Urban	M4 LOTS	Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.6	-0.6
Urban	M4 LOTS	Stormflow Total Suspended Solids Mean (log mg/L)	2.15	2.15	2.15
Urban	M4 ROAD	Baseflow Total Nitrogen Mean (log mg/L)	0.11	0.11	0.11
Urban	M4 ROAD	Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-0.85	-0.85
Urban	M4 ROAD	Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.2	1.2
Urban	M4 ROAD	Stormflow Total Nitrogen Mean (log mg/L)	0.34	0.34	0.34
Urban	M4 ROAD	Stormflow Total Phosphorus Mean (log mg/L)	-0.3	-0.3	-0.3
Urban	M4 ROAD	Stormflow Total Suspended Solids Mean (log mg/L)	2.43	2.43	2.43

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