Vigor Master

Stormwater Management Assessment: 72/74/76 Willandra Road, Oxford Falls, NSW

P2008074JR01V05
October 2023

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Head Office
Suite 201, 20 George St
Hornsby, NSW 2077, Australia
ACN 070 240 890 ABN 85 070 240 890
Phone: +61-2-9476-9999
Fax: +61-2-9476-8767
Email: mail@martens.com.au
Web: www.martens.com.au

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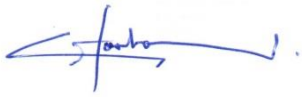
Author(s)	Reviewer(s)	Project Manager	Signature
Brenna Nichols A. van Gogh	Grant Harlow	Grant Harlow	

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All enquiries regarding this project are to be directed to the Project Manager.

Contents

1 Background

1.1 Scope

Martens & Associates Pty Ltd (MA) have prepared this stormwater assessment to support a development application (DA) for a proposed development at 72/74/76 Willandra Road, Oxford Falls, NSW (the site).

This report is to be read in conjunction with the Concept Civil Works Plan by Martens and Associates, document reference P2008074PS01 and the Waterway Impact Assessment by Martens and Associates, document reference P2008074JR02V04.

1.2 Relevant Guidelines

This report has been prepared in accordance with the following standards / guidelines:

- Northern Beaches Council Water Management for Development Policy (2021).
- NSW MUSIC Modelling Guidelines (August 2015), compiled by BMT WBM.
- Northern Beaches Council WSUD & MUSIC Modelling Guidelines (2016).
- Adoption Guidelines for Stormwater Biofiltration Systems (2009), by the Facility for Advancing Water Biofiltration.

2 Stormwater Quality Assessment

2.1 Stormwater Quality Objectives

According to Northern Beaches Council Water Management for Development Policy, the site is undeveloped land which is within a high quality catchment (Wheeler Creek). To comply with Council objectives the development must ensure that:

- Stormwater quality discharging from the development shall not impact the receiving waters.

To satisfy this objective, the development is to have a neutral or beneficial (NorBe) effect on water quality. The post development pollutant load discharged to the receiving environment is to be equal or lower than existing pollutant loads.

Further to the above, the following stormwater treatment targets as required by Northern Beaches Council WSUD & MUSIC Modelling Guidelines (2016) have also been checked to ensure that treatment train modelling is conservative:

- 85% reduction in total suspended solids (TSS).
- 65% reduction in total phosphorus (TP).
- 45% reduction in total nitrogen (TN).
- 90% reduction in gross pollutants (GP).

2.2 Modelling Methodology

2.2.1 Overview

MUSIC (version 6.3) developed by CRC for Catchment Hydrology was used to evaluate treatment train effectiveness (TTE) and pre development and post development pollutant loads from the site. The following modelling scenarios were considered:

1. Pre development – existing site condition modelled to determine baseline pollutant generation rates for TSS, TP, TN and GP.
2. Post development (untreated) – developed site condition modelled without any water quality treatment devices.

3. Post development (treated) – developed site condition modelled with water quality treatment devices to achieve adopted objectives for nutrients and gross pollutants.

2.2.2 Approach

An iterative approach was used for post development modelling to determine appropriate types, sizes and locations of stormwater treatment devices to achieve water quality objectives.

2.2.3 Rainfall Data

MUSIC was run on a 6-minute time step from 01/01/1981 – 31/12/1985 using the Sydney Observatory pluviography (Northern Beaches Council, 2016). Average monthly evapotranspiration data for Sydney was obtained from Northern Beaches Council WSUD & MUSIC Modelling Guidelines (2016).

2.2.4 Input Parameters

Input parameters for source and treatment nodes are consistent with relevant guidelines and manufacturer's specifications.

All MUSIC modelling inputs and treatment node parameters are provided in Attachment A.

2.2.5 Catchment Areas

Proposed catchments were based on the architectural design provided by Vigor Master and the grading design. Land proposed to be altered, have a change of land use or adjoining upslope land proposed to be treated by a modelled water quality device is considered to be part of the development and has been included in the MUSIC model. Pre development and post development pervious and impervious catchment areas are provided in MA planset P2008074PS01 drawing E700.

2.3 Treatment Train Philosophy

The stormwater treatment strategy for the site uses roof water capture and reuse in combination with end of line controls to ensure objectives are satisfied. These are described below:

2.3.1 Rainwater Tank

A rainwater tank will be provided to capture roof water for reuse. Captured water shall be used for outdoor irrigation. The following was included in the modelling:

- 1 x 15 kL rainwater tank modelled at 80% of the volume capacity.
- An average external reuse rate of 151 L/day (BMT WBM, 2015).

2.3.2 Gross Pollutant Traps (GPTs)

SPEL Stormsacks (or equivalent) pit inserts are proposed to be installed in nominated pits. This GPT device will be used to capture litter, debris and other pollutants. Pit inserts have been proposed to reduce the burden and ease maintenance requirements of the bioretention basins.

2.3.3 Bioretention Basin

A biorientation basin has been proposed to treat water before leaving the site. The basin provides tertiary treatment of water through filtration, biological uptake of nutrients, infiltration, evapotranspiration and detention. The basin has been sized to provide the necessary treatment to meet Council requirements

The basin has been located to ensure surface and groundwater flows continue to discharge to the downstream watercourse, thus mimicking pre development scenarios. This is discussed further in the Waterway Impact Assessment (P2008074JR01V04).

2.4 MUSIC Results

Modelling against the NorBE criteria for the developed site has been undertaken with the results provided in Table 1.

Table 1: MUSIC NorBe results.

Parameter	Pre development	Post development	Achieved Reduction	Complies (Y/N)
TSS (kg/year)	1140	212	81.4%	Y
TP (kg/year)	1.02	0.667	34.6%	Y
TN (kg/year)	6.82	6.26	8.2%	Y
GP (kg/year)	32.8	9.65	70.6%	Y

These results demonstrate that the NorBe criteria is achieved for the site. Water quality controls proposed reduce developed site pollutant loads below pre development loads.

The results of the MUSIC model were also compared against Council's reduction targets to measure the systems treatment train effectiveness (TTE). These reduction targets are not a control for this development however results of this check are available in Table 2. This configuration uses the proposed development with no treatment as the base case and

compares it against the post development with treatment devices. MUSIC results demonstrate that the TTE criteria are achieved.

Table 2: MUSIC TTE results.

Parameter	Source	Residual Load	Achieved Reduction	Required Reduction	Complies (Y/N)
TSS (kg/year)	1840	212	88.5%	85%	Y
TP (kg/year)	1.95	0.667	65.8%	65%	Y
TN (kg/year)	14.2	6.26	55.9%	45%	Y
GP (kg/year)	160	9.65	94.0%	90%	Y

2.5 Conclusion

The MUSIC modelling results demonstrate that the proposed development does not increase sediment, nitrogen, phosphorus and gross pollutant loads. Therefore, the effectiveness of the proposed stormwater quality treatment system is assessed as compliant with Council's objectives. Detailed design of the water quality treatment devices should be undertaken during detailed design stage of the development.

3 Stormwater Quantity Assessment

3.1 Water Quantity Objectives

Site stormwater quantity performance objectives are consistent with Northern Beaches Council Water Management for Development Policy. Objectives are outlined below:

- OSD is to be provided to ensure post development discharge rates do not exceed the rate of runoff for existing conditions up to and including the 1% Annual Exceedance Probability (AEP) storm event.
- System to be designed to safely carry all flows during major storm events, up to and including the 1% AEP, by way of the pit and pipe network and overland flow paths.

3.2 Modelling Methodology and Approach

3.2.1 Overview

DRAINS hydrological and hydraulic modelling package was used with the ILSAX engine to determine preliminary site storage requirements to ensure peak post development discharge is less than or equal to peak pre development discharge for the site.

3.2.2 Approach

Sizing of the OSD was completed through iterative modelling to achieve compliance with site objectives. Modelling was undertaken for all durations of the following storms:

- 20% AEP.
- 5% AEP.
- 1% AEP.

3.2.3 Rainfall/IFD Data

Intensity Frequency Duration (IFD) parameters were obtained from BOM and storm temporal patterns from the AR&R 2019 datahub.

3.2.4 Catchment Areas

Existing catchment delineation was developed using LIDAR and survey data for the site. Proposed catchments were based on the architectural

design provided by Vigor Master and the grading design. See MA planset P2008074PS01 drawing PS02-E600 for the catchment plan. Impervious fractions were based on Council's Water Management Policy for Development for existing conditions model and consistent with the proposed design for the post development model.

3.3 Results

OSD storage has been modelled to limit post development peak discharge for storms up to and including the 1% AEP. The results for all storms modelled are provided below in Table 3, Table 4 and Table 5 and in MA planset in P2008074PS01 drawing PS01-E600.

Table 3: DRAINS 20% AEP modelling results.

Duration	Pre Development Flow Rate (m^3/s)	Post Development Flow Rate (m^3/s)	Difference (m^3/s)
10 Minutes	0.114	0.083	0.031
15 Minutes	0.132	0.091	0.041
20 Minutes	0.137	0.095	0.042
25 Minutes	0.136	0.096	0.040
30 Minutes	0.121	0.091	0.030
45 Minutes	0.133	0.094	0.039
1 Hour	0.109	0.087	0.022
1.5 Hours	0.091	0.077	0.014
2 Hours	0.103	0.077	0.026
3 Hours	0.070	0.061	0.009

Table 4: DRAINS 5% AEP modelling results.

Duration	Pre Development Flow Rate (m^3/s)	Post Development Flow Rate (m^3/s)	Difference (m^3/s)
10 Minutes	0.202	0.111	0.091
15 Minutes	0.236	0.123	0.113
20 Minutes	0.229	0.126	0.103
25 Minutes	0.221	0.123	0.098
30 Minutes	0.216	0.127	0.089
45 Minutes	0.167	0.121	0.046
1 Hour	0.215	0.124	0.091
1.5 Hours	0.147	0.110	0.037
2 Hours	0.148	0.100	0.048
3 Hours	0.119	0.091	0.028

Table 5: DRAINS 1% AEP modelling results.

Duration	Pre Development Flow Rate (m^3/s)	Post Development Flow Rate (m^3/s)	Difference (m^3/s)
10 Minutes	0.310	0.141	0.169
15 Minutes	0.356	0.159	0.197
20 Minutes	0.355	0.231	0.124
25 Minutes	0.329	0.250	0.079
30 Minutes	0.314	0.210	0.104
45 Minutes	0.286	0.217	0.069
1 Hour	0.255	0.150	0.105
1.5 Hours	0.227	0.134	0.093
2 Hours	0.223	0.141	0.082
3 Hours	0.161	0.119	0.042

DRAINS modelling indicates that the total site requires approximately 350 m^3 of storage which has been proposed to be provided within an above ground basin.

3.4 Conclusion

Preliminary hydraulic modelling indicates that provision of OSD achieves water quantity objectives. Detailed design of the site drainage system and OSD structures should be undertaken during detailed design stage of the development.

4 References

BMT WBM (2015) *NSW MUSIC Modelling Guidelines,* August 2015.

FAWB (2009). *Adoption Guidelines for Stormwater Biofiltration Systems*, Facility for Advancing Water Biofiltration, Monash University, June 2009.

Northern Beaches Council (2016). *WSUD & MUSIC Modelling Guidelines*.

Northern Beaches Council (2021) *Water Management for Development Policy,* February 2021.

5 Attachment A – Summary of MUSIC Input Parameters

Element	Factor	Input	Source
Setup	Climate File	Climate file, mlb file from Sydney Observatory pluviography (66062)	eWater
Source Nodes	Node Type	Site modelled as residential, unsealed road, roof, sealed road, and forest uses.	BMT WBM (2015)
	Rainfall Threshold	Based on surface type specified in Table 5-4 of NSW MUSIC Modelling Guidelines	BMT WBM (2015)
	Pervious Area Properties	Soil identified as sand, based on examined soils up to 0.5 m deep	Site Soil Tests
	Base & Storm flow Parameter	As per Table 5-6 & 5-7 of NSW MUSIC Modelling Guidelines	BMT WBM (2015)
	Estimation Method	Stochastically generated	BMT WBM (2015)
Gross Pollutant Traps	Low Flow Bypass	0 m^3/s	SPEL Stormsack MUSIC node
	High Flow Bypass	8 x 0.011 m^3/s	
	Treatment Efficiency	Per manufacturer's specifications	
Bioretention Basin	Low Flow By-Pass	0 m^3/s	BMT WBM (2015)
	High Flow By-Pass	100 m^3/s	Set to ensure all flows drain to bioretention
	Extended Detention Depth	0.30 m	By design, within FAWB recommended range
	Surface Area	100 m^2, filter area without a battered slope	By design
	Filter Area	100 m^2	By design
	Unlined filer media	0.01 m	Structure is lined
	Saturated Hydraulic Conductivity	100 mm/hr	BMT WBM (2015) default
	Filter Depth	0.5	By design, within FAWB (2009) standard range
	TN content of filter media	400 mg/kg	BMT WBM (2015) default
	Orthophosphate content of filter media	40 mg/kg	BMT WBM (2015) default
	Exfiltration rate	0 mm/hr	Structure is lined
	Base lined	Yes	By design
	Vegetation properties	With effective nutrient removal plants	By design
	Overflow weir width	2 m	By design
	Underdrain present	Yes	By design
	Submerged zone	No	By design
Rainwater Tank	Low Flow By-Pass	0 m^2/s	BMT WBM (2015)
	High Flow By-Pass	0.01 m^2/s	BMT WBM (2015)
	Volume Below Overflow	12 kL	80% of capacity
	Depth above overflow	0.2 m	By design
	Surface Area	12 m^2	By design

Element	Factor	Input	Source
Rainwater Tank	Overflow Pipe Diameter	90 mm	By design
	Re-use Outdoor – Irrigation	55 kL/yr	BMT WBM (2015)
	Re-use Indoor – Toilet Flushing	0 kL/day	BMT WBM (2015)