10 August 2018

Our Reference: 047-18-DA-SWMR-B

Stormwater Management Report

Proposed Townhouses

119 Cudgegong Road, Rouse Hill, NSW

Revision B

For Poly (Australia) Real Estate Developments

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INDEX

1 Background 1
1.1 Site Description 1
1.2 Proposed Works 2
2 Reference Policies and Guidelines 3
3 Stormwater Quantity Management 4
3.1 Objective 4
3.2 Methodology 4
3.3 Pre-Development Conditions 5
3.4 Interim Post-Developed Conditions 5
3.4.1 Tailwater 5
3.5 Ultimate Development Conditions 5
3.5.1 Modelling Summary 6
4 Stormwater Quality Management 7
4.1 Objectives 7
4.2 Methodology 7
4.2.1 Data Inputs 7
4.3 Overall Treatment Effectiveness 9
4.4 Stream Erosion Index 10
5 Conclusions 11
Appendix 'A' – MUSICLink Report 12

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1 Background

Craig & Rhodes has been engaged by Poly (Australia) Real Estate Developments (POLY) to prepare the Development Application (DA) documentation for the civil works, stormwater drainage, stormwater detention and water sensitive urban design treatment train for the proposed development at 119 Cudgegong Road, Rouse Hill, NSW (the site).

The full set of engineering drawings to accompany the DA is referred to as Drawings **047-18C-DA-001– 911** Revision B.

This site is located within Blacktown Local Government Area.

1.1 Site Description

The total site area is approximately 3.1ha and is currently zoned R3 – Medium Density Residential. The site is occupied by rural residential developments, dense vegetation, a 30m wide transmission easement and an existing Mobile Telecommunication tower. The site is surrounded by similar rural residential developments to the north, south, east and west. The site is bounded by Cudgegong Road to the east, Macquarie Road to the south, existing rural residential properties to the north and west.

Figure 1 – Site Location

The site sits on a crest, with the majority of the site west of the transmission easement falling towards the south west to an existing farm dam prior to discharging to Macquarie Road and ultimately First Ponds Creek approximately 900m west of the site. The remaining portion of the site falls to the east and Cudgegong Road, eventually making its way to Second Ponds Creek approximately 800m west of the subject site.

1.2 Proposed Works

The total development area for the site is approximately 2.4ha.

The proposed development consists of a series of townhouses with basement carparking, associated roads, stormwater drainage, utility infrastructure, as well as the half road upgrade of Macquarie Road fronting the development.

The development is located within the North West Priority Growth Area and sits within the Cudgegong Road Station (Area 20) Precinct. However, the site generally drains towards First Ponds Creek which lies within the Riverstone East Planning Precinct, falling under a separate Water Cycle management strategy.

Stormwater detention and stormwater quality improvement for both precincts are to be provided in regional basins that are proposed under the 'Section 94 Contributions Plan No.22W – Rouse Hill (Works), which determines Rouse Hill as the Area 20 and Riverstone East precincts.

The development site ultimately drains through the First Ponds Creek catchment and is managed by the regional stormwater management measures including culverts, channels, GPT's and bioretention basins whilst ultimately being received at regional detention Basin F1.1. This regional basin will be built by Blacktown City Council under the Section 94 Contributions Plan No. 22W – Rouse Hill (Works).

As the development site is zoned R3 Residential, Council's policy is that water sensitive urban design (WSUD) shall be provided as on-lot treatment to meet Council's WSUD targets.

A stormwater detention tank is proposed to provide the temporary requirement for stormwater detention for the site until Councils S94 basins are delivered (note – this will be a permanent structure to the site). Permanent water quality treatment measures will be provided for the development as part of the works.

2 Reference Policies and Guidelines

The following documents have been referenced in developing the stormwater drainage and water sensitive urban design strategy for the proposed development:

1. Blacktown City Council, 2005, *Engineering Guide for Development*
2. Blacktown City Council, 2015, *Delivery of S94 Stormwater Infrastructure by Developers in the North West Growth Centre*
3. Blacktown City Council, 2013, *Developer Handbook for Water Sensitive Urban Design*
4. Blacktown City Council, 2015, *Blacktown Development Control Plan – Part J Water Sensitive Urban Design and Integrated Water Cycle Management*
5. Engineers Australia, 1987, *Australian Rainfall & Runoff: A Guide to Flood Estimation*
6. Geosciences Australia, 2016*, Australian Rainfall & Runoff: A Guide to Flood Estimation*
7. NSW Government, 2010, *Draft NSW MUSIC Modelling Guidelines*

3 Stormwater Quantity Management

3.1 Objective

The stormwater management objective for the proposed development is driven by the Growth Centre Precinct Development Control Plan (DCP) and the Blacktown City Council Engineering Guidelines.

As the site is part of the Cudgegong Road Station (Area 20) Precinct (within the North West Priority Growth Area), regional detention basins are proposed to be provided through Section 94 contributions collected from the developments as they are released. However, as the timing of these regional basins has not yet been confirmed, Council requires developments to provide temporary stormwater detention systems that will be decommissioned when the regional basins are constructed and become operational.

Blacktown Council's temporary stormwater quantity management requirements request that the post-development flows generated by the development be limited to the pre-development levels for all storm events up to and including the 1 in 100 year ARI (1% AEP) event.

The proposed stormwater detention tank has been designed for the development of the site to ensure the total site post-development flows are less than the site pre-development flows. It is noted that the tank provided for the temporary requirement will become a permanent feature of the development as it is contained beneath the proposed structures.

3.2 Methodology

A DRAINS model, using the ILSAX Time-Area method, was prepared to assist with the sizing of the temporary stormwater detention tank for the proposed development.

The following table is a summary of the inputs used within the model:

Parameter	Value	
Paved Depression Storage	1.0 mm	
Grassed Depression Storage	5.0 mm	
Soil Type	3	
AMC	1 to 5-year ARI	2.5
	10 to 20-year ARI	3.0
	50 to 100-year ARI	3.5

Table 1 - DRAINS Model Parameters

The DRAINS models used to size the on-site detention tank accommodate the existing, interim and ultimate conditions for the development. The catchment plans are shown in the Craig & Rhodes engineering drawings **047-18C-DA-001– 911** Revision B.

Rainfall intensities were adopted from Table 3.0 of Council's Engineering Guide for Development (2005).

3.3 Pre-Development Conditions

The existing site is predominantly pervious (a covering of mass vegetation) with some minor impervious areas (including existing cottage and dilapidated buildings, etc.).

The approximate fraction imperviousness was assumed to be 5%, which has been adopted for all catchments within the development extents in the pre-development hydrological model. The pre-development peak flows have been summarised in Table 1.

A catchment planning showing the assumed catchments used within the DRAINS model is shown in Craig & Rhodes engineering drawings **047-18C-DA-001– 911** Revision B.

3.4 Interim Post-Developed Conditions

A DRAINS model was prepared to assess the amount of temporary stormwater detention required to achieve Blacktown City Council's stormwater quantity objectives of post-development flows not exceeding pre-development flows.

In accordance with Blacktown City Council's Engineering Guide for Development (2005), new residential areas should adopt a fraction imperviousness of 85%. This has been adopted for the extents of the development site (townhouses and common areas). A fraction imperviousness of 95% was adopted for the half-road construction at the site frontages (as per Council guidelines).

To cater for the increased peak flows under the developed site conditions, it is proposed to provide an on-site stormwater detention tank within the basement levels of the development to detain stormwater runoff temporarily and release it at a flow rate that does not exceed the existing site flows from the catchment.

It is noted that the detention of stormwater for this development site is required under interim conditions only (until the future regional detention basin is constructed and comes online).

The development's stormwater drainage network shall be designed to collect flows from the townhouse development and direct captured runoff to the on-site detention tank. The external roads (half roads) are not directed into the townhouse/building hydraulics network, and thus not detained by the proposed OSD tank.

For the interim calculations and modelling, the design has accounted for the development area which includes the townhouse areas and the half roads being constructed. In ultimate conditions, i.e. when adjoining land is developed and full road construction is completed, it is anticipated that the regional basins will be online, and the requirement for storage on this site is redundant. The tank however will remain as a permanent structure within the development.

3.4.1 Tailwater

As the downstream stormwater network has not been designed to a level of detail for sufficient modelling, an indicative stormwater network has been modelled downstream of the development. A tailwater levels for the DRAINS model adopted 150mm below the pit grate level for all storms events up to the 50 year event. A tailwater condition set at the grate level of the downstream pit was adopted for the 100 year event.

3.5 Ultimate Development Conditions

The proposed stormwater infrastructure within the development extents will be sized and constructed taking the external catchments draining through the development site into consideration.

The sizing of this stormwater infrastructure will be in accordance with Blacktown City Council's Engineering Guidelines for Major/Minor events. The infrastructure will connect with the existing drainage infrastructure along Rouse Road south of the site.

3.5.1 Modelling Summary

The following table is a summary of the site stormwater runoff under development conditions. Note all post development flows from the site are less than the pre-development flows, which complies with Blacktown Council requirements.

ARI Event (years)	Total Pre-Development Flow (m3/s)	Total Interim Post-Development Flow (m3/s)	OSD Tank Top Water Level (m AHD)
5	0.379	0.362	62.77
10	0.636	0.445	63.02
20	0.751	0.542	63.05
50	0.902	0.592	63.08
100	1.01	0.632	63.10

Table 1 – Drains Model Results Summary Table

4 Stormwater Quality Management

4.1 Objectives

The stormwater quality objective for the proposed development is driven by the Growth Centre Precinct Development Control Plan and Council's Development Control Plan Part J.

As the proposed development is a medium density residential development, Council's Development Control Plans require the development to provide water quality treatment on-site as part of the proposed development. Under DCP requirements, the road reserves will be treated by the regional water quality basins downstream of the development and have not been included in the model.

The following table is a summary of the Council requirements for water sensitive urban design:

Pollutant	Stormwater Management Objective	'Ideal Stormwater Outcome'
Total Suspended Solids	85% reduction	95% reduction
Total Phosphorus	65% reduction	95% reduction
Total Nitrogen	45% reduction	85% reduction
Gross Pollutants	90% reduction	100% reduction
Stream Erosion Index	3.5-5.0 : 1	1 : 1

Table 2 - Stormwater Quality Performance Targets

4.2 Methodology

The stormwater quality management modelling has been prepared using MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Version 6.2. The input parameters for the model are consistent with Council's MUSIC Modelling Guide and MUSICLink.

4.2.1 Data Inputs

Climate Data

Council has provided a MUSIC base file to be used for the MUSIC model. This incorporates rainfall and evaporation data from the Liverpool Meteorologic station 067035 between 1967 and 1976 providing an average annual rainfall of 857mm and average evapotranspiration of 1261mm. This period provides a mix of wet, dry and average rainfall years.

Source Nodes

Council has provided nodes for use within the Blacktown Local Government Area to represent the various catchment types within the North West Growth Precinct.

The following table summarises the source node inputs used within the MUSIC model.

Land use Category		Total Suspended Solids (mg/L Log_{10})		Total Phosphorus (mg/L Log_{10})		Total Nitrogen (mg/L Log_{10})	
		Storm Flow	Base Flow	Storm Flow	Base Flow	Storm Flow	Base Flow
Roof Areas	Mean Std Dev	1.30 0.32	n/a	-0.89 0.25	n/a	0.30 0.19	n/a
Road Areas	Mean Std Dev	2.43 0.32	n/a	-0.30 0.25	n/a	0.34 0.19	n/a
Other Impervious Areas	Mean Std Dev	2.15 0.32	n/a	-0.60 0.25	n/a	0.30 0.19	n/a
Pervious Areas	Mean Std Dev	2.15 0.32	1.20 0.17	-0.60 0.25	-0.85 0.19	0.30 0.19	0.11 0.12

Table 3- Stormwater Quality Parameters Source Nodes

Treatment Train

The proposed treatment train consists of conveying surface and roof runoff from the development through the sites stormwater network, first by treating the target pollutants through a series of Enviropods. Following the collection of roofwater and surface runoff in the Enviropods, stormwater will then be directed to the sites proposed Rainwater tank. A potion of flows (approx. 700m2 of roof water) will be directed via a proposed splitter pit to the sites rainwater tank. This rainwater tank is required to contain 15,000L of storage as per BASIX requirements. Refer to the ESD Synergy BASIX Assessment report for details on BASIX requirements and water re-use functions for development. Overflow from the Rainwater tank and all other flows captured in the internal sites stormwater networks are then directed to the on-site detention tank. Within this on-site detention tank, a series of Storwater360 Stormfilters (20 units) will provide treatment prior to discharging to the street drainage network within the proposed Macquarie Road upgrade.

It is not proposed to provide stormwater quality improvement to Council's targets for the future roads. It is proposed to provide pit basket inserts (Stormwater360 Enviropods or SPEL Stormsacks) in all on site pit (including within the proposed roads). These baskets will be removed once Council's regional water quality basin downstream of the development is constructed and become operational.

The MUSIC model layout is provided in Figure 2 below.

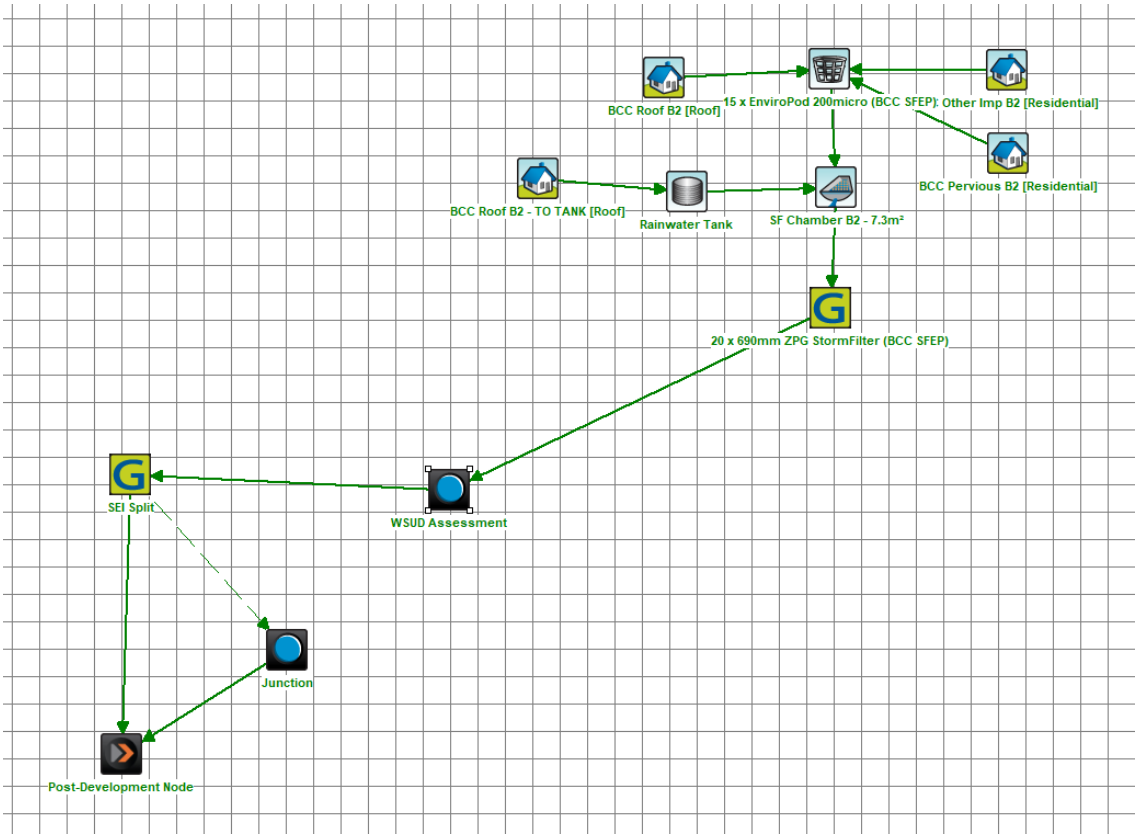

Figure 2 - MUSIC Model Layout

4.3 *Overall Treatment Effectiveness*

The MUSIC model indicates that the proposed on-lot treatment train exceeds Council's Stormwater Management Objectives as outlined in Table 5 below.

Pollutant	Post-Development without Treatment (kg/yr)	Post-Development with Treatment (kg/yr)	Overall Reduction (%)	Meets Council Objectives
Total Suspended Solids	536	68.1	87.3	Yes
Total Phosphorus	1.37	0.458	66.4	Yes
Total Nitrogen	14.4	7.91	45.1	Yes
Gross Pollutants	152	0	100	Yes

Table 5 - MUSIC Summary Table

The MUSICLink Summary can be found in Appendix A of this report.

4.4 Stream Erosion Index

The Stream Erosion Index (SEI) was determined for the development using the method outlined in the Blacktown City Council's MUSIC Modelling Guideline Draft (June 2013).

The critical flow was determined for the catchment within the development. The values are presented in the following table.

Catchment Area (m^2)	17,600
Time of Concentration (min)	9.8
2y Intensity (mm/hr)	76
Critical Flow (m^3/s)	0.0413
Q_{pre} (ML/y)	0.237
Q_{post} (ML/y)	0.584
Stream Erosion Index	2.464

Table 2 - Stream Erosion Index

For the development site, the calculations for the SEI indicate that the values for each of the catchments are less than Council's target values of 3.5 – 5.0.

5 Conclusions

The proposed civil engineering works for the development at 119 Cudgegong Road consists of a series of townhouses with basement carparking, associated road frontages, stormwater drainage, utility infrastructure, as well as the half road upgrade of Macquarie Road fronting the development.

Stormwater detention for the site is only required temporarily until future regional basins are delivered downstream of the development. Due to the nature of the development, a permanent structure is required to contain post-development flows from the development to be equal to or lower than the existing discharge from the existing catchment.

This on-site detention will be provided for in the development in the form of an underground tank which has been detailed on the associated Craig & Rhodes engineering drawings **047-18C-DA-001– 911** Revision B.

The proposed stormwater treatment for water quality using rainwater tanks, Pit inserts (Enviropods) and Stormfilter cartridges meets Blacktown Council's Development Control Plan and Engineering Guidelines for the development site.

The proposed development has been designed to comply with the Blacktown Council requirements.

Appendix ‘A’ – MUSICLink Report

MUSIC-*link* Report

Project Details		Company Details	
Project:	119 Cudgegong Road	**Company:**	Craig & Rhodes Pty Ltd
Report Export Date:	10/08/2018	**Contact:**	Andrew Hilly
Catchment Name:	047-18-DA-WSUD-001	**Address:**	Suite 7.01, Level 7, 3 Rider Blvd Rhodes NSW 2138
Catchment Area:	1.26ha	**Phone:**	98691855
Impervious Area*:	63.49%	**Email:**	ahilly@crhodes.com.au
Rainfall Station:	67035 LIVERPOOL(WHITLAM		
Modelling Time-step:	6 Minutes		
Modelling Period:	1/01/1967 - 31/12/1976 11:54:00 PM		
Mean Annual Rainfall:	857mm		
Evapotranspiration:	1261mm		
MUSIC Version:	6.3.0		
MUSIC-link data Version:	6.31		
Study Area:	Blacktown		
Scenario:	Blacktown Development		

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

Treatment Train Effectiveness

Node: WSUD Assessment	Reduction
Flow	3.45%
TSS	87.1%
TP	66.1%
TN	45.3%
GP	100%

Treatment Nodes

Node Type	Number
Sedimentation Basin Node	1
Rain Water Tank Node	1
Generic Node	3
GPT Node	1

Source Nodes

Node Type	Number
Urban Source Node	5

Comments

SF Chamber odes not treat for any nutrient. Re-use is in accordance with the BASIX report.

Passing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
GPT	15 x EnviroPod 200micro (BCC SFEP)	Hi-flow bypass rate (cum/sec)	None	None	0.3
Post	Post-Development Node	% Load Reduction	None	None	3.45
Post	Post-Development Node	GP % Load Reduction	90	None	100
Post	Post-Development Node	TN % Load Reduction	45	None	45.3
Post	Post-Development Node	TP % Load Reduction	65	None	66.1
Post	Post-Development Node	TSS % Load Reduction	85	None	87.1
Pre	Pre-Development Node	% Load Reduction	None	None	0
Pre	Pre-Development Node	GP % Load Reduction	None	None	0
Pre	Pre-Development Node	TN % Load Reduction	None	None	-1.59
Pre	Pre-Development Node	TP % Load Reduction	None	None	-2.03
Pre	Pre-Development Node	TSS % Load Reduction	None	None	-1.57
Sedimentation	SF Chamber B2 - 7.3m^2	High Flow Bypass Out (ML/yr)	None	None	0
Sedimentation	SF Chamber B2 - 7.3m^2	Notional Detention Time (hrs)	None	None	0.0438
Urban	BCC Other Imp B2	Area Impervious (ha)	None	None	0.263
Urban	BCC Other Imp B2	Area Pervious (ha)	None	None	0
Urban	BCC Other Imp B2	Total Area (ha)	None	None	0.263
Urban	BCC Pervious B2	Area Impervious (ha)	None	None	0
Urban	BCC Pervious B2	Area Pervious (ha)	None	None	0.46
Urban	BCC Pervious B2	Total Area (ha)	None	None	0.46
Urban	BCC Roof B2	Area Impervious (ha)	None	None	0.467
Urban	BCC Roof B2	Area Pervious (ha)	None	None	0
Urban	BCC Roof B2	Total Area (ha)	None	None	0.467
Urban	BCC Roof B2 - TO TANK	Area Impervious (ha)	None	None	0.07
Urban	BCC Roof B2 - TO TANK	Area Pervious (ha)	None	None	0
Urban	BCC Roof B2 - TO TANK	Total Area (ha)	None	None	0.07
Urban	Pre-Development	Area Impervious (ha)	None	None	0
Urban	Pre-Development	Area Pervious (ha)	None	None	1.2
Urban	Pre-Development	Total Area (ha)	None	None	1.2

Only certain parameters are reported when they pass validation

Failing Parameters

Node Type	Node Name	Parameter	Min	Max	Actual
Rain	Rainwater Tank	% Reuse Demand Met	80	None	12.84
Sedimentation	SF Chamber B2 - 7.3m^{2}	Total Nitrogen - k (m/yr)	40	40	0
Sedimentation	SF Chamber B2 - 7.3m^{2}	Total Phosphorus - k (m/yr)	300	300	0
Sedimentation	SF Chamber B2 - 7.3m^{2}	Total Suspended Solids - k (m/yr)	400	400	0

Only certain parameters are reported when they pass validation