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Our Ref: 19-000162_167 Riverstone Road

20 June 2019

Attention: Blacktown City Council General Manager

Dear Kerry Robinson,

167 Riverstone Road, Riverstone - Stormwater Management

Calibre Professional Services (NSW) Pty Ltd has been engaged by Santelli Pty Ltd to prepare documentation to support the Development Application for the residential subdivision at 167 Riverstone Road, Riverstone formally known as Lot 13 in DP712 and Lot B in DP 362093.

This stormwater management strategy has been prepared with reference to the 167 Riverstone Road Development Application drawing set '*167 Riverstone Road, Riverstone – Road & Drainage Design (DA – REV0)*' dated 19/06/19.

1 PROJECT DESCRIPTION

The 167 Riverstone Road site is formally known as Lot 13 in DP712 and Lot B in DP 362093 is located in the suburb of Riverstone. The site is part of the North West Land Release Area and is subject to *Blacktown City Council Growth Area Precincts Development Control Plan (2018).* The site is bounded by Regent Street to the north and Riverstone Road to the south as presented in Figure 1.

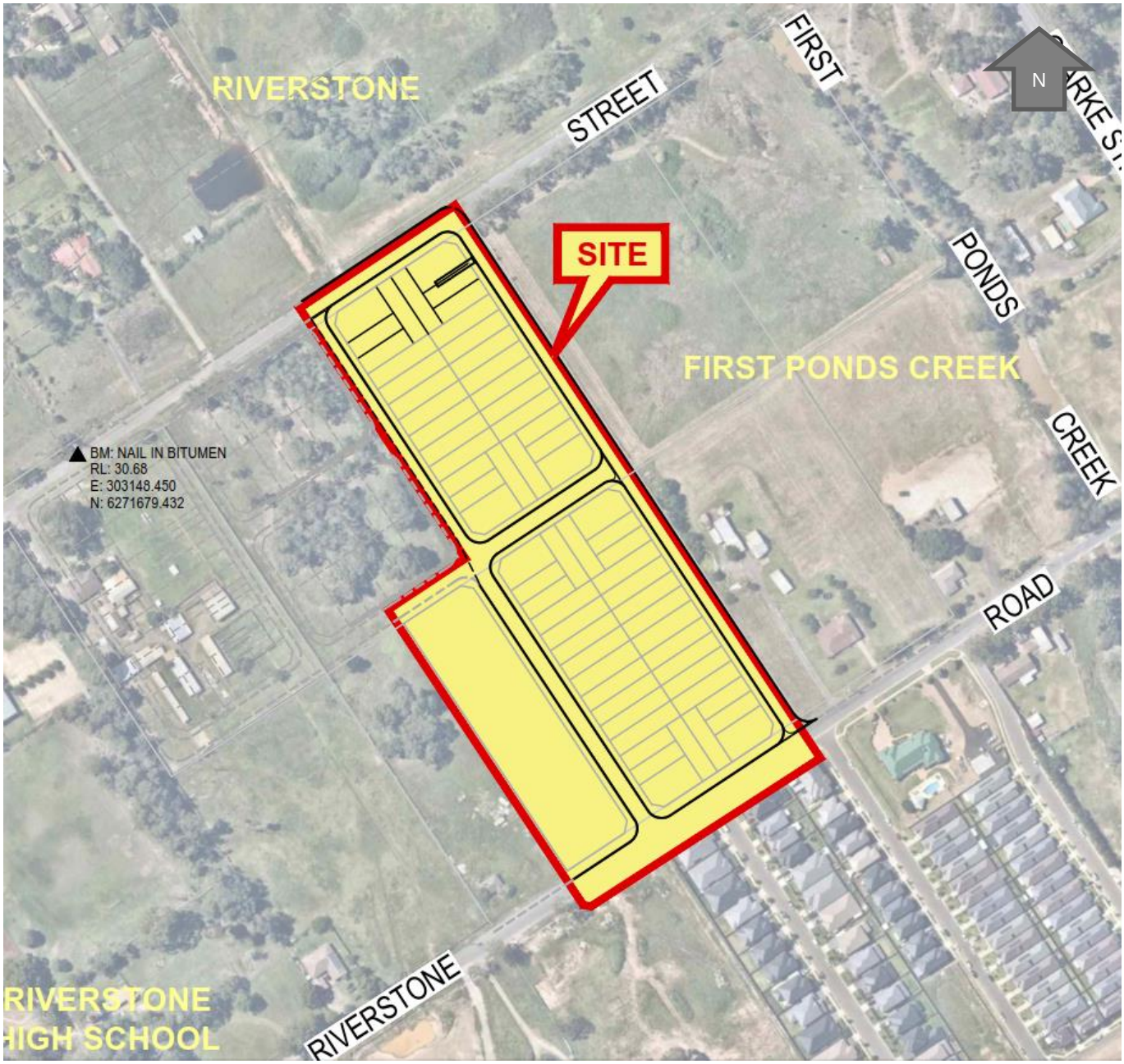


Figure 1: Subdivision Plan

The site is characterised as rural with existing farm structures present. The site slopes to the north and drains to First Ponds Creek.

The 167 Riverstone Road site is approximately 4.04ha with proposed development of a total of 64 lots with lot areas ranging from 285m^2 to 504m^2, local roads and a proposed 6778m^2 superlot for a proposed school lands. The lots front Regent Street with a full width 13.5m road proposed on the eastern boundary and full width 16m wide road on the south western boundary. An 8m half width road is proposed along the western boundary of Lot 13 of DP712 as presented in the subdivision plan in Figure 1.

2 DESIGN FRAMEWORK

The basin has been designed in accordance with the following Blacktown City Council guidance documents and correspondence, along with Australian Standards:

- Blacktown City Council – *Engineering Guide For Development* (February 2005, updated November 2012)
- Blacktown City Council - *Growth Area Precincts Development Control Plan (2018).*
- Blacktown City Council – *Developer Handbook for Water Sensitive Urban Design* (Version 1.1 – November 2013)
- Blacktown City Council – *Draft General Criteria Flood Assessment, Detention Basins and Channels*
- Australian/New Zealand Standard – *Plumbing and Drainage Part 3: Stormwater drainage (AS/NZS 3500.3:2003)*
- Institution of Engineers Australia, (1998) *Australian Rainfall and Runoff*
- Blacktown City Council – *Delivery of S94 Stormwater infrastructure by Developers in the North West Growth Centre* (August 2015)
- Blacktown City Council – *Part J: Water Sensitive Urban Design and Integrated Water Cycle Management (2015)*

3 STORMWATER DRAINAGE STRATEGY

The stormwater strategy for 167 Riverstone Road has been designed to achieve water quantity and quality targets for both the interim and ultimate scenario, in accordance with Blacktown City Council guides.

The ultimate scenario is defined as the full development of the site and upstream external catchments as delineated in *Figure 3-2* of *Schedule 2: Riverstone Precinct* of the *Blacktown City Council Growth Area Precincts Development Control Plan (2018)* as presented in Figure 2.

Figure 2: Key elements of the water cycle management and ecology strategy (Schedule 2: Riverstone Precinct BCC NWGC DCP, 2018)

In the Ultimate Scenario, downstream Regional Basins are assumed to be fully operational and providing water quality and quantity to all developments draining to it. The planned Regent Street upgrade is assumed to have been fully constructed and operational.

The interim scenario is defined as the full development of the site in the absence of downstream Regional Basins, as presented in Figure 3. Upstream existing catchments are assumed to be 'pre-developed'. Upstream developed catchments are assumed to have provided on-lot water quality and quantity to 'pre-developed' conditions. The planned Regent Street upgrade is assumed to have been constructed and operational. Temporary detention/bio-retention basins located within the site will be provide water quality and quantity in the absence of Regional Basins. The temporary basins will ultimately drain to First Ponds Creek to the east.

3.1 Interim Scenario

The interim stormwater layout of the 167 Riverstone Road development is presented in Figure 3.

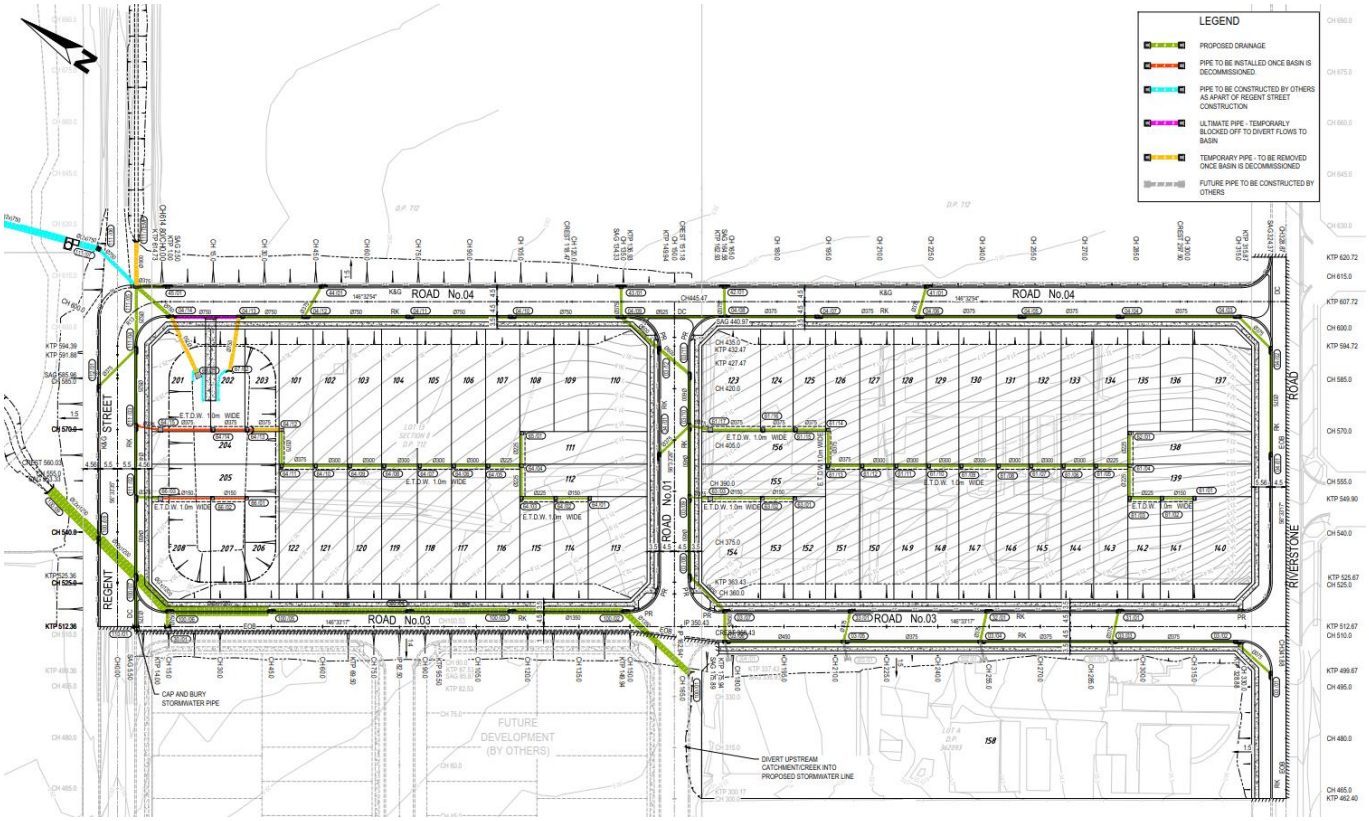


Figure 3 Interim Stormwater Drainage Layout of 167 Riverstone Road development

Temporary detention/bioretention basin, located within site, is proposed to achieve water quality and quantity targets for the 167 Riverstone Road development in accordance with Council guidelines.

The combined detention and bio-retention basin will provide sufficient storage to attenuate 'post-developed' runoff to be below the permissible site discharge (PSD) before discharging into First Ponds Creek for 2 year ARI storms up to 100 year ARI storms for range of storm durations. The PSD has been defined as the peak 'pre-developed' runoff off the site. The basin will also provide sufficient bioretention filter area to treat frequent storms up to 3 month ARI events. 3month ARI storms has been defined as the 50% of the peak 1 year ARI storm in accordance with Council's *Part J: Water Sensitive Urban Design and Integrated Water Cycle Management (2015).*

During minor storms, defined as storms up to 5 year ARI, site runoff will be entirely captured via pit and pipe drainage and conveyed to the temporary basin. The basin will be sufficiently sized to provide compensatory storage for bypass areas not able to drain to the basin. The temporary basin will drain to the existing creek via a temporary swale.

During major storms, defined as storms up to 100 year ARI, site runoff will largely be captured via pit and pipe drainage and overland flow into the temporary basin. The basin will be sufficiently sized to provide compensatory storage for flows bypassing the basin.

External upstream catchments, assumed to be in 'pre-developed' state in the interim scenario, will be conveyed through the proposed site, via a trunk drainage line, as presented in Figure 4. The trunk drainage line will be kept separate to the site drainage. The trunk drainage line will be sized for the 'post-developed' upstream catchment representing the Ultimate Scenario.

The trunk drainage has been sized for the 10 year ARI event. Storms greater than the 10 year ARI event will be conveyed via a combination of piped drainage (trunk line) and overland flow path (road).

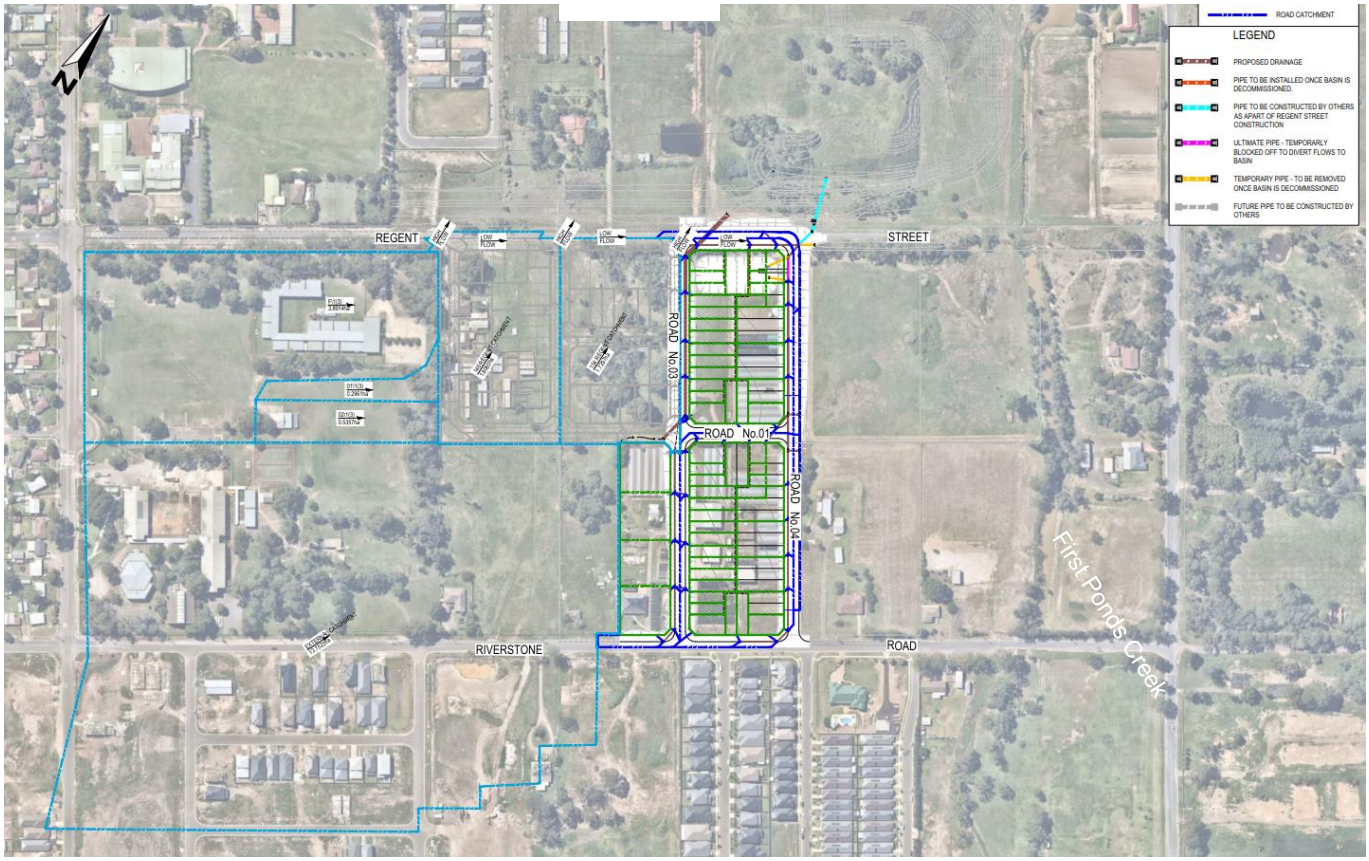


Figure 4 Interim External Catchments

The 167 Riverstone Road site is affected by regional flooding of the First Ponds Creek in the 100 year ARI storms. The finished floor level of lots will be set 0.5m above the regional flood level in accordance with Blacktown City Council's *'Engineering Guide for Development' (2005)*. The impact of the regional flooding on the operation of the temporary detention basin has been considered in *Section 4*.

3.2 Ultimate Scenario

The ultimate scenario is defined as the full development of the site and upstream external catchments. Downstream Regional Basins are assumed to be fully operational and providing water quality and quantity to all developments draining to it. As such, the temporary basin will be no longer be required and will be decommissioned during the ultimate scenario. The site drainage will cross under Regent Street and discharge into the future channel located within the SP2 Drainage zoned land. The future channel concept design has been provided by Council on 3rd March 2017 and has been used to determine ultimate drainage outlet levels.

External upstream catchments, assumed to be in 'post-developed' state in the ultimate scenario. The trunk drainage line will convey the upstream developed flows into the SP2 drainage lands.

4 WATER QUANTITY MANAGEMENT (DETENTION BASIN)

Stormwater quantity modelling has been undertaken using the stormwater runoff routing model *XP-RAFTS 2018* for the 167 Riverstone Road basin, as shown in Figure 3. The XP-RAFTS model, *19-000162_DA_Rev02_190423.xp,* and supporting modelling documents has been provided to Council as part of the Development Application Submission.

The basins have been sized to attenuate peak post development flows to peak pre-development flow rates for the 2, 5, 20 and the 100 year average recurrence interval storms for range of storm durations in accordance with Blacktown City Guidelines.

The design parameters adopted for the *XP-RAFTS* model are presented in Table 1 and are in accordance with Blacktown City Council's '*Engineering Guide for Development (2005)'*.

Table 1 XP-RAFTS Model Parameters

Parameter	Catchment Condition	Value	Comment/Departures
Hydrology			
Catchment Characteristics			
Fraction Impervious	Existing	5%	
	Lot	80%	
	Road	95%	
Rainfall Loss Model (ARBM)			
Storage Capacity		Capacity/Initial	
	Impervious	1.5/0.5	
	Interception	1.5/0.5	
	Depression	5/0	
	Upper Soil	25/20	
	Lower Soil	100/80	

The *XP-RAFTS* catchment map representing the proposed site and upstream catchments is shown in Figure 5.

Figure 5 XP-RAFTS Model Layout (Ref: 19-000162_DA_Rev02_190423.xp*)*

Modelling results are presented in Table 2.

Table 2 XP-RAFTS Peak flow rates at downstream site boundary (at Node Q_PostDev)

Storm Event	Pre-developed		Post-developed (no attenuation)		Post-developed (with basin)	
	Flow (m^3/s)	Critical Storm (min)	Flow (m^3/s)	Critical Storm (min)	Flow (m^3/s)	Critical Storm (min)
Q100	1.11	120	1.94	90	0.84	120
Q20	0.77	120	1.61	25	0.37	120
Q10	0.6	120	1.37	90	0.31	90
Q5	0.47	120	1.19	90	0.29	90
Q2	0.26	720	0.91	25	0.22	120

The temporary basin configuration (as shown in Figure 3) is presented In Table 3.

Table 3 – Temporary Basin Configuration

Parameter	Value
Basin Invert Level	RL 27.5
Active Storage Volume (100 year ARI)	1320m^3
Peak Basin Stage (100 year ARI)	RL 28.95
Low Flow Pipe RL	RL 27.80 (375dia. RCP)
High Flow Spillway RL	RL 28.80 (1200x1200 GSIP)

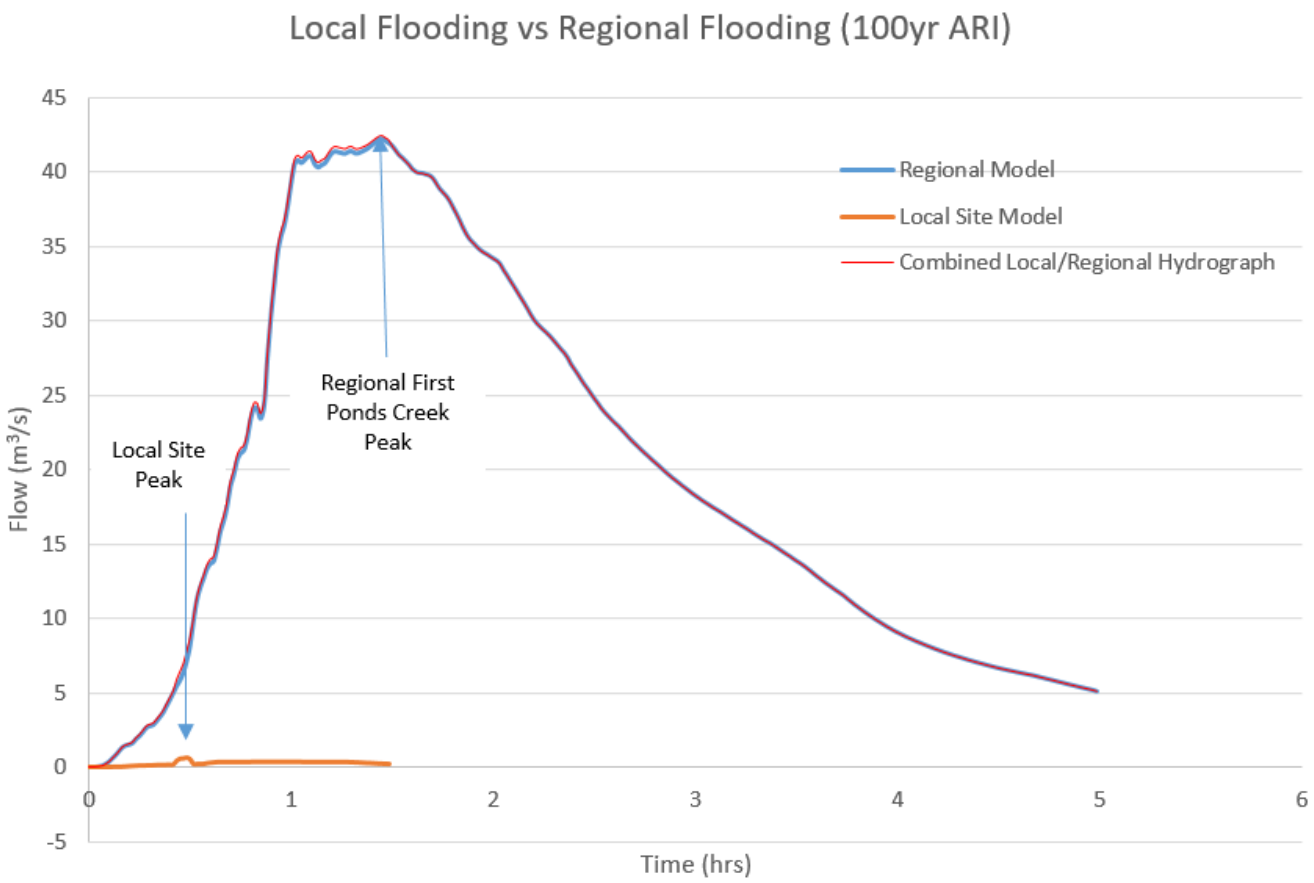
The modelling results, presented in Table 2, indicate that the proposed detention basins will limit post development peak flows to pre-development peak flow in accordance with Council's stormwater quantity requirements.

The extended detention volume of the water quality component of this basin has been excluded from the stage storage calculations for the purposes of detention modelling. Stormwater ponding depths have also been limited to 1.5 metres above the extended detention level of the basin.

4.1 Regional Flooding Impacts to Basin Performance

With regards to the impact of regional flooding of First Ponds Creek, the local site hydrograph and the regional hydrograph near the site location was compared. The regional hydrograph of the First Ponds Creek at the location of Regent Street was sourced from Node 49 of '*Package_D_CC_Dev_v2_100y.xp*' RAFTS model. The model was prepared by Calibre for Blacktown Council as part of Section 94 Basin Regional Basin works *'Package D'*. The comparison of the 100yr ARI hydrographs are shown in Figure 6.

Figure 6 Local vs Regional Flooding (First Ponds Creek) – 100yr ARI



The figure shows that the 100yr ARI local site hydrograph peak occurs much earlier than the 100yr ARI Regional First Ponds Creek hydrograph peak and thus does not coincide. As such, the detention basin outlet has been assumed to be free draining and fully operational for events up to 100yr ARI events.

5 WATER QUALITY MANAGEMENT

As discussed in the Section 3 – Stormwater Drainage Strategy, the temporary bio-retention basin, located in the SP2 drainage zoned land, will provide water quality in the interim scenario for the peak flows in 3 months ARI storms. In the ultimate scenario, the future Section 94 regional basin will provide water quality for the site. The peak 3 month ARI flows has been defined as 50% of the peak flows generated in the 1 year ARI events.

The design incorporates a bio-retention basin to reduce export loads to the pollutant target removal requirements of Blacktown City Council. These target reduction rates are provided in the following documents:

- Blacktown City Council – *Part J: Water Sensitive Urban Design and Integrated Water Cycle Management (2015)*
  - Gross pollutant (>5 mm) 90%
  - Total suspended solids 85%
  - Total phosphorus 65%
  - Total nitrogen 45%

5.1 MUSIC Modelling

The water quality model was modelled using *MUSIC Version 6.2 (Build 0.1433)* with inputs for the pollutant generation rates for various landtype based on the stormwater water quality parameters for *MUSIC* source nodes documented in Blacktown City Council's *Developer Handbook for Water Sensitive Urban Design (2013)*. Additional modelling parameters were adopted in accordance with Blacktown City Council's '*Developer Handbook for Water Sensitive Urban Design (Version 1.1 – November 2013)*'.

The *MUSIC* model layout for the temporary basin is presented in Figure 7.

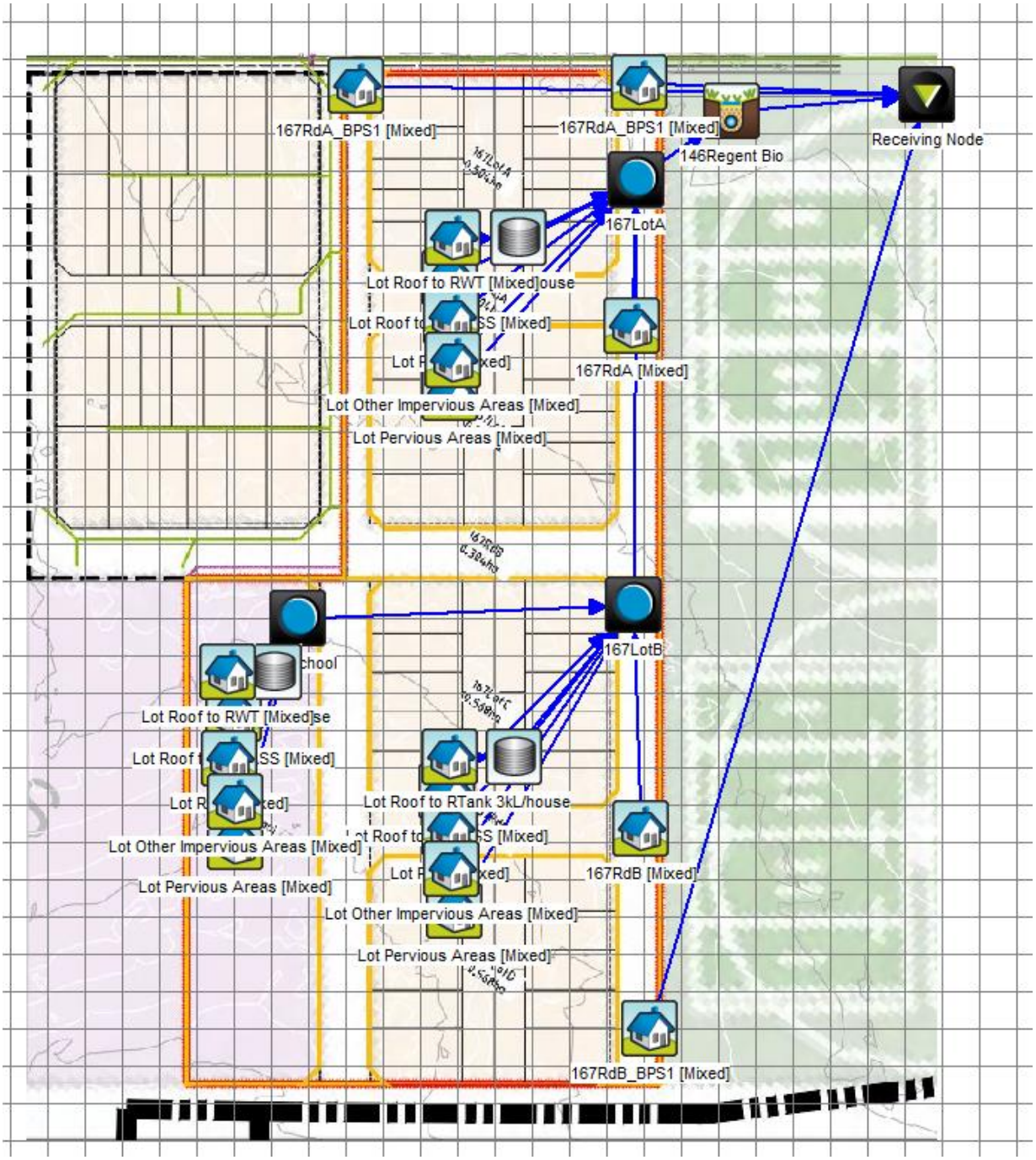


Figure 7: MUSIC Model Layout

The bioretention node parameters for the temporary basin are presented in Table 4.

Table 4 MUSIC Bioretention node parameters

Parameter	Value
Extended Detention Depth	0.3m
Filter Area	1100m^2
Filter Depth	0.5m

The pollutant removal results for the temporary basin is presented in Table 5.

Table 5 MUSIC Modelled Pollutant Removal Rates (at Receiving Node)

Pollutant	Sources (kg/year)	Residual Load (kg/year)	Reduction Achieved (%)	Reduction Targets (%)
Gross Pollutants	681	33.8	95	90
Total Suspended Solids	4460	646	85.5	85
Total Phosphorus	8.79	2.35	73.3	65
Total Nitrogen	60.6	20.3	66.5	45

The results presented in Table 5 indicate that the proposed treatment train has been modelled to limit stormwater pollution reduction targets at the site discharge point in accordance with Blacktown City Council guidelines.

6 CONCLUSION

The temporary combined bio-retention and detention basin has been designed to provide stormwater quality treatment and stormwater detention management to facilitate the development of 167 Riverstone Road, Riverstone in accordance with Blacktown City Council requirements.

The stormwater strategy involves the construction of a single combined detention and bioretention basin for 167 Riverstone Road development.

The *MUSIC* modelling demonstrates the estimated mean annual pollutant load reductions generated from the development to be in accordance with Blacktown City Council water quality target requirements.

The rainfall routing *XP-RAFTS* modelling, undertaken for the stormwater quantity management, indicate that the peak post development site discharge has been limited to peak pre-development site discharge.

The overall stormwater management strategy bio-retention area and stormwater detention control outlets have been designed for both the construction and operational phases of the development and have been designed and modelled in accordance with current Blacktown City Council's guidelines and targets.

Yours sincerely
Calibre Professional Services Pty Ltd

Troy Eyles
Principal Engineer – Water & Environment