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Precinct Level Stormwater Management Plan For Proposed Rezoning

1, 18 and 51 Brickworks Road, Thornton

Prepared for: **North Thornton Group, Stevens Group and Lion Quarries**

Project no: **NSW200743**

Date: **26/06/2020**

Revisions

Date	Revision/ Issue No.	Revision Description	Prepared by	Reviewed by	Approved by
26/06/2020	A	For Client Review	U. Knight	B. Staniland	B. Staniland

It is the responsibility of the reader to verify the currency of the version number of this report.

Table of Contents

1 INTRODUCTION

1.1 General

ACOR Consultants have been engaged by DeWitt Consulting on behalf of North Thornton Group, Stevens Group and Lion Quarries to prepare a Precinct Level Stormwater Management Plan for the proposed rezoning of the following properties:

- 1 Brickworks Road, Thornton (Lot 161 DP136183) - The North Thornton Group holds title to a 18.9 hectare parcel currently zoned RU2 Rural Landscape under the Maitland LEP 2011.
- 18 Brickworks Road, Thornton (Lot 282 DP 852771 and Lot 462 DP 870019) - Stevens Group holds title to a 5.74 hectare parcel currently zoned RU2 Rural Landscape under the Maitland LEP 2011.
- 51 Brickworks Road, Thornton (Lot 14 DP 1078459 and Lot 15 DP 10419) - Lion Quarries holds title to a 22.15 hectare parcel currently zoned RU2 Rural Landscape under the Maitland LEP 2011.

This report is an addendum to the Stormwater Management Plans prepared by ACOR Consultants for each property as listed below:

- NE170232 Revision C Dated 14/01/2019 – Stormwater Management Plan, Gateway Planning Proposal, 1 Brickworks Toad, Thornton prepared for North Thornton Group
- NE190042 Revision A Dated 18/06/2019 – Stormwater Management Plan for Proposed Rezoning, 51 Brickworks Road Thornton prepared for Lion Civil / Elford Group
- NE190111 Revision A Dated 10/10/2019 – Stormwater Management Plan for Proposed Rezoning, 18 Brickworks Road Thornton prepared for Stevens Group

The total combined development area including Brickworks Road is 48.09ha.

This report covers both stormwater quantity management and stormwater quality management for the proposed precinct level development, as well as assessing the impact of the stormwater discharge on Four Mile Creek catchment.

The stormwater quantity item to be addressed in this report includes stormwater detention and conveyance of major stormwater flows.

The stormwater quality item to be addressed in this report includes operational water quality management incorporating Water Sensitive Urban Design (WSUD) principles.

2 SITE

2.1 Location

The combined development site is located at 1, 18 and 51 Brickworks Road, Thornton. The site is bounded to the north by Raymond Terrace Road, to the east by Haussman Drive, to the south by the Main Northern Railway corridor and to the west by a rural residential property.

The development also incorporates Brickworks Road which runs east to west from Haussman Drive to Raymond Terrace Road.

Figure 1 shows the location of the development.

2.2 Topography

There is a defined crest from Haussman Drive, across the northern ends of 1 and 51 Brickworks Road running east to west. This divides the development site, with Brickworks Road, 18 Brickworks Road, and the northern ends of 1 and 51 Brickworks Road draining to the north west towards Raymond Terrace Road, and the southern ends of 1 and 51 Brickworks Road draining to the south west towards the railway corridor and adjoining private property to the west. Figure 2 shows the site survey information and Figure 3 shows the existing topography of the site

2.3 Existing Site Drainage

The existing drainage for the combined development site drains to the north west and to the south east from the crest running east to west from Haussman Drive across 1 and 51 Brickworks Road.

For this precinct level assessment, the lot boundaries have been ignored, and predevelopment catchments determined based in existing contours and land features.

Figure 4 shows the predevelopment catchments.

2.4 External Catchments

Currently, there is an existing road catchment of 0.35 hectares from Haussman Drive that is directed into Brickworks Road.

This existing road catchment has not been included in this stormwater modelling assessment as the proposed development will have the flows from Haussman Drive draining directly to Raymond Terrace Road.

2.5 Proposed Development

The proposed business development masterplan for the site includes:

- Small, medium and large commercial lots including roads and carparking
- Landscape buffer / Wildlife corridor
- Stormwater drainage infrastructure including detention/water quality basin
- Access roads to the development from Haussman Drive and Raymond Terrace Road
- Acquisition of Brickworks Road
- Acquisition of adjoining property to the west near Raymond Terrace Road

The proposed development of the site may incorporate light industry, retail, warehousing or service station.

Refer to de Witt Consulting Concept Plan contained in Appendix A for details.

The flows from the proposed development including the commercial lots, roads and carparking areas will be directed to the proposed detention/water quality basins located in the southern end of 1 Brickworks Road and south west corner of 51 Brickworks Road.

Some areas of the development will need to be regraded to ensure that majority of the flows from the site are directed to the basins. A small area along the western boundary will not be able to be drained to the proposed basins. The site regrading will be determined at the DA and CC approval stages.

Refer to Figure 5 detailing the post development catchments.

3 STORMWATER QUANTITY MANAGEMENT

3.1 Objectives

The objectives of the stormwater quantity management for the site are:

- Provide a stormwater conveyance system in accordance with Australian Rainfall and Runoff's minor/major system philosophy and the requirements of Maitland City Council. The minor stormwater conveyance system should be designed to convey peak flows from the 10% Annual Exceedance Probability (AEP) storm event and the major stormwater conveyance system should be designed to convey the peak flows from the 1% AEP storm events. It should be noted however that for this stage of the project only the 1% AEP storm events are accounted for to determine the maximum area required for the proposed detention and treatment basins.
- Provide stormwater detention to reduce the peak developed flows from the site to below the current undeveloped peak runoff from the site.

3.2 Stormwater Conveyance

3.2.1 Minor Storm Event Conveyance

Minor stormwater conveyance system for the proposed development will be via the traditional pit and pipe system. The minor stormwater system will have the capacity to convey the peak flows from a 10% AEP storm event and pipe outlets will drain into the proposed detention/water quality basins.

3.2.2 Major Storm Event Conveyance

Major stormwater conveyance system for the proposed development will be via overland flows. This will be via traditional trunk drainage utilising the internal roads, carparking areas and grassed swales. The major stormwater system will have the capacity to convey the peak flows from a 1% AEP storm event. The flows will be contained within the designated overland flow paths ensuring that stormwater flows do not enter any buildings and that the velocity depth product is limited to or below 0.4 m^2/s. Major flows will also be directed to the proposed detention/water quality basins.

3.3 Stormwater Detention

3.3.1 General

Stormwater detention needs to be provided to ensure that the post development flows from the total site are reduced to the predevelopment flows for 1% AEP storm events. The proposed site runoff is to drain to the two proposed detention basins in the southeast corner and the southwest corner. The outlet from the detention basin in the southeast corner (Basin 1) will discharge into the railway corridor. The outlet from the detention basin in the southwest corner (Basin 2) will discharge via a grassed swale to the existing culverts under Raymond Terrace Road.

In accordance with council's standards for business areas, a fraction impervious of 100% was adopted for the proposed commercial lots and associated roads and carparking as shown in Figure 5.

3.3.2 DRAINS Modelling

DRAINS modelling was undertaken to determine the predeveloped and developed peak flows for 1% AEP for storm durations ranging from 5 minutes to 6 hours for the proposed development.

3.3.1 Detention Basin

The following concept basin configurations were used in the DRAINS model:

Basin 1 – located in the southeast corner within 1 Brickworks Road

- Top level of Basin: RL 17 m
- Bottom level of Basin: RL 15.5 m
- Outlet Pipe – 9x600 mm diameter outlet pipe with invert level at RL 15.5 m
- Weir - 5 m wide, RL 16.5 m
- The stage storage areas for basin 1 are shown in Table 1 below. The areas incorporate both detention and bioretention basin areas.

Table 1: Basin 1 - Stage Storage Areas

Height	Surface Area
(m)	**(m^2)**
15.5	3014
16.2	5514
16.5	6424
17.0	8115

- The outlet from Basin 1 will discharge into the railway corridor. Approval to discharge into the railway corridor has been provided by ARTC.
- At this stage, the configuration of the existing partially filled void/dam has been ignored. Further investigations are required to determine the size and volume of the existing dam, and methods to utilise the existing dam for detention/water quality.
- The proposed basin location is shown in Figure 5.

Basin 2 – located in the southwest corner within 51 Brickworks Road

- Top level of Basin: RL 11.7 m
- Bottom level of Basin: RL 10.2 m
- Outlet Pipe – 11x600 mm diameter outlet pipes with invert level at RL 10.2m
- Weir - 5 m wide, RL 11.2 m
- The stage storage areas for basin 2 are shown in Table 2. The areas incorporate both detention and bioretention basin areas.

Table 2: Basin 2 - Stage Storage Areas

Height	Surface Area
(m)	**(m^2)**
10.2	7330
10.9	10903
11.2	11982
11.7	13655

- The outlet from Basin 2 will be via a grassed swale along the western boundary and discharging to the existing culverts under Raymond Terrace Road.
- The proposed basin location is shown in Figure 5.

3.3.1.1 DRAINS Results

The predeveloped and post developed peak flows from the site (without detention) for the 1% AEP are shown in Table 3.

Table 3: Predeveloped vs Developed Peak Flows without Detention

Pre-Developed Peak Flow	Developed Peak Flow (without detention)	Difference	Increase
(m^3/s)	(m^3/s)	(m^3/s)	(%)
11.80	23.50	11.70	99

The predeveloped and post developed peak flows from the site (with detention) are shown in Table 4.

Table 4: Predeveloped vs Developed Peak Flows with Detention

Pre-Developed Peak Flow	Developed Peak Flow (with detention)	Difference	Reduction
(m^3/s)	(m^3/s)	(m^3/s)	(%)
11.80	11.40	0.4	3

DRAINS inputs and results for the predeveloped and developed model are shown in Appendix B.

As can be seen from the above results, the conceptual basins as detailed with the volumes and outlet configuration discussed above have reduced the peak developed flows from the proposed development below the predeveloped peak flows for the 1% AEP storm events. Detailed modelling covering lesser AEPs will be undertaken at the DA stage.

The location and size of the proposed detention basins will need to be reassessed at the DA approval stage once the layout for the development has been confirmed.

4 STORMWATER QUALITY MANAGEMENT

4.1 Objectives

The objectives of the stormwater quality management for the site are:

- Meet the water quality objectives of Maitland City Council for the operational phase of the site by using best practice stormwater treatment measures. The water quality reductions required by Maitland City Council are:
- % Reductions from the developed site of:
  - 80% reduction in Total Suspended Solids (TSS)
  - 45% reduction in Total Phosphorus (TP)
  - 45% reduction in Total Nitrogen (TN)

- 70% reduction in litter/gross pollutants

4.2 Operational Phase Water Quality Management

4.2.1 General

To meet the water quality requirements of Maitland City Council, a range of water quality improvement devices will be required. The proposed water quality improvement devices for the site can include:

- Rainwater tanks
- HumeGard GPTs
- Grassed swales
- Bioretention basins

The above water quality improvement devices act as a treatment train, progressively reducing pollutants as they pass through each one.

4.2.2 Stormwater Quality Modelling

4.2.2.1 Introduction

The MUSIC model version 6 was used to assess the pollutant generation from the development and the performance of the stormwater quality treatment train. As Maitland City Council do not have a MUSIC Link, MUSIC modelling was undertaken in accordance with the Port Stephens Council MUSIC Link and the NSW MUSIC Modelling Guidelines (WBM, 2015).

4.2.2.2 MUSIC Modelling

The proposed treatment train for this development includes roof water draining to rainwater tanks with overflows to the minor pit/pipe stormwater drainage system. The flows from the roads and carparking will be directed to the minor pit/pipe stormwater drainage system. The minor flows will be treated through Humegard GPTs and then through the bioretention basins.

For this approval stage, the treatment devices included are rainwater tanks for 1 Brickworks Road, GPTs, and bioretention basins. Rainwater tanks have been included for 1 Brickworks Road as a preliminary lot layout to determine the number of lots has been prepared.

At the DA and CC stage, additional treatment devices such as rainwater tanks and grass swales can be considered. Additional treatment devices may reduce the size of the proposed bioretention basin.

4.2.2.3 Rainfall Data and Evaporation Data

The rainfall data and evapotranspiration data for the project was adopted from the Port Stephens Council MUSIC link. The data is from the Williamtown RAAF base. This rainfall data was considered appropriate for the site due to its proximity.

4.2.2.4 MUSIC Model Source Inputs

The source data for the MUSIC model for the developed model were adopted from the Port Stephens Council MUSIC link. A fraction impervious of 100% was adopted for the proposed development. All the post development catchments were modelled as mixed surface types.

The source node parameters adopted for the projects are shown in Table 5.

Table 5: MUSIC Rainfall-Runoff Parameters

Soil Parameter	Value
Rainfall Threshold (mm/day)	1.40
Soil Storage Capacity (mm)	120
Initial Storage (% of Capacity)	30
Field Capacity	85
Infiltration Capacity Coefficient – a	150
Infiltration Capacity Exponent – b	3.50
Groundwater Initial Depth (mm)	10
Groundwater Daily Recharge Rate (%)	25
Groundwater Daily Baseflow Rate (%)	5
Groundwater Daily Deep Seepage Rate (%)	0

4.2.2.5 Catchments Pollutant Mean Concentrations

The pollutant Event Mean Concentration (EMC) values for the development were adopted from Port Stephens Council's MUSIC link for both base flows and storm flows for mixed surface types. Table 6 shows the base flow and stormflow Pollutant Event Mean Concentrations adopted for the modelling.

Table 6: Base Flow and Storm Flow Pollutant Event Mean Concentration Values

Catchment Type	Flow	TSS (log 10)		TP (log 10)		TN (log 10)	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Commercial	Base Flow	1.20	0.17	-0.85	0.19	0.11	0.12
	Storm Flow	2.15	0.32	-0.60	0.25	0.30	0.19
Roof	Base Flow	1.10	0.17	-0.82	0.19	0.32	0.12
	Storm Flow	1.30	0.32	-0.89	0.25	0.30	0.19
Roads	Base Flow	1.20	0.17	-0.85	0.19	0.11	0.12
	Storm Flow	2.43	0.32	-0.30	0.25	0.34	0.19
Revegetated	Base Flow	1.15	0.17	-1.22	0.19	-0.05	0.12
	Storm Flow	1.95	0.32	-0.66	0.25	0.30	0.19
Mixed	Base Flow	1.20	0.17	-0.85	0.19	0.11	0.12
	Storm Flow	2.15	0.32	-0.60	0.25	0.30	0.19

4.2.2.6 MUSIC Model Treatment Train

The stormwater quality treatment train can include rainwater tanks, HumeGuard GPT, grassed swales, a bioretention basin etc. For this rezoning approval, some rainwater tanks, GPTs and bioretention basins have been included as treatment devices in the MUSIC model.

A brief description on each treatment measure is listed below:

- HumeGard GPT's are proposed upstream of the bioretention basin. These products remove gross pollutants, sediment and attached nutrients. The MUSIC nodes for the GPT's was provided by Humes. The removal efficiencies have been confirmed via independent testing. An equivalent product could be used. The flows to the GPT should be limited to the 3-month peak flow (approximately 1/3 1 EY) with larger flows flowing directly into the downstream basin. Table 7 shows the removal efficiencies of the HumeGard GPTs.

Table 7: HumeGard Removal Efficiencies

Gross Pollutant Removal (%)	TSS Removal (%)	TP Removal (%)	TN Removal (%)
85	41	34	24

- Bioretention basins are part of the proposed treatment train for the site. Bioretention systems remove sediments (TSS) as well as nutrients (TN and TP) from the stormwater. The bioretention basin consists of a shallow dry basin with deep rooted vegetation and grass on the surface, over an infiltration/filtration area and an underdrain area.

  The bioretention basin is proposed to be located upstream of the detention basin. The bioretention basin will overflow into the detention basin once it fills up.

  Vegetation in the bioretention basins will be in accordance with Maitland City Council requirements.

  Table 8 and 9 show the bioretention basin inputs for Basin 1 and 2 respectively.

Table 8: Bioretention Basin 1 MUSIC Model Inputs

Property	
Extended Detention Depth (m)	0.3
Surface Area (m^2)	1400
Filter Area (m^2)	1100
Unlined Filter Material (m)	0.01
Saturated Hydraulic Conductivity (mm/hr)	100
Filter Depth (m)	0.6
TN Content of Filter Media (mg/kg)	400
Orthophosphate of Filter Media (mg/kg)	40
Exfiltration Rate (mm/hr)	0
Base Lined	Yes
Vegetated with Effective Nutrient Removal Plants	Yes
Under Drain Present	Yes

Table 9: Bioretention Basin 2 MUSIC Model Inputs

Property	
Extended Detention Depth (m)	0.3
Surface Area (m^2)	2450
Filter Area (m^2)	2050
Unlined Filter Material (m)	0.01
Saturated Hydraulic Conductivity (mm/hr)	100
Filter Depth (m)	0.6
TN Content of Filter Media (mg/kg)	400
Orthophosphate of Filter Media (mg/kg)	40
Exfiltration Rate (mm/hr)	0
Base Lined	Yes
Vegetated with Effective Nutrient Removal Plants	Yes
Under Drain Present	Yes

A schematic of the MUSIC model is shown in Appendix C.

4.2.3 Stormwater Quality Modelling Results

The results of the MUSIC model for the total catchment showing the mean annual pollutant loads for the existing and the developed catchment for the site are shown in Table 10.

Table 10: MUSIC Model Existing vs Developed Results

	Source Mean Annual Load	Residual Mean Annual Load	Reduction	% Developed Reduction	MCC % Required Reduction
TSS (kg/yr.)	82,100	15,600	66,500	81	80
TP (kg/yr.)	145	53.2	91.8	63.2	45
TN (kg/yr.)	958	516	442	46.2	45
Gross Pollutants (kg/yr.)	9,670	128	9,542	98.7	70

The results of the modelling show that the reductions in the pollutants meet or exceed the requirement of Maitland City Council. The MUSIC model summary report detailing the inputs and results of the modelling are shown in Appendix C.

The location and size of the proposed water quality basin will need to be reassessed at the DA approval stage once the layout for the development has been confirmed.

5 CONCLUSION

This precinct level stormwater management plan addresses the stormwater quantity and quality for a Planning Proposal to rezone land at 1, 18 and 51 Brickworks Road, Thornton.

Stormwater quantity and stormwater quality have been addressed.

Stormwater conveyance for the site will be in accordance with the minor/major system philosophy and the requirements of Maitland City Council.

Detention modelling for the site determined that the peak flow for the 1% AEP storm event can be reduced to or below the predeveloped peak flows with detention basins.

Water quality management for the site should consist of a treatment train utilizing HumeGard GPTs and a bioretention basin as a minimum to reduce the pollutant runoff from the site in accordance with the requirements of Maitland City Council.

As the peak flows from the development can be reduced to the predeveloped peak flows, and the pollutant runoff reduced to Council requirements, there should be no impact on Four Mile Creek catchment from the proposed development.

A concept layout for the detention/water quality basin has been provided for the rezoning approval process. The location and size of the proposed detention/water quality basin will need to be reassessed at the DA approval stage once the layout for the development has been confirmed.

6 REFERENCES

- Maitland City Council DCP
- NSW MUSIC Modelling Guidelines (WBM 2015)
- Using MUSIC in Sydney's Drinking Water Catchment – A Sydney Catchment Authority Standard
- Port Stephens Council MUSIC Link function in the MUSIC program
- Landcom Managing Urban Stormwater: Soils and Construction Volume 1, 4th Edition 2004

FIGURES

SCALE 1:10000 @ A1
SCALE 1:20000 @ A3

0 100 200 400 600 800 1000 metres

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Project
PRECINCT LEVEL STORMWATER MANAGEMENT PLAN FOR PROPOSED REZONING
1, 18 AND 51 BRICKWORKS ROAD
THORNTON

Drawing Title
LOCALITY PLAN

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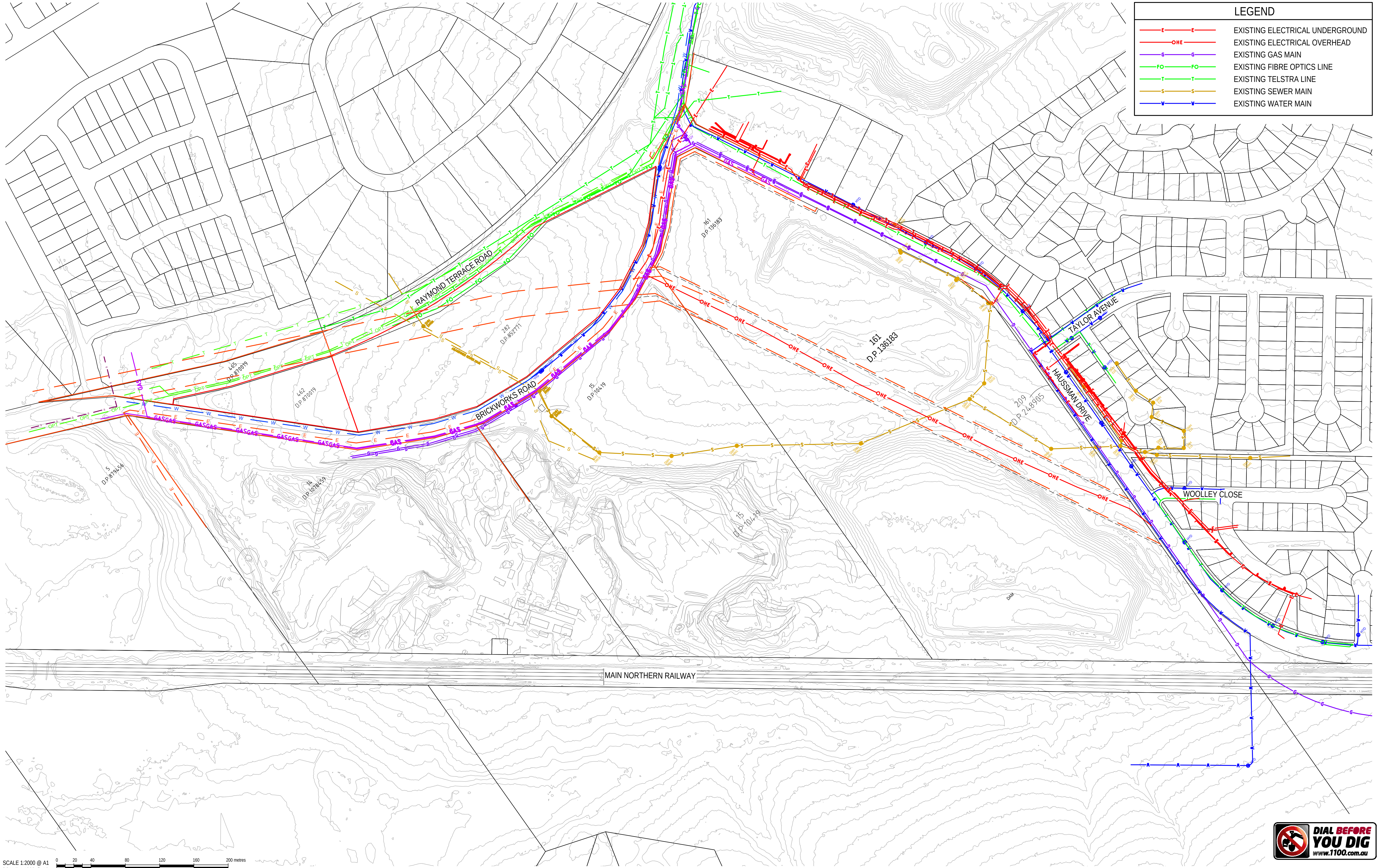

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PRECINCT LEVEL STORMWATER MANAGEMENT PLAN FOR PROPOSED REZONING
1, 18 AND 51 BRICKWORKS ROAD
THORNTON

Drawing Title
SITE SURVEY

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SCALE 1:4000 @ A3
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PRECINCT LEVEL STORMWATER MANAGEMENT PLAN FOR PROPOSED REZONING
1, 18 AND 51 BRICKWORKS ROAD
THORNTON

Drawing Title
EXISTING TOPOGRAPHY PLAN

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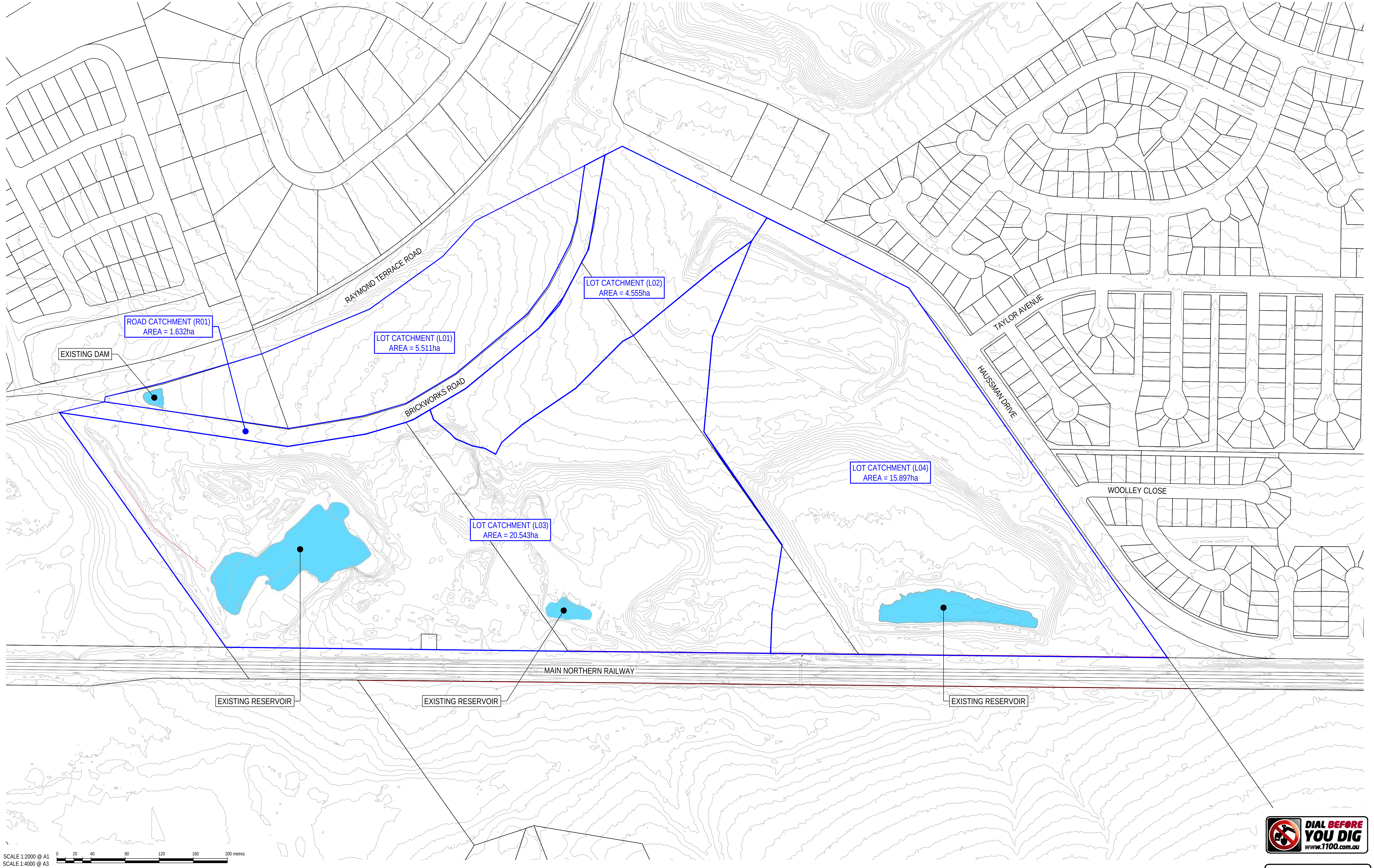

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PRECINCT LEVEL STORMWATER MANAGEMENT PLAN FOR PROPOSED REZONING
1, 18 AND 51 BRICKWORKS ROAD
THORNTON

Drawing Title
PRE DEVELOPEMENT CATCHMENT PLAN

Drawn	Date	Scale A1	Q.A. Check	Date
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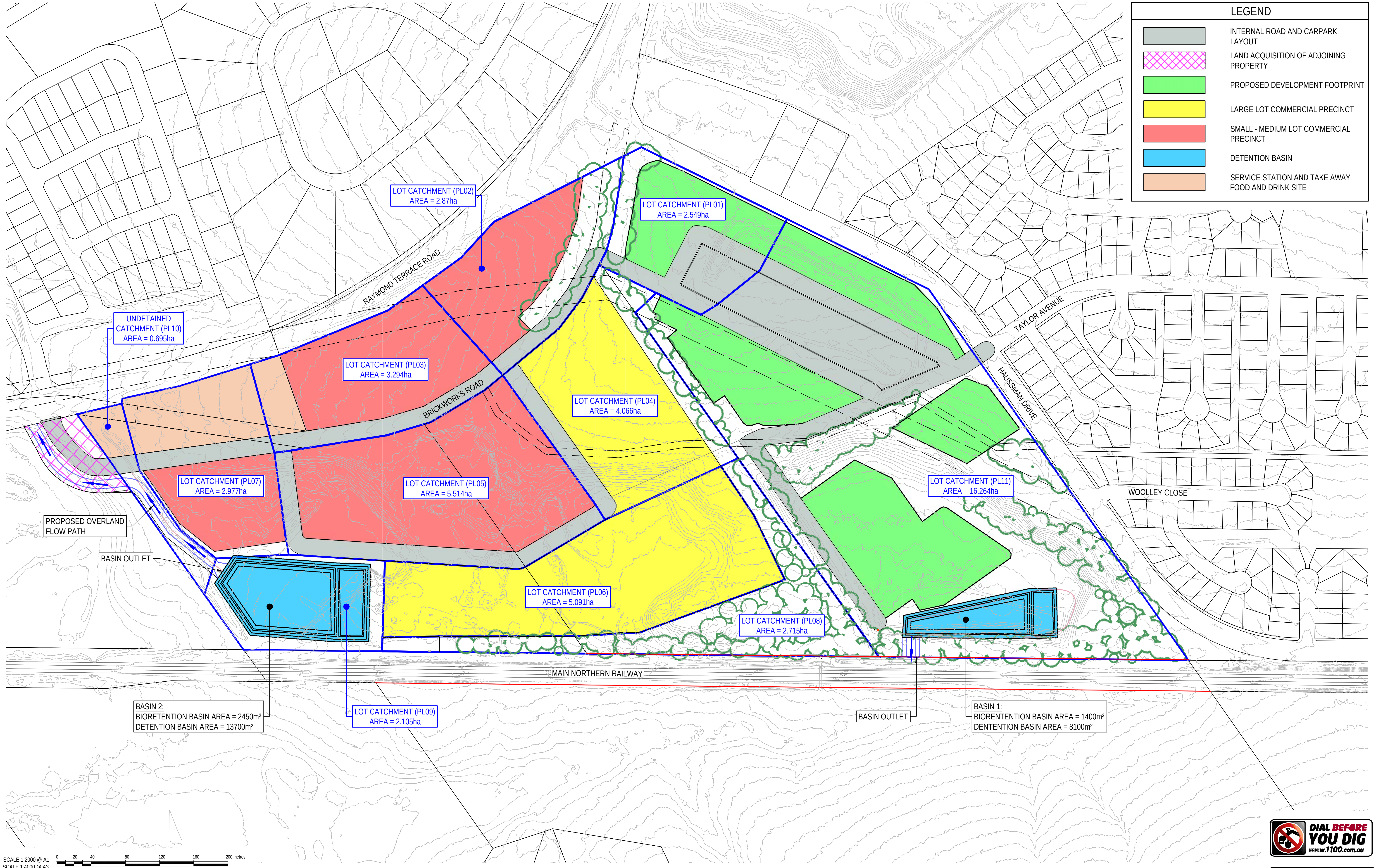

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Project: PRECINCT LEVEL STORMWATER MANAGEMENT PLAN FOR PROPOSED REZONING
1, 18 AND 51 BRICKWORKS ROAD THORNTON

Drawing Title: POST DEVELOPEMENT CATCHMENT PLAN

Drawn	Date	Scale A1	Q.A. Check	Date
ADS	JUNE 2020	1:2000		

Designed	Project No.	Dwg. No.	Issue
UK	NSW200743	FIGURE-5	A

Appendix A

de Witt Consulting – Concept Plan

de Witt Consulting
planning ■ surveying ■ project management

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ABN 23 104 067 405

FIGURE 1-1

DRAFT CONCEPT PLAN

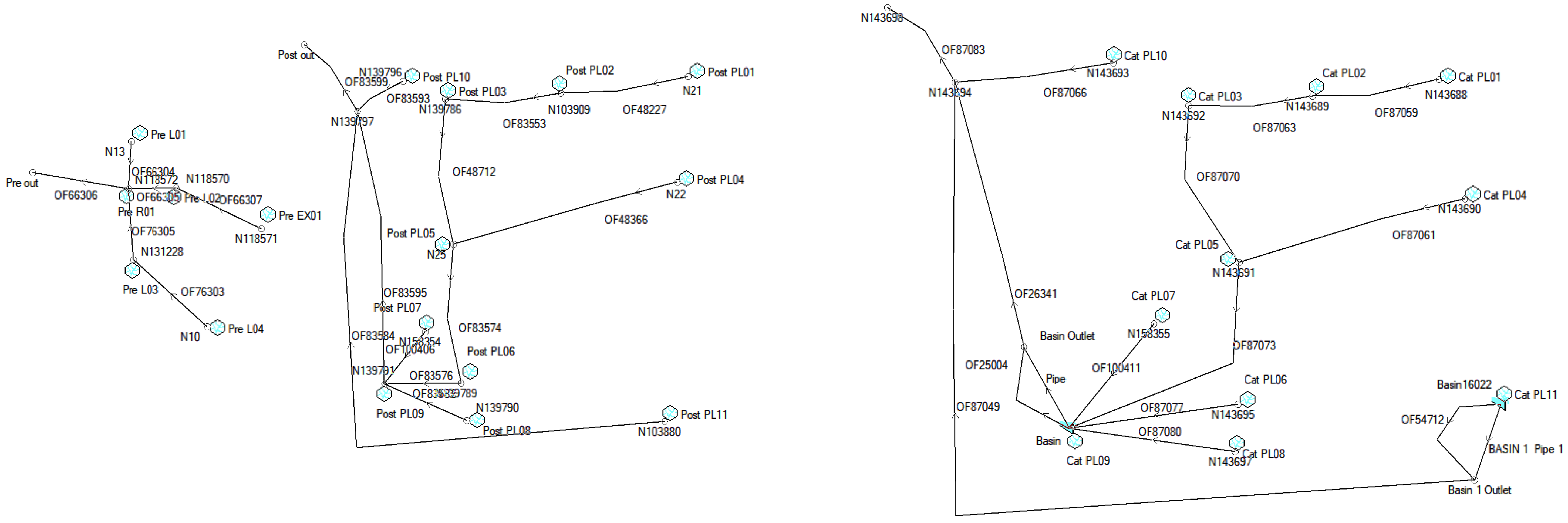
0 50 100 150 200 m

JOB ADDRESS:	RAYMOND TERRACE ROAD, THORNTON NEW SOUTH WALES | AUSTRALIA				
CLIENT:	STEVENS GROUP				
A3 SCALE:	1:5000	DRAWN:	MB	JOB REF:	9424
PLAN DATE:	16/10/19	CHECKED:	DRAFT	ISSUE:	N/A

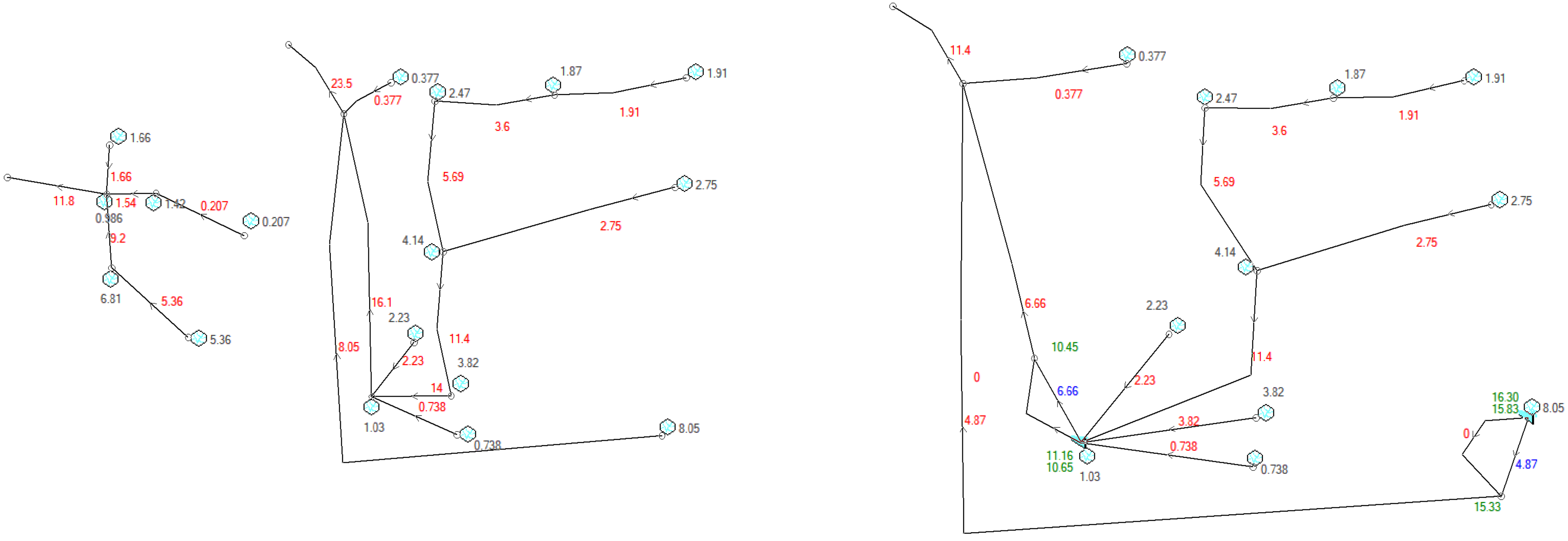
N

Appendix B

DRIANS Inputs and Results



NSW200743 - Brickworks Rd, Thornton
Predeveloped and Post developed
DRAINS Schematic



NSW200743 - Brickworks Rd, Thornton
Predeveloped and Post developed
DRAINS Schematic - 1% AEP FLOWS

NSW 200743 - Brickworks Road Thornton
Predeveloped and Post developed
DRAINS Input Data

PIT / NODE DETAILS			Version 15														
Name	Type	Family	Size	Ponding	Pressure	Surface	Max Pond	Base	Blocking	x	y	Bolt-down	id	Part Full	Inflow	Pit is	Internal
				Volume	Change	Elev (m)	Depth (m)	Inflow	Factor			lid		Shock Loss	Hydrograph		Width
				(cu.m)	Coeff. Ku			(cu.m/s)									(mm)
N10	Node							0		372962.9	6373646		148069		No		
Basin Outlet	Node					11		0		373047.1	6373643		150215		No		
N21	Node							0		373012.5	6373671		223903		No		
N22	Node							0		373011.4	6373660		226950		No		
N25	Node							0		372988.4	6373654		227524		No		
Basin 1 Outlet	Node					16		0		373093.5	6373630		246104		No		
N103880	Node							0		373010.1	6373636		246124		No		
Post out	Node							0		372972.9	6373675		246126		No		
N103909	Node							0		372999.4	6373670		246240		No		
N13	Node							0		372955.2	6373665		284501		No		
Pre out	Node							0		372945	6373661		284513		No		
N118570	Node							0		372959.8	6373660		284514		No		
N118571	Node							0		372968.6	6373656		284516		No		
N118572	Node							0		372954.9	6373660		284523		No		
N131228	Node							0		372955.4	6373652		317197		No		
N139786	Node							0		372987.5	6373669		339697		No		
N139789	Node							0		372989.1	6373640		339729		No		
N139790	Node							0		372989.7	6373636		339740		No		
N139791	Node							0		372981.3	6373640		339741		No		
N139796	Node							0		372983.1	6373671		339771		No		
N139797	Node							0		372978.4	6373668		339777		No		
N143688	Node							0		373089.9	6373671		350360		No		
N143689	Node							0		373076.9	6373669		350363		No		
N143690	Node							0		373092.5	6373659		350369		No		
N143691	Node							0		373069.3	6373652		350372		No		
N143692	Node							0		373064.1	6373668		350379		No		
N143693	Node							0		373056.3	6373673		350385		No		
N143694	Node							0		373040.1	6373671		350386		No		
N143695	Node							0		373069.2	6373638		350397		No		
N143697	Node							0		373068.9	6373633		350409		No		
N143698	Node							0		373033.1	6373678		350415		No		
N158354	Node							0		372985.4	6373645		390841		No		
N158355	Node							0		373060.5	6373646		390862		No		
DETENTION BASIN DETAILS																	
Name	Elev	Surf. Area	Not Used	Outlet Typ	K	Dia(mm)	Centre RL	Pit Family	Pit Type	x	y	HED	Crest RL	Crest Leng	id		
Basin	10.2	7330		Culvert	0.5					373051.8	6373635	No			152442		
	10.9	10903															

	11.2	11982															
	11.7	13655															
Basin16022	15.5	3014		Culvert	0.5					373096.2	6373638	No			246100		
	16.2	5514															
	16.5	6424															
	17	8115															
SUB-CATCHMENT DETAILS																	
Name	Pit or	Total	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp	Paved	Grass	Supp
	Node	Area	Area	Area	Area	Time	Time	Time	Length	Length	Length	Slope(%)	Slope	Slope	Rough	Rough	Rough
		(ha)	%	%	%	(min)	(min)	(min)	(m)	(m)	(m)	%	%	%			
Pre L04	N10	15.897	0	100	0	0	7.5	0	0	100	0	1	5	0	0.013	0.2	0
Cat PL09	Basin	2.105	0	100	0	5	10	0									
Post PL01	N21	2.549	100	0	0	5	10	0									
Post PL04	N22	4.066	85	15	0	5	10	0									
Post PL05	N25	5.514	100	0	0	5	10	0									
Cat PL11	Basin1602	16.264	60	40	0	8	16	0									
Post PL11	N103880	16.264	60	40	0	8	16	0									
Post PL02	N103909	2.868	80	20	0	5	10	0									
Pre L01	N13	5.511	0	100	0	5	10.5	0	0	100	0	0	3.8	0	0.013	0.2	0
Pre L02	N118570	4.555	0	100	0	0	8.4	0	0	100	0	1	3.7	0	0.013	0.2	0
Pre EX01	N118571	0.343	70	30	0	5	10	2									
Pre R01	N118572	1.632	70	30	0	5	10	0									
Pre L03	N131228	20.543	0	100	0	5	8.4	0	0	100	0	1	5	0	0.013	0.2	0
Post PL03	N139786	3.294	100	0	0	5	10	0									
Post PL06	N139789	5.098	100	0	0	5	10	0									
Post PL08	N139790	2.715	0	100	0	5	30	0									
Post PL09	N139791	2.105	0	100	0	5	10	0									
Post PL10	N139796	0.695	45	55	0	5	10	0									
Cat PL01	N143688	2.549	100	0	0	5	10	0									
Cat PL02	N143689	2.868	80	20	0	5	10	0									
Cat PL04	N143690	4.066	85	15	0	5	10	0									
Cat PL05	N143691	5.514	100	0	0	5	10	0									
Cat PL03	N143692	3.294	100	0	0	5	10	0									
Cat PL10	N143693	0.695	45	55	0	5	10	0									
Cat PL06	N143695	5.098	100	0	0	5	10	0									
Cat PL08	N143697	2.715	0	100	0	5	30	0									
Post PL07	N158354	2.977	100	0	0	5	10	0									
Cat PL07	N158355	2.977	100	0	0	5	10	0									
PIPE DETAILS																	
Name	From	To	Length	U/S IL	D/S IL	Slope	Type	Dia	I.D.	Rough	Pipe Is	No. Pipes	Chg From	At Chg	Chg	RI	Chg
			(m)	(m)	(m)	(%)		(mm)	(mm)						(m)	(m)	(m)
Pipe	Basin	Basin Outl	20	10.2	10	1	RCP-2	600	600	0.012	NewFixed	11	Basin	0			
BASIN 1 Pipe 1	Basin1602	Basin 1 Ou	25	15.5	15	2	RCP-2	600	600	0.012	NewFixed	9	Basin1602	0			

DETAILS of SERVICES CROSSING PIPES																	
Pipe	Chg	Bottom	Height of S	Chg	Bottom	Height of S	Chg	Bottom	Height of S	etc							
	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	(m)	Elev (m)	(m)	etc							
CHANNEL DETAILS																	
Name	From	To	Type	Length	U/S IL	D/S IL	Slope	Base Widtl	L.B. Slope	R.B. Slope	Manning	Depth	Roofed				
				(m)	(m)	(m)	(%)	(m)	(1:?)	(1:?)	n	(m)					
OVERFLOW ROUTE DETAILS																	
Name	From	To	Travel	Spill	Crest	Weir	Cross	Safe Depth	SafeDepth	Safe	Bed	D/S Area		id			
			Time	Level	Length	Coeff. C	Section	Major Stor	Minor Stor	DxV	Slope	Contributing					
			(min)	(m)	(m)			(m)	(m)	(sq.m/sec)	(%)	%					
OF76303	N10	N131228	14.2				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		317189			715
OF25004	Basin	Basin Outle	1	11.2	5	2	4 m wide pathway	0.3	0.15	0.4	1	0		150216			
OF26341	Basin Outle	N143694	4.1				WEIR 1 in 6 with 8 m base	0.3	0.3	0.4	0.5	0		154787			200
OF48227	N21	N103909	1.2				9m roadway 3% CF 5m footw	0.3	0.15	0.4	4	0		226684			172
OF48366	N22	N25	2.7				9m roadway 3% CF 5m footw	0.3	0.15	0.4	4	0		226951			380
OF83574	N25	N139789	1.6				4 m wide pathway	0.3	0.15	0.4	1	0		339725			200
OF54712	Basin1602	Basin 1 Ou	0.1	16.5	5	2	6m pathway	0.3	0.15	0.4	1	0		246116			
OF87049	Basin 1 Ou	N143694	15.7				Swale with 1:4 sideslopes	0.45	0.3	1	1	0		350345			1138
OF83584	N103880	N139797	15.7				Swale with 1:4 sideslopes	0.45	0.3	1	1	0		339759			1138
OF83553	N103909	N139786	1.2				9m roadway 3% CF 5m footw	0.3	0.15	0.4	4	0		339691			172
OF66304	N13	N118572	0.1				Swale with 1:6 sideslopes	0.15	0.1	1	3	0		284510			
OF66305	N118570	N118572	7				Swale with 1:6 sideslopes	0.15	0.1	1	3	0		284511			431
OF66307	N118571	N118570	0.1				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		284515			
OF66306	N118572	Pre out	0.1				Swale with 1:6 sideslopes	0.15	0.1	1	3	0		284512			
OF76305	N131228	N118572	8				Swale with 1:6 sideslopes	0.15	0.1	1	1	0		317192			283
OF48712	N139786	N25	1.6				4 m wide pathway	0.3	0.15	0.4	1	0		227638			200
OF83576	N139789	N139791	14.2				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		339736			715
OF83582	N139790	N139791	14.2				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		339745			715
OF83595	N139791	N139797	2.3				4 m wide pathway	0.3	0.15	0.4	1	0		339779			283
OF83593	N139796	N139797	0.1				7.5 m roadway with 3% cross	0.3	0.15	0.4	1	0		339776			10
OF83599	N139797	Post out	0.1				4 m wide pathway	0.3	0.15	0.4	1	0		339784			
OF87059	N143688	N143689	1.2				9m roadway 3% CF 5m footw	0.3	0.15	0.4	4	0		350361			172
OF87063	N143689	N143692	1.2				9m roadway 3% CF 5m footw	0.3	0.15	0.4	4	0		350377			172
OF87061	N143690	N143691	2.7				9m roadway 3% CF 5m footw	0.3	0.15	0.4	4	0		350370			380
OF87073	N143691	Basin	1.6				4 m wide pathway	0.3	0.15	0.4	1	0		350395			200
OF87070	N143692	N143691	1.6				4 m wide pathway	0.3	0.15	0.4	1	0		350392			200
OF87066	N143693	N143694	0.1				7.5 m roadway with 3% cross	0.3	0.15	0.4	1	0		350388			10
OF87083	N143694	N143698	0.1				4 m wide pathway	0.3	0.15	0.4	1	0		350413			
OF87077	N143695	Basin	14.2				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		350403			715
OF87080	N143697	Basin	14.2				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		350410			715
OF100406	N158354	N139791	14.2				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		390838			715
OF100411	N158355	Basin	14.2				Swale with 1:6 sideslopes	0.15	0.1	1	2	0		390859			715

NSW 200743 - Brickworks Road Thornton
Predeveloped and Post developed
DRAINS Input Data

DRAINS results prepared from Version 2020.036								
PIT / NODE DETAILS				Version 8				
Name	Max HGL	Max Pond	Max Surface	Max Pond	Min	Overflow	Constraint	
		HGL	Flow Arriving	Volume	Freeboard	(cu.m/s)		
			(cu.m/s)	(cu.m)	(m)			
Basin Outlet	10.45		0.089					
Basin 1 Outlet	15.33		0					
SUB-CATCHMENT DETAILS								
Name	Max	Paved	Grassed	Paved	Grassed	Supp.	Due to Storm	
	Flow Q	Max Q	Max Q	Tc	Tc	Tc		
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)		
Pre L04	5.356	0	5.356	0	21.58	0	1% AEP, 25 min burst, Storm 5	
Cat PL09	1.033	0	1.033	5	10	0	1% AEP, 15 min burst, Storm 2	
Post PL01	1.912	1.912	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Post PL04	2.753	2.592	0.161	5	10	0	1% AEP, 5 min burst, Storm 1	
Post PL05	4.135	4.135	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Cat PL11	8.051	6.163	1.889	8	16	0	1% AEP, 10 min burst, Storm 7	
Post PL11	8.051	6.163	1.889	8	16	0	1% AEP, 10 min burst, Storm 7	
Post PL02	1.873	1.721	0.152	5	10	0	1% AEP, 5 min burst, Storm 1	
Pre L01	1.665	0	1.665	5	26.46	0	1% AEP, 30 min burst, Storm 7	
Pre L02	1.422	0	1.422	0	23.81	0	1% AEP, 25 min burst, Storm 7	
Pre EX01	0.207	0.18	0.027	5	10	2	1% AEP, 5 min burst, Storm 1	
Pre R01	0.986	0.857	0.13	5	10	0	1% AEP, 5 min burst, Storm 1	
Pre L03	6.811	0	6.811	5	22.48	0	1% AEP, 25 min burst, Storm 6	
Post PL03	2.47	2.47	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Post PL06	3.823	3.823	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Post PL08	0.738	0	0.738	5	30	0	1% AEP, 45 min burst, Storm 3	
Post PL09	1.033	0	1.033	5	10	0	1% AEP, 15 min burst, Storm 2	
Post PL10	0.377	0.199	0.178	5	10	0	1% AEP, 10 min burst, Storm 7	
Cat PL01	1.912	1.912	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Cat PL02	1.873	1.721	0.152	5	10	0	1% AEP, 5 min burst, Storm 1	
Cat PL04	2.753	2.592	0.161	5	10	0	1% AEP, 5 min burst, Storm 1	
Cat PL05	4.135	4.135	0	5	10	0	1% AEP, 5 min burst, Storm 1	

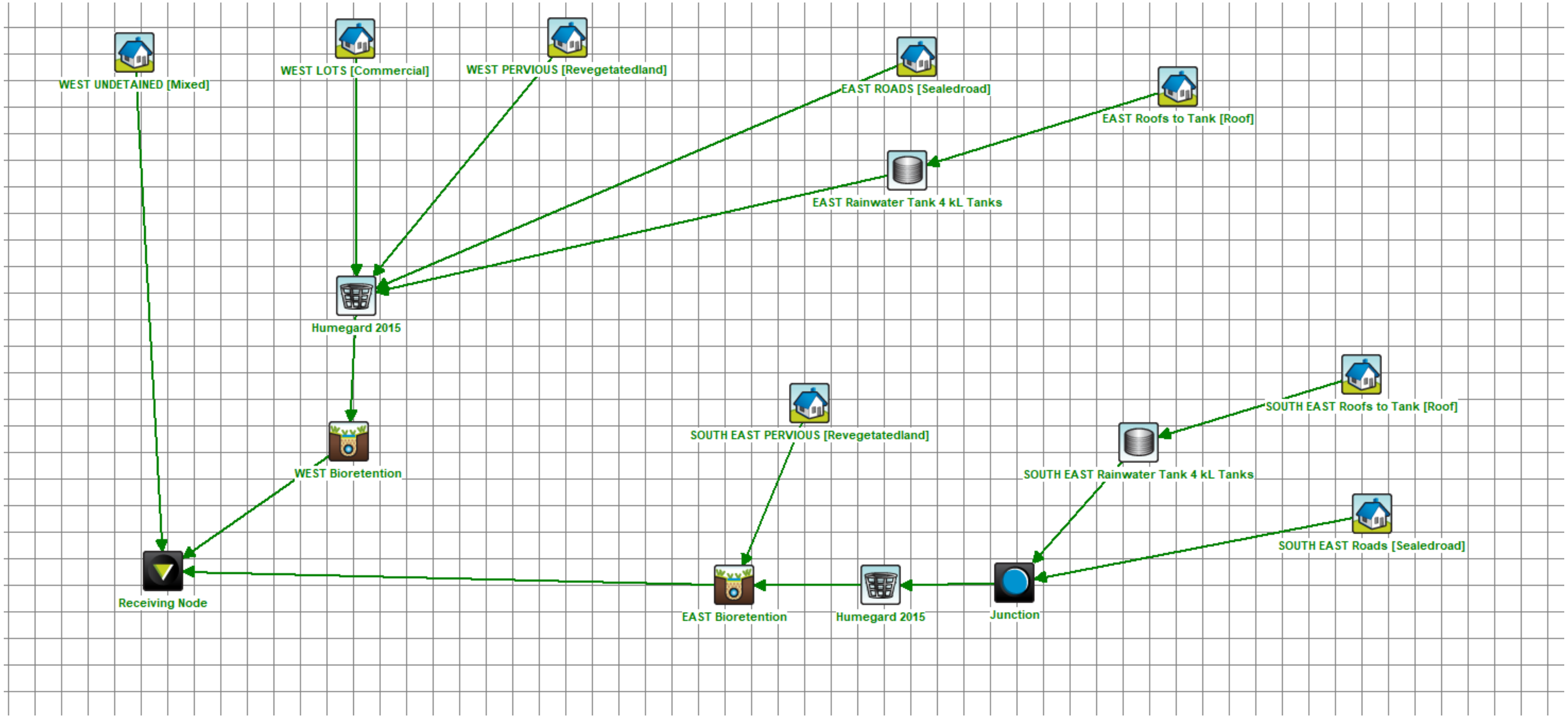
Cat PL03	2.47	2.47	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Cat PL10	0.377	0.199	0.178	5	10	0	1% AEP, 10 min burst, Storm 7	
Cat PL06	3.823	3.823	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Cat PL08	0.738	0	0.738	5	30	0	1% AEP, 45 min burst, Storm 3	
Post PL07	2.233	2.233	0	5	10	0	1% AEP, 5 min burst, Storm 1	
Cat PL07	2.233	2.233	0	5	10	0	1% AEP, 5 min burst, Storm 1	
PIPE DETAILS								
Name	Max Q	Max V	Max U/S	Max D/S	Due to Storm			
	(cu.m/s)	(m/s)	HGL (m)	HGL (m)				
Pipe	6.661	2.64	10.863	10.454	1% AEP, 45 min burst, Storm 2			
BASIN 1 Pipe 1	4.874	3.44	15.98	15.327	1% AEP, 25 min burst, Storm 9			
CHANNEL DETAILS								
Name	Max Q	Max V			Due to Storm			
	(cu.m/s)	(m/s)						
OVERFLOW ROUTE DETAILS								
Name	Max Q U/S	Max Q D/S	Safe Q	Max D	Max DxV	Max Width	Max V	Due to Storm
OF76303	5.356	5.356	0.225	0.167	2.68	4	16.05	1% AEP, 25 min burst, Storm 5
OF25004	0	0	1.479	0	0	0	0	
OF26341	6.661	6.661	2.372	0.532	0.6	14.38	1.12	1% AEP, 45 min burst, Storm 2
OF48227	1.912	1.912	0.835	0.212	0.65	7.13	3.05	1% AEP, 5 min burst, Storm 1
OF48366	2.753	2.753	0.835	0.236	0.8	8.09	3.4	1% AEP, 5 min burst, Storm 1
OF83574	11.421	11.421	1.479	0.69	2.92	4	4.23	1% AEP, 10 min burst, Storm 5
OF54712	0	0	0.807	0	0	0	0	
OF87049	4.874	4.874	0.979	0.5	2.44	4	4.88	1% AEP, 25 min burst, Storm 9
OF83584	8.051	8.051	0.979	0.5	4.03	4	8.05	1% AEP, 10 min burst, Storm 7
OF83553	3.602	3.602	0.835	0.256	0.94	8.9	3.67	1% AEP, 10 min burst, Storm 5
OF66304	1.665	1.665	0.276	0.167	0.83	4	4.99	1% AEP, 30 min burst, Storm 7
OF66305	1.542	1.542	0.276	0.167	0.77	4	4.62	1% AEP, 25 min burst, Storm 7
OF66307	0.207	0.207	0.225	0.145	0.12	3.47	0.82	1% AEP, 5 min burst, Storm 1
OF66306	11.807	11.807	0.276	0.167	5.91	4	35.37	1% AEP, 45 min burst, Storm 1
OF76305	9.202	9.202	0.159	0.167	4.6	4	27.57	1% AEP, 25 min burst, Storm 10
OF48712	5.687	5.687	1.479	0.442	1.47	4	3.33	1% AEP, 10 min burst, Storm 1
OF83576	14.04	14.04	0.225	0.167	7.02	4	42.06	1% AEP, 10 min burst, Storm 6
OF83582	0.738	0.738	0.225	0.167	0.37	4	2.21	1% AEP, 45 min burst, Storm 3
OF83595	16.136	16.136	1.479	0.867	4.11	4	4.73	1% AEP, 10 min burst, Storm 7

OF83593	0.377	0.377	1.201	0.161	0.19	4.62	1.21	1% AEP, 10 min burst, Storm 7
OF83599	23.548	23.548	1.479	1.121	5.97	4	5.32	1% AEP, 10 min burst, Storm 1
OF87059	1.912	1.912	0.835	0.212	0.65	7.13	3.05	1% AEP, 5 min burst, Storm 1
OF87063	3.602	3.602	0.835	0.256	0.94	8.9	3.67	1% AEP, 10 min burst, Storm 5
OF87061	2.753	2.753	0.835	0.236	0.8	8.09	3.4	1% AEP, 5 min burst, Storm 1
OF87073	11.421	11.421	1.479	0.69	2.92	4	4.23	1% AEP, 10 min burst, Storm 5
OF87070	5.687	5.687	1.479	0.442	1.47	4	3.33	1% AEP, 10 min burst, Storm 1
OF87066	0.377	0.377	1.201	0.161	0.19	4.62	1.21	1% AEP, 10 min burst, Storm 7
OF87083	11.404	11.404	1.479	0.689	2.92	4	4.23	1% AEP, 45 min burst, Storm 1
OF87077	3.823	3.823	0.225	0.167	1.91	4	11.45	1% AEP, 5 min burst, Storm 1
OF87080	0.738	0.738	0.225	0.167	0.37	4	2.21	1% AEP, 45 min burst, Storm 3
OF100406	2.233	2.233	0.225	0.167	1.12	4	6.69	1% AEP, 5 min burst, Storm 1
OF100411	2.233	2.233	0.225	0.167	1.12	4	6.69	1% AEP, 5 min burst, Storm 1
DETENTION BASIN DETAILS								
Name	Max WL	MaxVol	Max Q	Max Q	Max Q			
			Total	Low Level	High Level			
Basin	11.16	9238.6	6.661	6.661	0			
Basin16022	16.3	3508.7	4.874	4.874	0			
Run Log for NSW200743_Pre and Post catchments_240620 run at 15:33:42 on 26/6/2020 using version 2020.036								

Appendix C

MUSIC Inputs and Results

MUSIC Model Schematic



MUSIC Model Reduction Result Summary

Treatment Train Effectiveness - Receiving Node

	Sources	Residual Load	% Reduction
Flow (ML/yr)	443	432	2.3
Total Suspended Solids (kg/yr)	82100	15600	81
Total Phosphorus (kg/yr)	145	53.2	63.2
Total Nitrogen (kg/yr)	958	516	46.2
Gross Pollutants (kg/yr)	9670	128	98.7

NSW200743 - Brickworks Road Thornton									
MUSIC Model Report									
Source nodes									
Location	EAST Roofs to Tank	EAST ROADS	SOUTH EAST Roofs to Tank	SOUTH EAST PERVIOUS	SOUTH EAST Roads	WEST UNDETAINED	WEST LOTS	WEST PERVIOUS	SOUTH EAST Roads
ID	1	3	4	6	7	12	14	15	16
Node Type	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode
Zoning Surface Type	Roof	Sealedroad	Roof	Revegetatedland	Sealedroad	Mixed	Commercial	Revegetatedland	Sealedroad
Total Area (ha)	1.732	3.484	3.406	7.539	5.32	0.707	21.563	6.099	5.32
Area Impervious (ha)	1.732	3.484	3.406	0	5.32	0.320656157	21.563	0	5.32
Area Pervious (ha)	0	0	0	7.539	0	0.386343843	0	6.099	0
Field Capacity (mm)	85	85	85	80	85	85	85	80	85
Pervious Area Infiltration Capacity coefficient - a	150	150	150	200	150	150	150	200	150
Pervious Area Infiltration Capacity exponent - b	3.5	3.5	3.5	1	3.5	3.5	3.5	1	3.5
Impervious Area Rainfall Threshold (mm/day)	1.4	1.4	1.4	1	1.4	1.4	1.4	1	1.4
Pervious Area Soil Storage Capacity (mm)	120	120	120	120	120	120	120	120	120
Pervious Area Soil Initial Storage (% of Capacity)	30	30	30	25	30	30	30	25	30
Groundwater Initial Depth (mm)	10	10	10	10	10	10	10	10	10
Groundwater Daily Recharge Rate (%)	25	25	25	25	25	25	25	25	25
Groundwater Daily Baseflow Rate (%)	5	5	5	5	5	5	5	5	5
Groundwater Daily Deep Seepage Rate (%)	0	0	0	0	0	0	0	0	0
Stormflow Total Suspended Solids Mean (log mg/L)	1.3	2.43	1.3	1.95	2.43	2.15	2.15	1.95	2.43
Stormflow Total Suspended Solids Standard Deviation (log mg/L)	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Stormflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0	0	0	0
Stormflow Total Phosphorus Mean (log mg/L)	-0.89	-0.3	-0.89	-0.66	-0.3	-0.6	-0.6	-0.66	-0.3
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Stormflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Phosphorus Serial Correlation	0	0	0	0	0	0	0	0	0
Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.34	0.3	0.3	0.34	0.3	0.3	0.3	0.34
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Stormflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Nitrogen Serial Correlation	0	0	0	0	0	0	0	0	0
Baseflow Total Suspended Solids Mean (log mg/L)	1.1	1.2	1.1	1.15	1.2	1.2	1.2	1.15	1.2
Baseflow Total Suspended Solids Standard Deviation (log mg/L)	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Baseflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Suspended Solids Serial Correlation	0	0	0	0	0	0	0	0	0
Baseflow Total Phosphorus Mean (log mg/L)	-0.82	-0.85	-0.82	-1.22	-0.85	-0.85	-0.85	-1.22	-0.85
Baseflow Total Phosphorus Standard Deviation (log mg/L)	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Baseflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Phosphorus Serial Correlation	0	0	0	0	0	0	0	0	0
Baseflow Total Nitrogen Mean (log mg/L)	0.32	0.11	0.32	-0.05	0.11	0.11	0.11	-0.05	0.11
Baseflow Total Nitrogen Standard Deviation (log mg/L)	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Baseflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Nitrogen Serial Correlation	0	0	0	0	0	0	0	0	0
Flow based constituent generation - enabled	Off	Off	Off	Off	Off	Off	Off	Off	Off
Flow based constituent generation - flow file									
Flow based constituent generation - base flow column									
Flow based constituent generation - pervious flow column									
Flow based constituent generation - impervious flow column									
Flow based constituent generation - unit									
OUT - Mean Annual Flow (ML/yr)	19	38.2	37.3	26.8	58.3	4.88	236	21.7	58.3
OUT - TSS Mean Annual Load (kg/yr)	494	1.35E+04	976	1.53E+03	2.05E+04	870	4.29E+04	1.31E+03	2.07E+04
OUT - TP Mean Annual Load (kg/yr)	2.9	22.6	5.74	3.99	34.5	1.42	70.2	3.25	34.4
OUT - TN Mean Annual Load (kg/yr)	41.9	92	81.8	39.7	141	10.5	518	32.1	141
OUT - Gross Pollutant Mean Annual Load (kg/yr)	465	936	915	0	1.43E+03	128	5.79E+03	0	1.43E+03
Rain In (ML/yr)	21.435	43.1176	42.1522	93.3018	65.8397	8.74974	266.861	75.4806	65.8397
ET Loss (ML/yr)	2.45159	4.93143	4.82103	66.6164	7.53015	3.86993	30.5214	53.8922	7.53015
Deep Seepage Loss (ML/yr)	0	0	0	0	0	0	0	0	0
Baseflow Out (ML/yr)	0	0	0	15.0886	0	0.263418	0	12.2066	0
Imp. Stormflow Out (ML/yr)	18.9835	38.1861	37.3312	0	58.3095	3.48706	236.34	0	58.3095
Perv. Stormflow Out (ML/yr)	0	0	0	11.717	0	1.13365	0	9.47894	0
Total Stormflow Out (ML/yr)	18.9835	38.1861	37.3312	11.717	58.3095	4.62071	236.34	9.47894	58.3095
Total Outflow (ML/yr)	18.9835	38.1861	37.3312	26.8055	58.3095	4.88413	236.34	21.6855	58.3095
Change in Soil Storage (ML/yr)	0	0	0	-0.12036	0	-0.0043366	0	-0.0973705	0
TSS Baseflow Out (kg/yr)	0	0	0	230.179	0	4.50662	0	186	0
TSS Total Stormflow Out (kg/yr)	493.887	13511.2	976.484	1304.17	20451.2	865.201	42920.8	1122.68	20724.9

TSS Total Outflow (kg/yr)	493.887	13511.2	976.484	1534.35	20451.2	869.708	42920.8	1308.68	20724.9
TP Baseflow Out (kg/yr)	0	0	0	1.00001	0	0.0409718	0	0.810048	0
TP Total Stormflow Out (kg/yr)	2.89971	22.5801	5.73751	2.98933	34.4578	1.37521	70.1944	2.4352	34.4472
TP Total Outflow (kg/yr)	2.89971	22.5801	5.73751	3.98934	34.4578	1.41619	70.1944	3.24525	34.4472
TN Baseflow Out (kg/yr)	0	0	0	13.9647	0	0.352582	0	11.2923	0
TN Total Stormflow Out (kg/yr)	41.8695	92.0059	81.7805	25.7165	141.342	10.1773	518.365	20.8274	140.644
TN Total Outflow (kg/yr)	41.8695	92.0059	81.7805	39.6813	141.342	10.5299	518.365	32.1197	140.644
GP Total Outflow (kg/yr)	465.389	936.153	915.195	0	1429.49	128.634	5793.99	0	1429.49
No Imported Data Source nodes									
USTM treatment nodes									
Location	EAST Rainwater Tank 4 kl	SOUTH EAST Rainwater Ta	EAST Bioretention	WEST Bioretention					
ID	2	5	8	13					
Node Type	RainWaterTankNode	RainWaterTankNode	BioRetentionNodeV4	BioRetentionNodeV4					
Lo-flow bypass rate (cum/sec)	0	0	0	0					
Hi-flow bypass rate (cum/sec)	3.6	3.6	100	100					
Inlet pond volume	0	0							
Area (sqm)	8	18	1400	2450					
Initial Volume (m^3)	1.6	3.6							
Extended detention depth (m)	0.4	0.4	0.3	0.3					
Number of Rainwater tanks	4	9							
Permanent Pool Volume (cubic metres)	14.4	32.4							
Proportion vegetated	0	0							
Equivalent Pipe Diameter (mm)	200	300							
Overflow weir width (m)	10	10	5	5					
Notional Detention Time (hrs)	1.51E-02	1.51E-02							
Orifice Discharge Coefficient	0.6	0.6							
Weir Coefficient	1.7	1.7	1.7	1.7					
Number of CSTR Cells	2	2	3	3					
Total Suspended Solids - k (m/yr)	400	400	8000	8000					
Total Suspended Solids - C* (mg/L)	12	12	20	20					
Total Suspended Solids - C** (mg/L)	0	0							
Total Phosphorus - k (m/yr)	300	300	6000	6000					
Total Phosphorus - C* (mg/L)	0.13	0.13	0.13	0.13					
Total Phosphorus - C** (mg/L)	0	0							
Total Nitrogen - k (m/yr)	40	40	500	500					
Total Nitrogen - C* (mg/L)	1.4	1.4	1.4	1.4					
Total Nitrogen - C** (mg/L)	0	0							
Threshold Hydraulic Loading for C** (m/yr)	0	0							
Horizontal Flow Coefficient			3	3					
Reuse Enabled	On	On	Off	Off					
Max drawdown height (m)	1.8	1.8							
Annual Demand Enabled	Off	Off	Off	Off					
Annual Demand Value (ML/year)									
Annual Demand Distribution									
Annual Demand Monthly Distribution: Jan									
Annual Demand Monthly Distribution: Feb									
Annual Demand Monthly Distribution: Mar									
Annual Demand Monthly Distribution: Apr									
Annual Demand Monthly Distribution: May									
Annual Demand Monthly Distribution: Jun									
Annual Demand Monthly Distribution: Jul									
Annual Demand Monthly Distribution: Aug									
Annual Demand Monthly Distribution: Sep									
Annual Demand Monthly Distribution: Oct									
Annual Demand Monthly Distribution: Nov									
Annual Demand Monthly Distribution: Dec									
Daily Demand Enabled	On	On	Off	Off					
Daily Demand Value (ML/day)	0.00173	0.00341							
Custom Demand Enabled	Off	Off	Off	Off					
Custom Demand Time Series File									
Custom Demand Time Series Units									
Filter area (sqm)			1100	2050					
Filter perimeter (m)			0.01	0.01					
Filter depth (m)			0.6	0.6					
Filter Median Particle Diameter (mm)									

Saturated Hydraulic Conductivity (mm/hr)			100	100						
Infiltration Media Porosity			0.35	0.35						
Length (m)										
Bed slope										
Base Width (m)										
Top width (m)										
Vegetation height (m)										
Vegetation Type			Vegetated with Effective Nutrient	Vegetated with Effective Nutrient Removal Plants						
Total Nitrogen Content in Filter (mg/kg)			400	400						
Orthophosphate Content in Filter (mg/kg)			40	40						
Is Base Lined?			Yes	Yes						
Is Underdrain Present?			Yes	Yes						
Is Submerged Zone Present?			No	No						
Submerged Zone Depth (m)										
B for Media Soil Texture	-9999	-9999	13	13						
Proportion of upstream impervious area treated										
Exfiltration Rate (mm/hr)	0	0	0	0						
Evaporative Loss as % of PET	0	0	100	100						
Depth in metres below the drain pipe										
TSS A Coefficient										
TSS B Coefficient										
TP A Coefficient										
TP B Coefficient										
TN A Coefficient										
TN B Coefficient										
Sfc			0.61	0.61						
S*			0.37	0.37						
Sw			0.11	0.11						
Sh			0.05	0.05						
Emax (m/day)			0.008	0.008						
Ew (m/day)			0.001	0.001						
IN - Mean Annual Flow (ML/yr)	19	37.3	121	315						
IN - TSS Mean Annual Load (kg/yr)	494	976	1.51E+04	4.20E+04						
IN - TP Mean Annual Load (kg/yr)	2.9	5.74	32	76.4						
IN - TN Mean Annual Load (kg/yr)	41.9	81.8	213	573						
IN - Gross Pollutant Mean Annual Load (kg/yr)	465	915	270	2.06E+03						
OUT - Mean Annual Flow (ML/yr)	18.5	36.3	118	309						
OUT - TSS Mean Annual Load (kg/yr)	471	926	3.05E+03	1.17E+04						
OUT - TP Mean Annual Load (kg/yr)	2.81	5.54	12.9	38.9						
OUT - TN Mean Annual Load (kg/yr)	40.6	79.2	125	380						
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0	0	0	0						
Flow In (ML/yr)	18.979	37.3334	121.314	314.269						
ET Loss (ML/yr)	0	0	3.03093	5.56207						
Infiltration Loss (ML/yr)	0	0	0	0						
Low Flow Bypass Out (ML/yr)	0	0	0	0						
High Flow Bypass Out (ML/yr)	0	0	0	0						
Orifice / Filter Out (ML/yr)	14.6717	29.8088	76.4647	159.677						
Weir Out (ML/yr)	3.82094	6.51193	41.8958	149.307						
Transfer Function Out (ML/yr)	0	0	0	0						
Reuse Supplied (ML/yr)	0.487884	1.01608	0	0						
Reuse Requested (ML/yr)	0.627724	1.25223	0	0						
% Reuse Demand Met	77.7227	81.1416	0	0						
% Load Reduction	2.56262	2.7125	2.43484	1.68175						
TSS Flow In (kg/yr)	493.886	976.484	15097.5	41977.9						
TSS ET Loss (kg/yr)	0	0	0	0						
TSS Infiltration Loss (kg/yr)	0	0	0	0						
TSS Low Flow Bypass Out (kg/yr)	0	0	0	0						
TSS High Flow Bypass Out (kg/yr)	0	0	0	0						
TSS Orifice / Filter Out (kg/yr)	374.554	763.746	153.04	338.641						
TSS Weir Out (kg/yr)	96.1806	162.146	2894.67	11373.1						
TSS Transfer Function Out (kg/yr)	0	0	0	0						
TSS Reuse Supplied (kg/yr)	8.06502	16.66	0	0						
TSS Reuse Requested (kg/yr)	0	0	0	0						
TSS % Reuse Demand Met	0	0	0	0						
TSS % Load Reduction	4.6876	5.18104	79.8132	72.1001						
TP Flow In (kg/yr)	2.89971	5.73751	31.9368	76.239						
TP ET Loss (kg/yr)	0	0	0	0						

TP Infiltration Loss (kg/yr)	0	0	0	0					
TP Low Flow Bypass Out (kg/yr)	0	0	0	0					
TP High Flow Bypass Out (kg/yr)	0	0	0	0					
TP Orifice / Filter Out (kg/yr)	2.22411	4.52445	4.1339	8.89633					
TP Weir Out (kg/yr)	0.583268	1.01462	8.77086	29.995					
TP Transfer Function Out (kg/yr)	0	0	0	0					
TP Reuse Supplied (kg/yr)	0.0675258	0.139705	0	0					
TP Reuse Requested (kg/yr)	0	0	0	0					
TP % Reuse Demand Met	0	0	0	0					
TP % Load Reduction	3.18418	3.45864	59.5929	48.9876					
TN Flow In (kg/yr)	41.8694	81.7804	213.174	571.875					
TN ET Loss (kg/yr)	0	0	0	0					
TN Infiltration Loss (kg/yr)	0	0	0	0					
TN Low Flow Bypass Out (kg/yr)	0	0	0	0					
TN High Flow Bypass Out (kg/yr)	0	0	0	0					
TN Orifice / Filter Out (kg/yr)	32.2309	65.1499	46.2711	96.8258					
TN Weir Out (kg/yr)	8.38448	14.012	79.0956	282.692					
TN Transfer Function Out (kg/yr)	0	0	0	0					
TN Reuse Supplied (kg/yr)	0.9891	2.03625	0	0					
TN Reuse Requested (kg/yr)	0	0	0	0					
TN % Reuse Demand Met	0	0	0	0					
TN % Load Reduction	2.99508	3.20187	41.1905	33.6363					
GP Flow In (kg/yr)	465.39	915.195	269.916	2059.42					
GP ET Loss (kg/yr)	0	0	0	0					
GP Infiltration Loss (kg/yr)	0	0	0	0					
GP Low Flow Bypass Out (kg/yr)	0	0	0	0					
GP High Flow Bypass Out (kg/yr)	0	0	0	0					
GP Orifice / Filter Out (kg/yr)	0	0	0	0					
GP Weir Out (kg/yr)	0	0	0	0					
GP Transfer Function Out (kg/yr)	0	0	0	0					
GP Reuse Supplied (kg/yr)	0	0	0	0					
GP Reuse Requested (kg/yr)	0	0	0	0					
GP % Reuse Demand Met	0	0	0	0					
GP % Load Reduction	100	100	100	100					
PET Scaling Factor			2.1	2.1					
Generic treatment nodes									
Location	Humegard 2015	Humegard 2015							
ID	10	17							
Node Type	GPTNode	GPTNode							
Lo-flow bypass rate (cum/sec)	0	0							
Hi-flow bypass rate (cum/sec)	0.49	0.49							
Flow Transfer Function									
Input (cum/sec)	0	0							
Output (cum/sec)	0	0							
Input (cum/sec)	10	10							
Output (cum/sec)	10	10							
Input (cum/sec)									
Output (cum/sec)									
Input (cum/sec)									
Output (cum/sec)									
Input (cum/sec)									
Output (cum/sec)									
Input (cum/sec)									
Output (cum/sec)									
Input (cum/sec)									
Output (cum/sec)									
Input (cum/sec)									
Output (cum/sec)									
Input (cum/sec)									
Output (cum/sec)									
Input (cum/sec)									
Output (cum/sec)									
Gross Pollutant Transfer Function									
Enabled	TRUE	TRUE							
Input (kg/ML)	0	0							
Output (kg/ML)	0	0							

Input (kg/ML)	14.9664	14.9664							
Output (kg/ML)	2.2499	2.2499							
Input (kg/ML)									
Output (kg/ML)									
Input (kg/ML)									
Output (kg/ML)									
Input (kg/ML)									
Output (kg/ML)									
Input (kg/ML)									
Output (kg/ML)									
Input (kg/ML)									
Output (kg/ML)									
Input (kg/ML)									
Output (kg/ML)									
Input (kg/ML)									
Output (kg/ML)									
Input (kg/ML)									
Output (kg/ML)									
Total Nitrogen Transfer Function									
Enabled	TRUE	TRUE							
Input (mg/L)	0	0							
Output (mg/L)	0	0							
Input (mg/L)	5	5							
Output (mg/L)	3.8	3.8							
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Total Phosphorus Transfer Function									
Enabled	TRUE	TRUE							
Input (mg/L)	0	0							
Output (mg/L)	0	0							
Input (mg/L)	5	5							
Output (mg/L)	3.3	3.3							
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Input (mg/L)									
Output (mg/L)									
Total Suspended Solids Transfer Function									
Enabled	TRUE	TRUE							
Input (mg/L)	0	0							
Output (mg/L)	0	0							
Input (mg/L)	500	500							

Output (mg/L)	295	295								
Input (mg/L)										
Output (mg/L)										
Input (mg/L)										
Output (mg/L)										
Input (mg/L)										
Output (mg/L)										
Input (mg/L)										
Output (mg/L)										
Input (mg/L)										
Output (mg/L)										
Input (mg/L)										
Output (mg/L)										
Input (mg/L)										
Output (mg/L)										
Input (mg/L)										
Output (mg/L)										
TSS Flow based Efficiency Enabled	Off	Off								
TSS Flow based Efficiency										
TP Flow based Efficiency Enabled	Off	Off								
TP Flow based Efficiency										
TN Flow based Efficiency Enabled	Off	Off								
TN Flow based Efficiency										
GP Flow based Efficiency Enabled	Off	Off								
GP Flow based Efficiency										
IN - Mean Annual Flow (ML/yr)	94.6	315								
IN - TSS Mean Annual Load (kg/yr)	2.14E+04	5.82E+04								
IN - TP Mean Annual Load (kg/yr)	40	98.8								
IN - TN Mean Annual Load (kg/yr)	221	683								
IN - Gross Pollutant Mean Annual Load (kg/yr)	1.43E+03	6.73E+03								
OUT - Mean Annual Flow (ML/yr)	94.6	315								
OUT - TSS Mean Annual Load (kg/yr)	1.36E+04	4.20E+04								
OUT - TP Mean Annual Load (kg/yr)	28	76.4								
OUT - TN Mean Annual Load (kg/yr)	174	573								
OUT - Gross Pollutant Mean Annual Load (kg/yr)	270	2.06E+03								
Flow In (ML/yr)	94.6321	314.269								
ET Loss (ML/yr)	0	0								
Infiltration Loss (ML/yr)	0	0								
Low Flow Bypass Out (ML/yr)	0	0								
High Flow Bypass Out (ML/yr)	10.9516	101.098								
Orifice / Filter Out (ML/yr)	0	0								
Weir Out (ML/yr)	0	0								
Transfer Function Out (ML/yr)	83.6794	213.367								
Reuse Supplied (ML/yr)	0	0								
Reuse Requested (ML/yr)	0	0								
% Reuse Demand Met	0	0								
% Load Reduction	0.00121576	-0.0625658								
TSS Flow In (kg/yr)	21377.1	58111.1								
TSS ET Loss (kg/yr)	0	0								
TSS Infiltration Loss (kg/yr)	0	0								
TSS Low Flow Bypass Out (kg/yr)	0	0								
TSS High Flow Bypass Out (kg/yr)	2397.09	18772.5								
TSS Orifice / Filter Out (kg/yr)	0	0								
TSS Weir Out (kg/yr)	0	0								
TSS Transfer Function Out (kg/yr)	11198.1	23220.6								
TSS Reuse Supplied (kg/yr)	0	0								
TSS Reuse Requested (kg/yr)	0	0								
TSS % Reuse Demand Met	0	0								
TSS % Load Reduction	36.403	27.7364								
TP Flow In (kg/yr)	39.9968	98.6099								
TP ET Loss (kg/yr)	0	0								
TP Infiltration Loss (kg/yr)	0	0								
TP Low Flow Bypass Out (kg/yr)	0	0								
TP High Flow Bypass Out (kg/yr)	4.70735	32.9089								
TP Orifice / Filter Out (kg/yr)	0	0								
TP Weir Out (kg/yr)	0	0								
TP Transfer Function Out (kg/yr)	23.2909	43.4069								

TP Reuse Supplied (kg/yr)	0	0							
TP Reuse Requested (kg/yr)	0	0							
TP % Reuse Demand Met	0	0							
TP % Load Reduction	29.9989	22.6084							
TN Flow In (kg/yr)	220.503	681.665							
TN ET Loss (kg/yr)	0	0							
TN Infiltration Loss (kg/yr)	0	0							
TN Low Flow Bypass Out (kg/yr)	0	0							
TN High Flow Bypass Out (kg/yr)	25.594	225.212							
TN Orifice / Filter Out (kg/yr)	0	0							
TN Weir Out (kg/yr)	0	0							
TN Transfer Function Out (kg/yr)	148.132	347.424							
TN Reuse Supplied (kg/yr)	0	0							
TN Reuse Requested (kg/yr)	0	0							
TN % Reuse Demand Met	0	0							
TN % Load Reduction	21.2138	15.9945							
GP Flow In (kg/yr)	1429.46	6730.06							
GP ET Loss (kg/yr)	0	0							
GP Infiltration Loss (kg/yr)	0	0							
GP Low Flow Bypass Out (kg/yr)	0	0							
GP High Flow Bypass Out (kg/yr)	72.5447	1319.38							
GP Orifice / Filter Out (kg/yr)	0	0							
GP Weir Out (kg/yr)	0	0							
GP Transfer Function Out (kg/yr)	197.369	740.055							
GP Reuse Supplied (kg/yr)	0	0							
GP Reuse Requested (kg/yr)	0	0							
GP % Reuse Demand Met	0	0							
GP % Load Reduction	94.925	80.3958							
Other nodes									
Location	Junction	Receiving Node							
ID	9	11							
Node Type	JunctionNode	ReceivingNode							
IN - Mean Annual Flow (ML/yr)	94.6	432							
IN - TSS Mean Annual Load (kg/yr)	2.14E+04	1.56E+04							
IN - TP Mean Annual Load (kg/yr)	40	53.2							
IN - TN Mean Annual Load (kg/yr)	221	516							
IN - Gross Pollutant Mean Annual Load (kg/yr)	1.43E+03	128							
OUT - Mean Annual Flow (ML/yr)	94.6	432							
OUT - TSS Mean Annual Load (kg/yr)	2.14E+04	1.56E+04							
OUT - TP Mean Annual Load (kg/yr)	40	53.2							
OUT - TN Mean Annual Load (kg/yr)	221	516							
OUT - Gross Pollutant Mean Annual Load (kg/yr)	1.43E+03	128							
% Load Reduction	1.06	2.28							
TSS % Load Reduction	0.236	81							
TN % Load Reduction	1.17	46.2							
TP % Load Reduction	0.494	63.2							
GP % Load Reduction	39	98.7							
Links									
Location	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link
Source node ID	1	4	5	7	9	10	6	8	13
Target node ID	2	5	9	9	10	8	8	11	11
Muskingum-Cunge Routing	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed
Muskingum K									
Muskingum theta									
IN - Mean Annual Flow (ML/yr)	19	37.3	36.3	58.3	94.6	94.6	26.8	118	309
IN - TSS Mean Annual Load (kg/yr)	494	976	926	2.05E+04	2.14E+04	1.36E+04	1.53E+03	3.05E+03	1.17E+04
IN - TP Mean Annual Load (kg/yr)	2.9	5.74	5.54	34.5	40	28	3.99	12.9	38.9
IN - TN Mean Annual Load (kg/yr)	41.9	81.8	79.2	141	221	174	39.7	125	380
IN - Gross Pollutant Mean Annual Load (kg/yr)	465	915	0	1.43E+03	1.43E+03	270	0	0	0
OUT - Mean Annual Flow (ML/yr)	19	37.3	36.3	58.3	94.6	94.6	26.8	118	309
OUT - TSS Mean Annual Load (kg/yr)	494	976	926	2.05E+04	2.14E+04	1.36E+04	1.53E+03	3.05E+03	1.17E+04
OUT - TP Mean Annual Load (kg/yr)	2.9	5.74	5.54	34.5	40	28	3.99	12.9	38.9
OUT - TN Mean Annual Load (kg/yr)	41.9	81.8	79.2	141	221	174	39.7	125	380
OUT - Gross Pollutant Mean Annual Load (kg/yr)	465	915	0	1.43E+03	1.43E+03	270	0	0	0

Catchment Details										
Catchment Name	Thornton MUSIC Model Combined_250620									
Timestep	6 Minutes									
Start Date	1/01/1998									
End Date	31/12/2007 23:54									
Rainfall Station	WILLIAMTOWN RAAF - Station 061078 - Zone C									
ET Station	User-defined monthly PET									
Mean Annual Rainfall (mm)	1238									
Mean Annual ET (mm)	1394									
MUSIC-link Area	Raymond Terrace									
MUSIC-link Scenario	Default Catchmen									