Engineering

ADW JOHNSON PTY LIMITED
ABN 62 129 445 398

Sydney
Level 35 One International Towers
100 Barangaroo Avenue
Sydney NSW 2000
02 8046 7411
sydney@adwjohnson.com.au

Central Coast
5 Pioneer Avenue
Tuggerah NSW 2259
02 4305 4300
coast@adwjohnson.com.au

Hunter Region
7/335 Hillsborough Road,
Warners Bay NSW 2282
02 4978 5100
hunter@adwjohnson.com.au

Stormwater Management Report

Proposed Residential Subdivision
Precinct A1

Property:
464 Cessnock Road, Gillieston Heights

Applicant:
Loxford Project Management Pty Ltd

Date:
February 2021

Working Beyond Expectations

Project Management • Town Planning • Engineering • Surveying
Visualisation • Social Impact • Urban Planning

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Document Control Sheet

Issue No.	Amendment	Date	Prepared By	Checked By
A	Initial Issue	February 2022	R Brown	R Kerr

Executive Summary

ADW Johnson has been engaged by Loxford Project Management Pty Ltd to complete a Stormwater Management Report to accompany the Development Application for a proposed residential subdivision along 464 Cessnock Road, Gillieston Heights. The development will contain 342 residential lots.

The strategy requires the assessment of the potential impacts on water quality, water quantity, effects to downstream wetlands and assessment of flooding for local overland flows and accessibility during flood events.

The objective of this report is to take a holistic approach to the treatment of stormwater runoff from the development for both quality and quantity purposes.

The methodology employed was to treat all stormwater within the limits of the development in order to maintain receiving waters in their current state. All water quality and quantity modelling has been completed based on the information provided by the client prior to lodgement of the Development Application.

Modelling indicated that stormwater detention basins will be required to attenuate storm flows to pre-development conditions. The detention basins were sized to determine the volumes of stormwater to be detained. The proposed location and footprint for these basins has also been identified based on these requirements.

An analysis of the Maitland City Council flood map showed no potential risk of flooding to the development given the RL's of the existing and potential future site.

The stormwater quality model utilised a treatment train approach which included rainwater tanks, gross pollutant traps and bioretention basins. The results of the modelling indicated the reduction in pollutant loads and peak discharge entering receiving waters meet their target objectives.

The study has concluded that with appropriate controls stormwater can be adequately managed for the site. Hence, stormwater management does not prevent the development of the site.

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1.0 Introduction

ADW Johnson has been engaged by Loxford Project Management Pty Ltd to complete a Stormwater Management Report to accompany the Development Application for a proposed residential subdivision along 464 Cessnock Road, Gillieston Heights. The development will contain 342 residential lots.

The site location is shown below in Figure 1.1: Site Location. The site fronts Cessnock Road and is situated to the south of Gillieston Heights Town Centre.

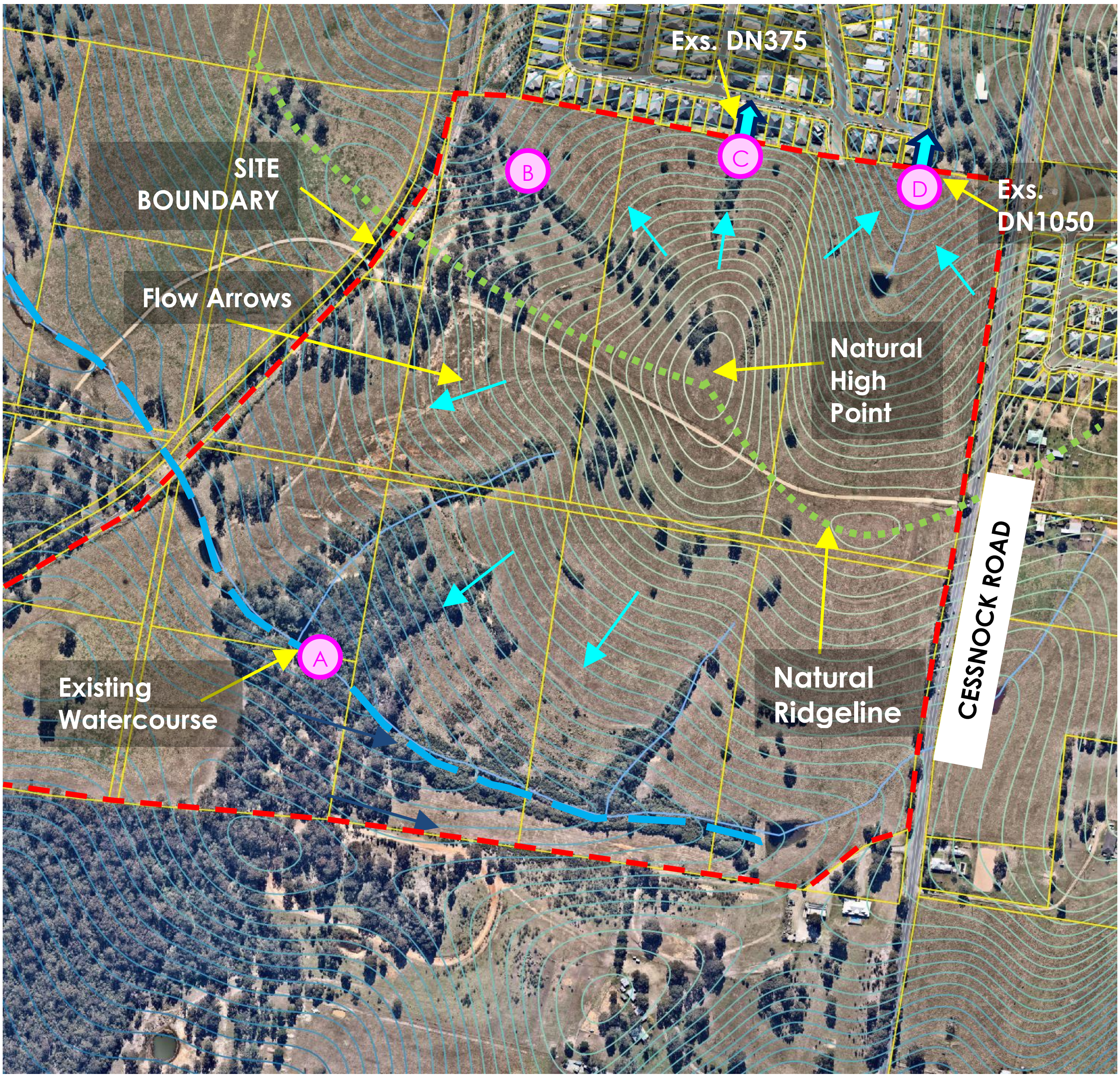

Figure 1.1: Site Location
(Source: Nearmap)

This report will cover localised flooding, water quality, stormwater detention and total water management of the site based on the requirements of Maitland City Council's Guidelines.

1.1 EXISTING SITE

The site is bounded by existing rural properties to the south, an existing subdivision to the North and Cessnock Road to the East. An existing rail corridor separates the development site from Wentworth Wetlands to the West.

The majority of the preliminary development area can be classified as fully pervious.

Site slopes within the development area are in the range of 3-15%. The existing site is primarily cleared open pasture with the exception of some scattered trees and more dense vegetation along the existing watercourse in the south of the site.

Review of Maitland City Council's Local Environmental Planning (LEP) mapping, the site is mapped as Class 5 and therefore there is low probability for the occurrence of acid sulphate soils through the site.

There are three (3) mapped first order watercourses and a single second order watercourse within the site. The first order watercourses are minor topographical depressions and have of little to no existing vegetated riparian zones. As such, these mapped watercourses are expected to be declassified, regraded and developed.

The development site is within the Wentworth Wetlands catchment with all stormwater runoff ultimately being conveyed there via four (4) different site discharge locations. These are labelled 'A' to 'D' in Figure 1.1.

The existing catchments as shown in Exhibit 001 are described as:

- Catchment A - Southern Catchment (shown by orange hatching)

  Stormwater runoff from the existing site is split in half by a natural ridgeline that runs East-West where all runoff South of this ridgeline drains to the existing second order watercourse in the southern section of the development site. This watercourse conveys runoff from catchments upstream of the site to the existing culverts under the rail corridor and towards Wentworth wetlands. The general location of the watercourses can be seen in Figure 1.1: Site Location.

- Catchment B - North Western Catchment (shown by purple hatching)

  All site runoff North of the main ridgeline concentrates in natural gullies drains to three discrete discharge locations. Catchment B concentrates in a natural gully prior to leaving site in an existing channel.

- Catchment C - Central North Catchment (shown by blue hatching)

  This Catchment concentrates in a natural gully and drains towards an existing 3m wide drainage corridor between two existing residential lots. A DN375 pipe and 1.5m concrete lined channel have been provided for connection.

- Catchment D - North Eastern Catchment (shown by green hatching)

  Catchment D concentrates in a natural gully and drains towards an existing 6m wide drainage corridor between two existing residential lots. A DN1050 pipe and grass lined swale has been provided for connection.

1.2 PROPOSED DEVELOPMENT

The proposed residential subdivision as depicted in Figure 1.2 will contain 342 lots comprising of 342 residential lots, 7 lots transferred to Council to be maintained as dedicated drainage reserves and 3 residue lots.

The stormwater management system designed for the development consists of a combination of pit and pipe networks and WSUD elements to convey runoff from the site and the upstream catchments to the four discharge locations as described in section 1.1.

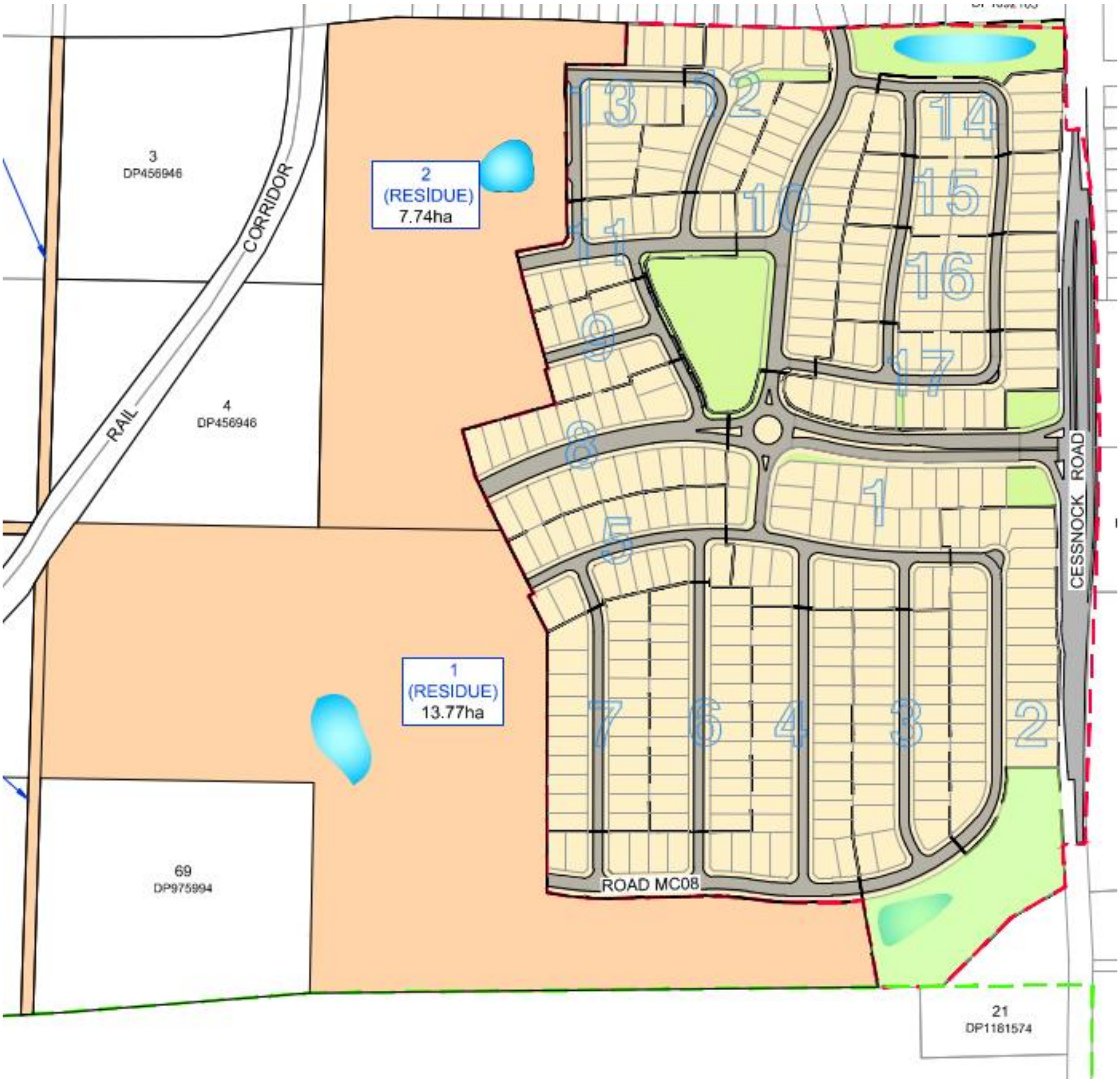

Figure 1.2: Proposed Development

2.0 Requirements

Stormwater management within the proposed development is designed to comply with Maitland City Council (MCC) documents including:

- MCC Manual of Engineering Standards – Stormwater (MOES);
- MCC Development Control Plan (DCP) 2011 – Part B.3 – Hunter River Floodplain Management;
- MCC Development Control Plan (DCP) 2011 – Part B.7 – Riparian Land and Waterways.

2.1 HYDROLOGY

Impervious fractions have been adopted from MOES and have been determined based on the proposed land usage. These impervious percentages can be found in
Table 2.1 below.

Table 2.1: Fraction Impervious Rates for Land Uses

LAND USE	PERCENTAGE IMPERVIOUS (%)
Residential Lot	60
Road Reserve	70
Public Recreation Areas	50

2.2 CONCEPT STORMWATER DESIGN

A concept stormwater design is required to demonstrate that stormwater runoff can be effectively conveyed from the proposed development to the existing discharge locations. The stormwater design is required to consider upstream catchments, drainage of both the lots and roads, and dispersal of flows via stabilized outlets to prevent scour of existing creek beds.

In accordance with MOES Section 3.2 "Recurrence Interval" - the pit and pipe network will need to be designed to cater for the minor storm event (10% AEP) without any surcharging within the system and minimising flow widths and ponding. Overland flow paths are to be designed to cater for the 1% AEP storm event.

The concept stormwater layout can be found in the concept engineering plans.

2.3 STORMWATER DETENTION

Where post-development peak runoff exceeds pre-development peaks, on-site stormwater detention systems may be required to reduce flooding of downstream. These detention devices attenuate peak post-development flow rates to pre-development peak flow rates for the critical duration for design storms with annual exceedance probabilities (AEPs) ranging from 63.2% to 1%.

2.4 STORMWATER QUALITY / WATER SENSITIVE URBAN DESIGN

The stormwater drainage system must effectively remove the nutrients and gross pollutants from the site prior to the runoff entering the existing downstream waterways.

The stormwater design for the proposed subdivision is to adopt Water Sensitive Urban Design

(WSUD) principles throughout the development to promote sustainable and integrated land and water resource management.

The guidelines for stormwater quality treatment objectives are expressed as mean annual reductions of pollutant loads. The target objectives were obtained from the MCC Manual of Engineering Standards – Stormwater and can be found in Table 2.2.

Table 2.2: Stormwater Treatment Objectives

Pollutant	Stormwater Treatment Objectives
Gross Pollutants > 5mm	70% retention of the average annual load
Suspended Solids	80% retention of the average annual load
Total Phosphorus	45% retention of the average annual load
Total Nitrogen	45% retention of the average annual load
Litter > 50mm	Retention up to the 3 mth peak flow
Oil and Grease	90% retention of the average annual load

2.5 EROSION AND SEDIMENTATION CONTROL

Erosion and sedimentation control measures need to be implemented during any construction activities on the proposed subdivision to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the construction site to downstream drainage. A sediment and erosion control plan has been prepared and can be found within the concept engineering plans.

3.0 Regional Mapping

3.1 REGIONAL FLOOD MODELLING

NSW Government Planning Portal (ePlanning) online flood mapping has been assessed for the site. The flood mapping shows the site is not flood affected. A screenshot of the flood map for the area is shown in Figure 3.1 below.

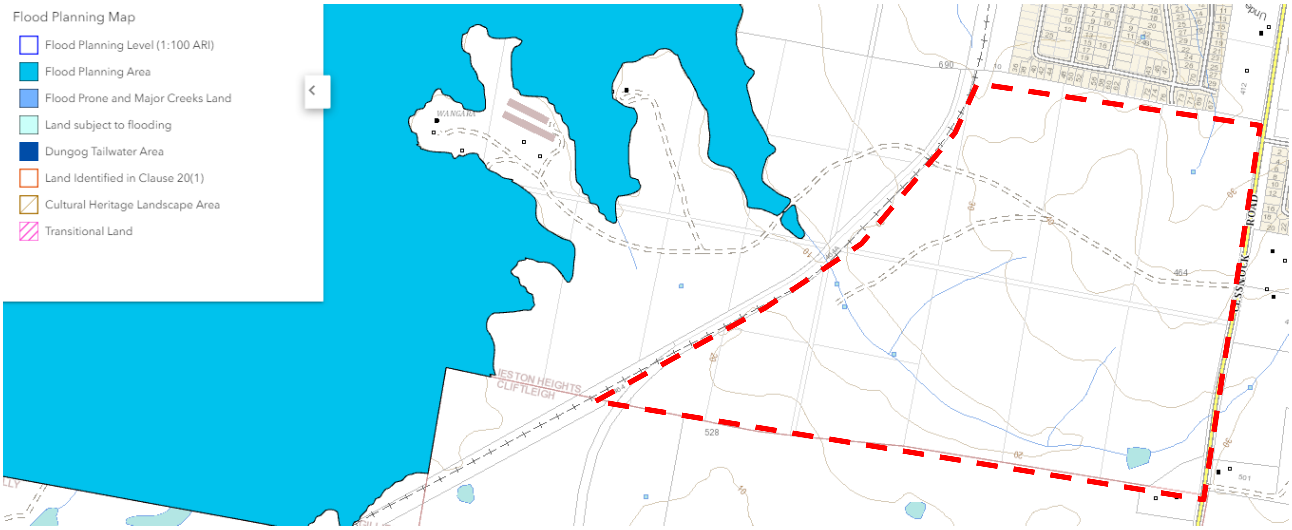

Figure 3.1: Screenshot of the Online Flood Map
(Source: NSW Government Planning Portal)

3.2 WETLAND MANAGEMENT

NSW Government Planning Portal (ePlanning) online SEPP (Coastal Management) 2018 mapping has been assessed for the site.

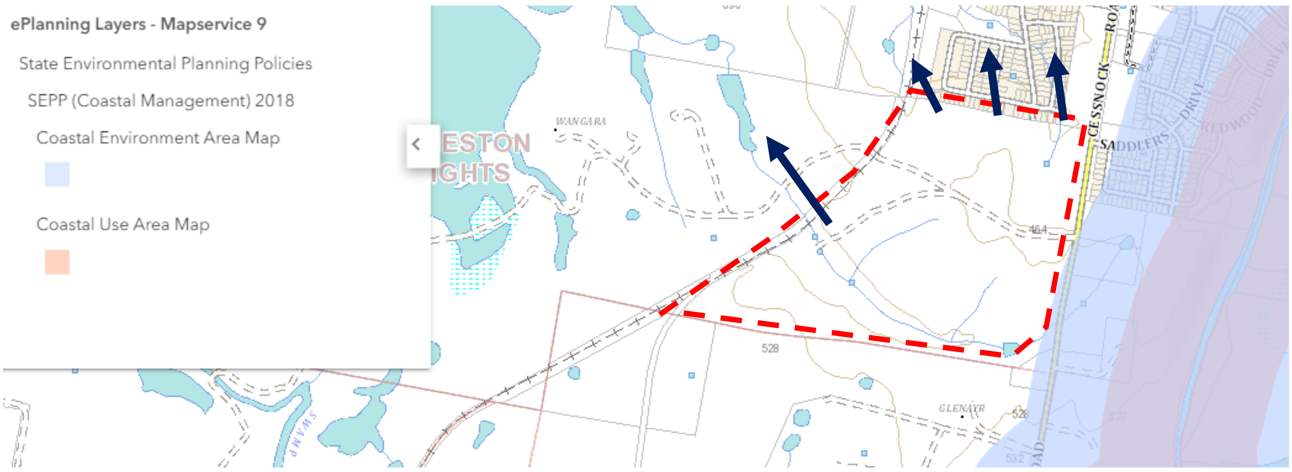

Figure 3.2: Screenshot of the Coastal Wetlands Extents
(Source: NSW Government Planning Portal)

Stormwater discharge from the proposed development will be directed towards the Wentworth Wetlands which is not included within the SEPP (Coastal Management) 2018 mapped area. The proposed stormwater management strategy incorporates WSUD elements to limit pollutant runoff from the site to meet the target objectives mentioned in Section 2.0 Table 2.2.

4.0 Stormwater Management Strategy

As described in Section 1.0, the site comprises of site grades that generally range from 3-15%. This allows for a limited selection of water quality treatment devices within the overall treatment train.

The proposed stormwater system contains a combination of conventional pit and pipe networks and WSUD elements to effectively convey stormwater runoff to the downstream waterways.

The following water quality/quantity treatment devices have been proposed:

- Rainwater Tanks

  Rainwater tanks will be utilised for each lot, meeting the general requirements of Maitland City Council and BASIX. Rainwater tanks will reduce potable water demand as well as having additional benefits in terms of reducing the volume of flow as well as pollutant loads being directed towards the downstream stormwater system.

- Gross Pollutant Traps (GPTs)

  The use of GPTs will be utilised in the development to treat stormwater runoff and reduce pollutant loads being directed towards the downstream stormwater system.

- Ponds/Sediment Basins

  Ponds will be utilised in the development as the downstream water quality treatment device. The ponds will also act as detention basins to allow post-development flows to be reduced to pre-development flows as stormwater runoff is discharged from the site towards the existing downstream stormwater system.

- Bioretention Basins

  Bioretention basins will be utilised in the development as the downstream water quality treatment device. The bioretention basins will also act as detention basins to allow post-development flows to be reduced to pre-development flows as stormwater runoff is discharged from the site towards the existing downstream stormwater system

5.0 Stormwater Detention

The proposed stormwater system has been designed to protect downstream properties and infrastructure from increased stormwater flows as a result of the development. To ensure there are no adverse impacts on the downstream properties and infrastructure, the stormwater system has to be designed to ensure that the peak flow rate of stormwater runoff post-development flows leaving the site are less than the pre-development peak flows for all and storm durations for the 63.2%, 10%, and 1% AEP storm events.

As the development of the site will result in an increased impervious area, on-site detention will be required to reduce the peak median flows back to existing conditions.

The proposed stormwater system, as detailed in Section 4.0, uses a combination of pit and pipe networks and WSUD elements to capture and convey stormwater runoff from the site.

The subject site is subdivided into a series of sub-catchments for the post development scenarios. Parameters of sub-catchment areas, imperviousness, and times of concentration are used to simulate the catchment response to storm events to generate hydrographs and estimate the peak median discharge flows.

5.1 MODELLING PARAMETERS

The stormwater management reports for the existing adjacent developments were sourced and the same hydrological model and parameters were adopted to improve standardization.

Catchment runoff hydrology was simulated using the ILSAX Hydrological model with the following modelling parameters.

5.1.1 Rainfall Data

Rainfall data was retrieved from the Maitland City Council MOES Appendix C.

5.1.2 Surface Roughness Coefficient 'n*'

There are two flow components considered when calculating the time of concentration for each sub-catchment - A constant component and a kinematic wave calculation component. The surface roughness coefficient 'n*' is required for the kinematic wave component.

This value is adjusted to represent the different response of rural and urbanised catchments, impervious and pervious surfaces. Values of Surface Roughness Coefficient 'n*' have been adopted from MOES Section 3.7.2 "Coefficient of Roughness".

5.1.1 Loss Model

The ILSAX loss model with utilises Horton infiltration curves was used to determine the rainfall excess hydrograph. The parameters for this loss model are shown in Table 5.1 and have been adopted from PCB report "Stormwater Management Report for Proposed Residential Development, 411 Cessnock Road, Gillieston Heights" dated February 2021.

Table 5.1: ILSAX Loss Model Parameters

Parameter	Value
Soil Type	3.5
Antecedent Moisture Content	4
Grassed Depression storage	5mm
Paved Depression storage	1mm

5.1.3 Catchments

The pre-development catchment areas were determined via detailed survey, Lidar contours, and site inspection.

The post-development catchment areas for the site were determined based on the topography of the site, proposed subdivision layout and discharge locations.

The pre and post-development catchments and the respective parameters can be seen in Table 5.2 and Table 5.3 respectively.

Table 5.2: Pre-Development Catchment Details

Catchment Name	Area (Ha)	Impervious Area (Ha)	Pervious Area (Ha)	Percentage Impervious (%)	Slope (%)	Roughness Coefficient n*	
						Perv.	Imperv.
Pre A2 Cat	27.82	0	27.82	0	6	0.4	-
Pre A3 Cat	21.68	1.3	20.38	6	4.5	0.4	0.02
Pre B Cat	2.69	0	2.69	0	7	0.4	-
Pre C Cat	1.94	0	1.94	0	6	0.4	-
Pre D Cat	9.88	0	9.88	0	8	0.4	-
Total Pre-developed	**64.01**	**1.3**	**62.71**				

Table 5.3: Post-Development Catchment Details

Catchment	Area (Ha)	Impervious Area (Ha)	Pervious Area (Ha)	Percentage Impervious (%)	Slope (%)	Roughness Coefficient n*	
						Perv.	Imperv.
Post Basin A2 Cat	16.58	6.96	9.62	42	5	0.35	0.02
Post Ext A2 Cat	9.65	0	9.65	100	6	0.35	0.02
Post Basin A3 Cat	6.28	3.96	2.32	63	5	0.35	0.02
Post Ext A3 Cat	17.651	0.706	16.945	4	4	0.35	0.02
Post B Cat	3.31	1.56	1.75	47	5	0.35	0.02
Post C Cat	0.405	0.243	0.162	60	5	0.35	0.02
Post D Cat	10.61	6.26	4.35	59	4	0.35	0.02
Total Developed	**64.49**	**19.69**	**44.80**				

5.1.4 Basin Data

The volumes and outlet configuration of the detention basins have been modelled using DRAINS to ensure that the peak discharge flows leaving the site are less than or equal to the pre-development flows at each of the discharge locations.

The details for the basins can be seen in Table 5.4 to Table 5.67

Table 5.4: Basin A2 Data

Basin Parameter	Detail
Base RL	RL 14.00m
Weir RL	RL 15.30m
Crest of Embankment RL	RL 15.80m
Outlet Controls	1500 x 1500 RGSIP – RL 14.30m
	10m Weir RL 15.30m
Total Storage at 1% AEP Stage	2046m³
1% AEP Storage Stage R.L. (m)	RL 15.55m

Table 5.5: Basin A3 Data

Basin Parameter	Detail
Base RL	RL 21.7m
Weir RL	RL 23.2m
Crest of Embankment RL	RL 23.5m
Outlet Controls	Twin DN1200mm pipes – IL 12.7m
Total Storage at 1% AEP Stage	3181m³
1% AEP Storage Stage R.L. (m)	RL 22.97m

Table 5.6: Basin B Data

Basin Parameter	Detail
Base RL	RL 28.00m
Weir RL	RL 29.50m
Crest of Embankment RL	RL 29.80m
Outlet Controls	DN300 pipe – IL 28.00m
	DN450 pipe – IL 28.60m
Total Storage at 1% AEP Stage	940m³
1% AEP Storage Stage R.L. (m)	RL 29.38m

Table 5.7: Basin D Data

Basin Parameter	Detail
Base RL	RL 17.359m
Weir RL	RL 18.859m
Crest of Embankment RL	RL 19.159m
Outlet Controls (Refer Figure 5.1)	Twin DN450 pipes – IL 17.559m (100mm High weir across headwall RL 17.659)
	2.2m Weir Control (Pit Cutout) – IL 18.209
	2.4m Weir Control (Top of Pit) – 18.609
Total Storage at 1% AEP Stage	2799m³
1% AEP Storage Stage R.L. (m)	RL 18.849m

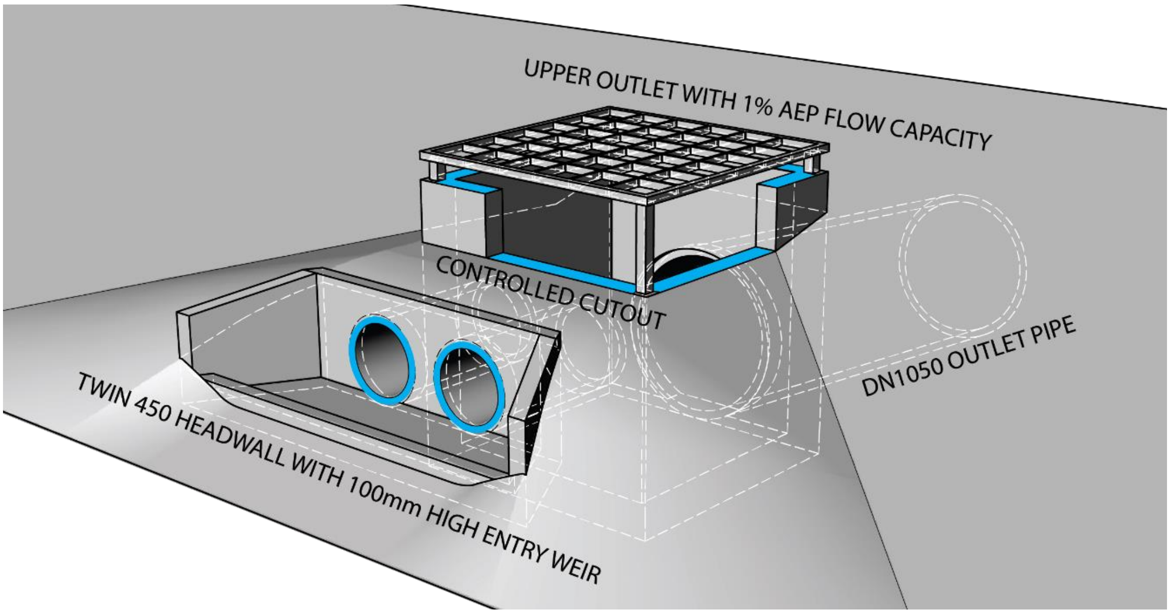

Figure 5.1: Basin D Outlet Control Structure

5.2 RESULTS

A summary of the results for the pre and post-development DRAINS analysis for each catchment can be seen in the following tables.

Table 5.8: DRAINS Peak Flow Pre and Post-Development for Discharge Point A

AEP	Peak Discharge Pre-Development (m^3/s)	Critical Storm Duration	Peak Discharge Post-Development Detained (m^3/s)	Critical Storm Duration
63.2%	2.293	90min	2.171	120min
10%	6.710	60min	6.473	60min
1%	11.693	60min	10.512	60min

Table 5.9: DRAINS Peak Flow Pre and Post-Development for Discharge Point B

AEP	Peak Discharge Pre-Development (m^3/s)	Critical Storm Duration	Peak Discharge Post-Development Detained (m^3/s)	Critical Storm Duration
63.2%	0.145	60min	0.132	120min
10%	0.435	60min	0.432	60min
1%	0.776	25min	0.588	60min

Table 5.10: DRAINS Peak Flow Pre and Post-Development for Discharge Point C

AEP	Peak Discharge Pre-Development (m^3/s)	Critical Storm Duration	Peak Discharge Post-Development Detained (m^3/s)	Critical Storm Duration
63.2%	0.100	60min	0.082	25min
10%	0.305	60min	0.159	25min
1%	0.537	25min	0.225	15min

Table 5.11: DRAINS Peak Flow Pre and Post-Development for Discharge Point D

AEP	Peak Discharge Pre-Development (m^3/s)	Critical Storm Duration	Peak Discharge Post-Development Detained (m^3/s)	Critical Storm Duration
63.2%	0.563	60min	0.547	120min
10%	1.645	60min	1.616	120min
1%	2.926	25min	2.754	120min

From the results, it can be seen that the post-development flows for all storm events are less than the existing flows leaving the site.

For the complete results for both the pre and post-development analysis refer to Appendix B.

6.0 Discharge Point 'D' Discussion

The legal point of discharge for Catchment D is the existing 6m wide council drainage corridor, Lot 610 DP1245051. The contributing catchment for this existing drainage corridor is comprised of the total of Catchment D and an external catchment proposed to be routed around the proposed Basin D via an existing overland drainage flowpath. This external catchment features a component from Wallis Creek development on the East of Cessnock Road drains through existing culvert towards a natural watercourse.

The existing Gillieston Grove development has significantly altered the levels and direction of the natural watercourse. The natural, existing and proposed aspects of this drainage corridor are discussed below.

6.1 BACKGROUND REPORTING

The adjacent developments to the North (Gillieston Grove) and East (Wallis Creek) have had numerous reports and drainage models that analyse the runoff routed through the drainage corridor. These reports have been utilised to calibrate the drainage model and provide inputs for incoming flows from the Wallis Creek catchment.

6.2 NATURAL FLOWPATH

Figure 6.1 shows the contours from a lidar survey in 2012 overlaid on an aerial image from 25/11/2010. From the contours and the vegetation colour, it can be seen that the natural flow path from the existing Cessnock Road culvert is approximately 20m wide and traverses along the boundary of Lot 22 DP1092105 and Lot 1 DP456946, with the majority of its flow width within the northern lot.

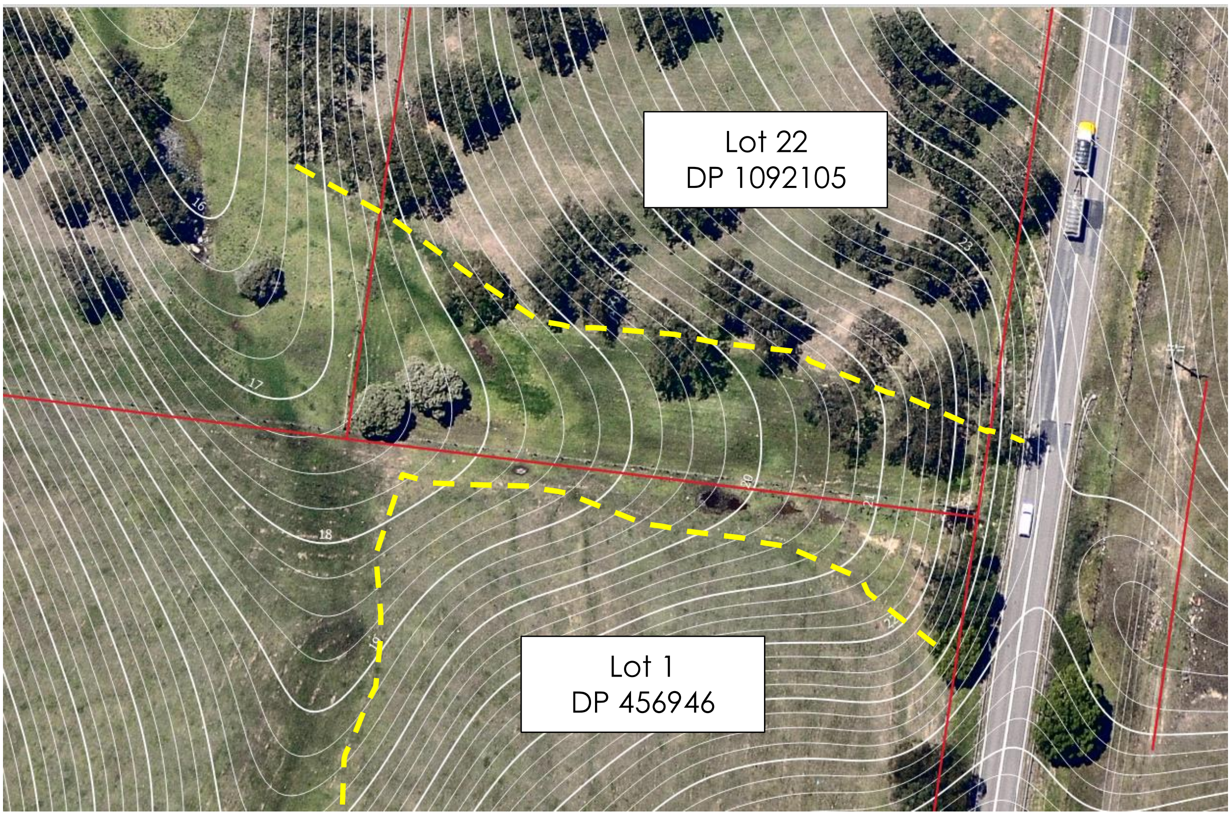

Figure 6.1: Natural Flow path Aerial
(Source: Nearmap)

The catchment runoff discharging to the existing Cessnock Road culvert has been modelled by PCB in the report "Stormwater Management Report for Proposed Residential Development, 411 Cessnock Road, Gillieston Heights, February 2021" and was provided to ADWJ by Maitland Council for reference. The peak flow rates from this report are tabulated below.

Table 6.1: DRAINS Peak Flow Pre and Post-Development for Discharge Point D

AEP	Pre-developed Flow (m³/s)	Post-developed Flow (m³/s)
63.2%	0.206	0.205
10%	1.627	1.469
1%	2.368	2.300

The 1% peak flow rate, and the 2010 Lidar contours were used to create a 1-dimensional model to determine the natural flow path of discharge from the culvert through Lot 22 DP1092105 and Lot 1 DP456946.

A diagram of the results is shown below.

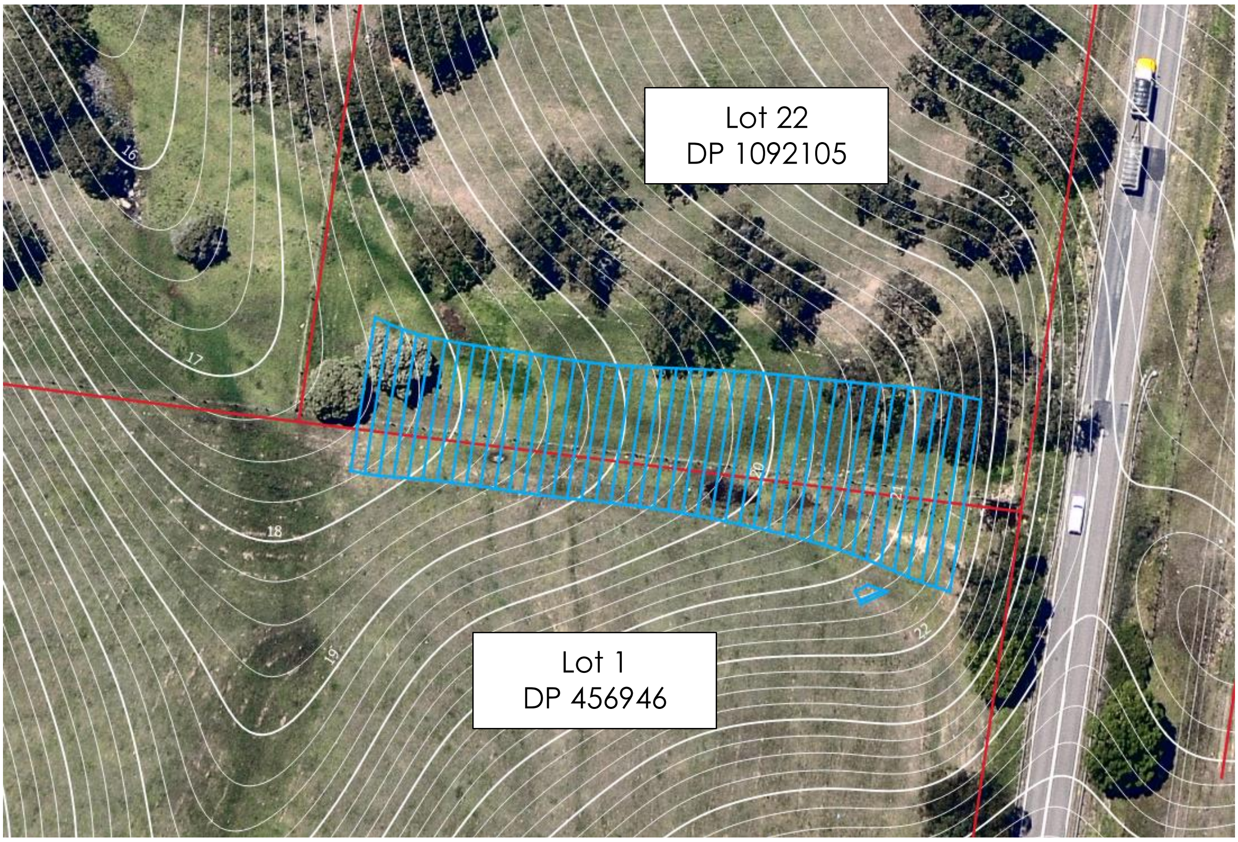

Figure 6.2: Existing Drainage Corridor Aerial
Source: Nearmap

It can be seen that approximately 60% of the flow path is located within the adjacent Lot 22 DP1092105.

6.3 EXISTING COUNCIL DRAINAGE CORRIDOR CONDITIONS

The existing drainage corridor has been designed to accept flows from the proposed catchment D, and the external catchments comprising of a portion of Lot 22 DP1092105, Cessnock Road and the Wallis Creek catchment via the DN900 Cessnock Road crossing. A recent aerial image of the drainage corridor is shown in Figure 6.3 and the cross section is shown in Figure 6.4 below.

Figure 6.3: Existing Drainage Corridor Aerial
Source: Nearmap

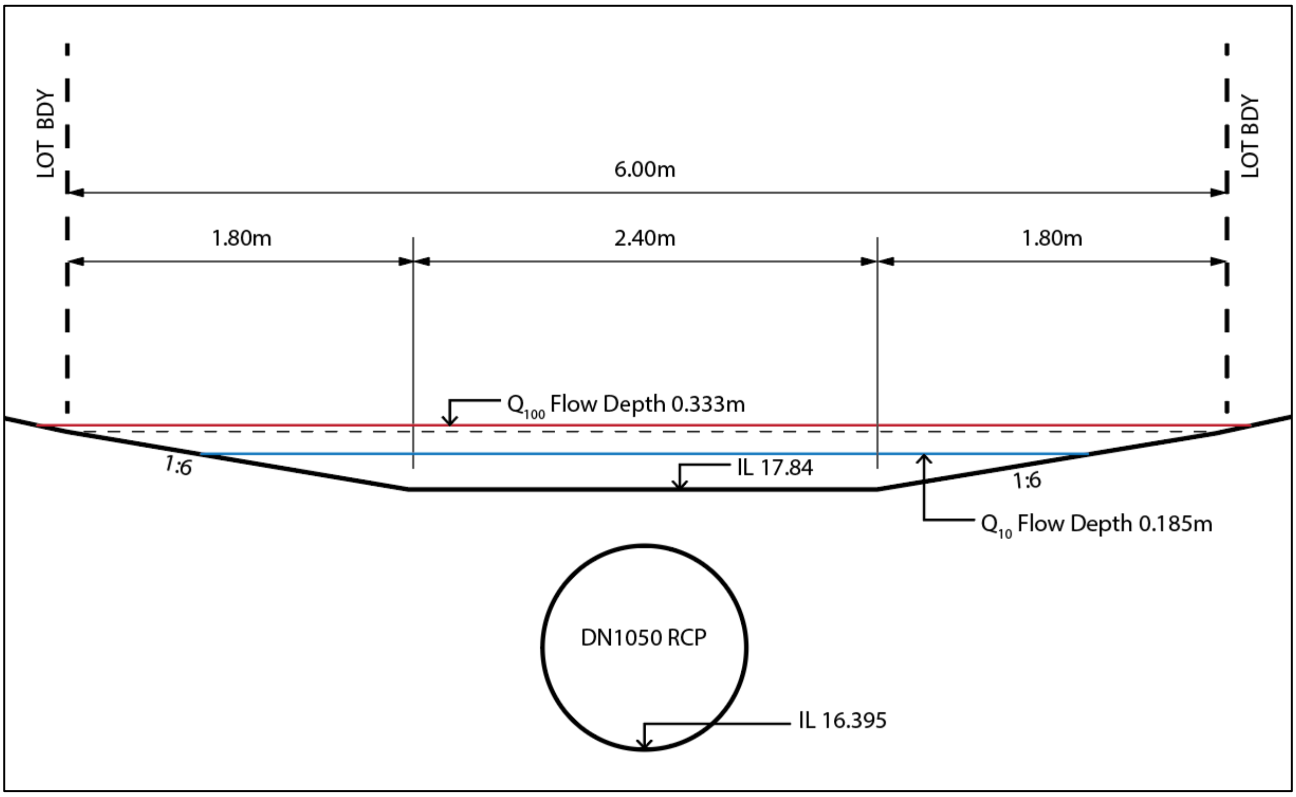

Figure 6.4: Existing Drainage Corridor Section

The 10% and 1% Storm events have been analysed to determine the existing conditions and distribution of flows. Peak runoff for the Wallis Creek catchment has been derived from the existing PCB report. In absence of the complete hydrograph and critical duration, it was assumed that hydrograph peaks aligned as a conservative measure.

Table 6.2: Peak Flow Existing Drainage Corridor

AEP	Peak Runoff (m^3/s)			
	Catchment D (Pre-Development)	Lot 22 DP1092105 & Half Cessnock Road	Wallis Creek (DN900 Culvert)	Total Flow to Corridor
10%	1.645	0.369	1.467	3.481
1%	2.926	0.542	2.300	5.768

The inlet capacity of the existing DN1050 culvert headwall was calculated using the orifice equation and the remaining flow was routed through the channel with resulting flow depths calculated using the Manning's equation and an 'n' of 0.03.

Table 6.3: Existing Drainage Corridor Flow Distribution

AEP	Total Corridor Flow (m^3/s)	DN1050 Inlet Flow (m^3/s)	Channel Flow (m^3/s)	Channel Flow Depth (m)
10%	3.481	2.474	1.007	0.185
1%	5.768	2.614	3.154	0.333

The results tabulated in Table 6.3 show that in the 10% AEP there is currently approximately 1000L/s of flow in the existing channel and in the 1% AEP the approach flow exceeds the capacity of the existing drainage corridor, requiring an additional 33mm in flow depth.

Section 3.2 of the Stormwater Drainage chapter of MOES requires the minor (pipe) system of drainage reserves be designed for the 10% AEP and the major (overland) system be designed for the 1% AEP.

6.4 PROPOSED CONDITIONS

The proposed development will improve the performance of the existing drainage corridor by increasing the inlet capacity of the existing DN1050. This increase in capacity is achieved by an additional inlet in the proposed detention basin where the headwater level provides a higher inlet capacity to the existing DN1050 pipe.

The proposed system has been modelled in DRAINS and results for minor and major storms are summarised below in Figure 6.5 and 6.6. Further details from the modelling can be found in Appendix B.

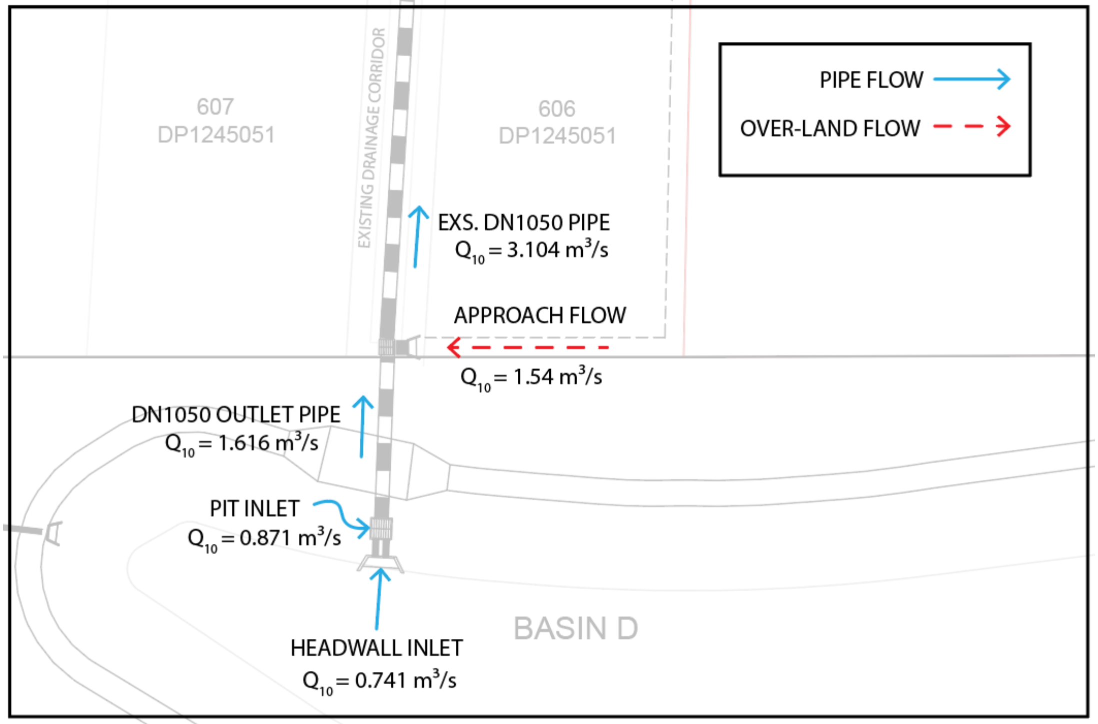

Figure 6.5: Proposed 10% AEP Flow Diagram

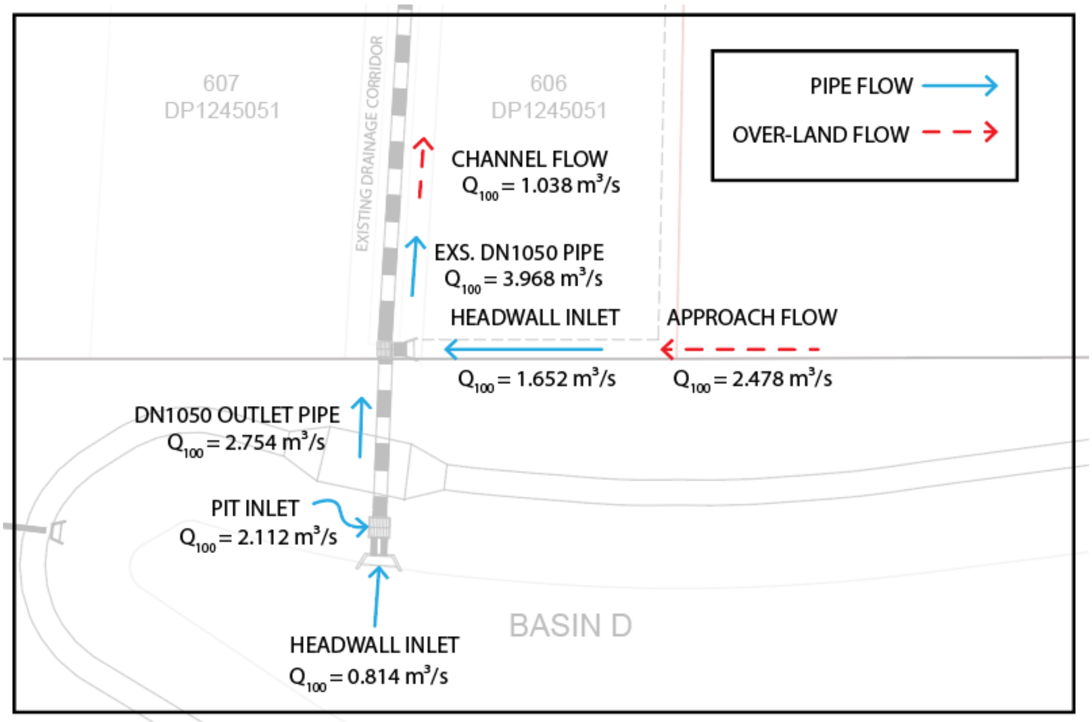

Figure 6.6: Proposed 1% AEP Flow Diagram

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7.0 Water Quality / Water Sensitive Urban Design

The proposed stormwater system, as detailed in Section 4.0, uses a combination of pit and pipe networks and water sensitive urban design elements to convey stormwater runoff from the site. It is intended to use a combination of treatment devices within the drainage system to remove nutrients and sediments from the stormwater prior to the runoff leaving the site.

7.1 TREATMENT DEVICES

The stormwater design for the proposed subdivision will consist of a combination of at source, conveyance, and end of line controls to treat the stormwater runoff from the site. The treatment train of at source, conveyance, and end of line controls will be modelled for demonstration of compliance with MCC's key performance objectives and can be summarized as follows:

- At Source

  The roof runoff for each of the future dwellings will be captured by rainwater tanks where the stormwater will receive at source treatment via a first flush system and a portion of the stormwater will be used for reuse.

- Conveyance

  Flows from Catchment A and D will be conveyed through a GPT which will be the conveyance control used to treat the stormwater. Flows from Catchment B will be conveyed through a headwall trash rack.

  As these Gross Pollutant Removal devices are the primary pollution control device in the treatment train after the stormwater is conveyed via the pit and pipe network, the devices will primarily remove litter, large debris and the nutrients attached to particles.

- End of Line

  Flows from Catchment A2 and D will be discharged to end-of-line Bioretention Basins. Flows from Catchment A3 and B will be discharged into sediment basins.

7.2 MUSIC MODELLING PARAMETERS

The software used for the water quality modelling is MUSIC. MUSIC (Model for Urban Stormwater Improvement Conceptualisation) is the industry standard model for prediction of stormwater quality outcomes from proposed development. The modelling approach is based on continuous simulation, operating at time steps to match the scale of the catchment.

The parameters used for the WSUD devices can be found in Appendix C.

7.2.1 Time Step

A time step of five (5) minutes was specified prior to any modelling. This is recommended by the software to increase reliability and output sensitivity.

7.2.2 Rainfall and Evapotranspiration

The rainfall data from Tocal Paterson weather station was input into the MUSIC model. Five (5) minute rainfall information for the year 1989 was analysed and deemed to be a reasonable representation of the average yearly rainfall and rainfall event distribution.

The rainfall data file was reviewed and it was noted that the rainfall for 1989 (904.6mm) was comparable to the annual average for the 47-year period from 1967 to 2015 being 930.4mm. During 1989, there were 89 days of rainfall which is equivalent to the long-term average of 89.9.

The average monthly area Potential Evapotranspiration (PET) rates for the site were sourced from the Bureau of Meteorology. The PET values for the model are summarised in Table 7.1.

Table 7.1: Monthly Average Area Potential Evapotranspiration (Bureau of Meteorology, 2015)

Month	Average PET (mm/month)
January	180
February	155
March	150
April	115
May	75
June	70
July	65
August	95
September	125
October	150
November	175
December	200

The annual rainfall and evapotranspiration time series graph for 1989 is shown in Figure 7.1.

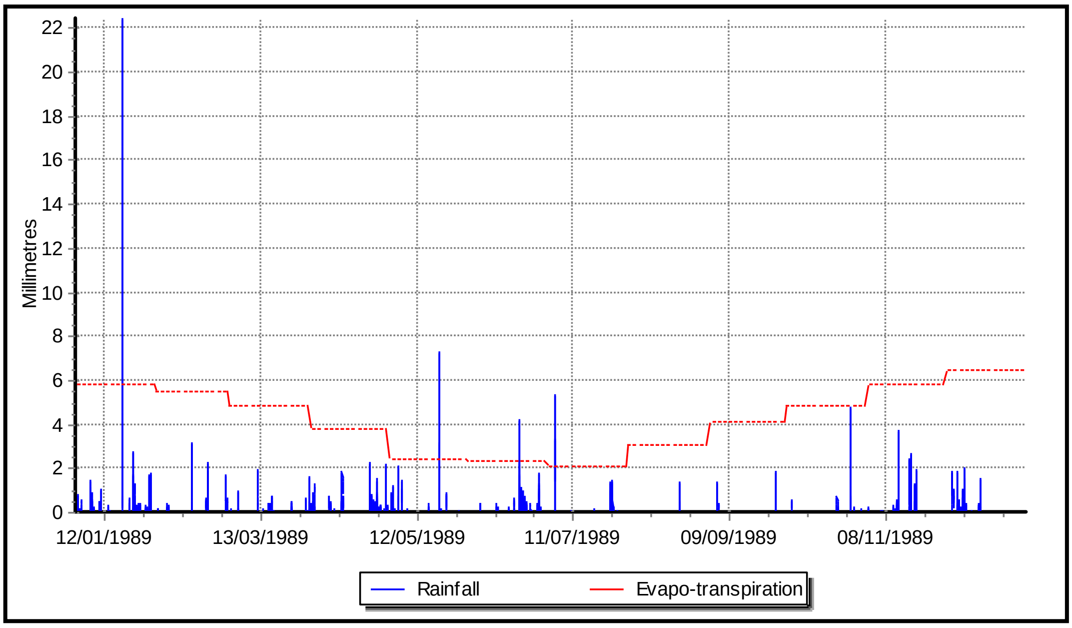

Figure 7.1: Rainfall and Evapotranspiration Graph

7.2.3 Source Nodes

The MUSIC model defined the following land uses:

- Roof (Urban) – This land use defines the impervious roof area of each lot, estimated at 250m^2 per lot and has been assumed to be 100% impervious;
- Lots (Urban) – This land use defines the lot area after the removal of the roof area. The impervious percentage of this node has been calculated so that the sum of the roof and lot equivalates to a total lot impervious percentage of 60% (as dictated in MOES);
- Road (Urban) – This land use defines the road reserve area. It has been assumed to be 70% impervious accounting for pervious road verge (as dictated in MOES).

7.2.4 Rainfall-Runoff Parameters

Pollutant source inputs were obtained from the *'Using MUSIC in the Sydney Drinking Water Catchment'* (Water NSW, 2012). The parameters adopted for the varying land uses were implemented in accordance with Table 3-2 and 3-7 of the above stated document assuming a 'clay' soil description.

The parameters used within the MUSIC model are presented in Table 7.2 and Table 7.3.

Table 7.2: MUSIC Rainfall-Runoff Parameters

Parameter	Value
Impervious Area Properties	
Rainfall Threshold (mm/day)	1
Pervious Area Properties	
Soil Storage Capacity (mm)	120
Initial Storage (% of Capacity)	30
Field Capacity (mm)	80
Infiltration - a	200
Infiltration - b	1
Groundwater Properties	
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	5
Daily Deep Seepage Rate (%)	0

Table 7.3: MUSIC Model Baseflow and Stormflow Pollutant Concentrations

Land Use		Mean Concentration		
		TSS	TP	TN
		mg/L	mg/L	mg/L
Roof	Baseflow	12.59	0.15	2.09
	Stormflow	19.95	0.13	2.00
Lot	Baseflow	12.85	0.15	2.03
	Stormflow	137.40	0.39	2.58

Road	Baseflow	12.85	0.15	2.03
	Stormflow	254.68	0.26	2.13
Basin	Baseflow	12.59	0.15	2.09
	Stormflow	158.49	0.35	2.63
Open Space	Baseflow	12.59	0.15	2.09
	Stormflow	158.49	0.35	2.63

7.2.5 Catchment Data

The catchments and associated parameters used for the model were based on the node parameters as detailed in Table 7.4. Water quality modelling was limited to the catchments that drain through the proposed treatment devices.

Table 7.4: MUSIC Node Sub-catchment Details

Catchment	Sub Catchment	Area (Ha)	Impervious Area (Ha)	Pervious Area (Ha)	Percentage Impervious (%)	Development Flows (m^3/s)	
						63% AEP	3 mth
Catchment A2	Roof	3.45	3.45	0.00	100		
	Lots area	4.16	1.12	3.04	27		
	Roads	3.41	2.39	1.02	70		
	Grassland	5.42	0.54	4.88	10		
Total		**16.44**	**7.50**	**8.94**	**46**	**1.809**	**0.905**
Catchment A3	Roof	1.95	1.95	0.00	100		
	Lots area	2.69	0.84	1.86	31		
	Roads	1.64	1.15	0.49	70		
	Grassland	16.60	0.83	15.77	5		
Total		**22.89**	**4.76**	**18.12**	**21**	**0.948**	**0.474**
Catchment B	Roof	0.50	0.50	0.00	100		
	Lots Area	0.75	0.25	0.50	33		
	Road	0.88	0.62	0.26	70		
Total		**2.13**	**1.36**	**0.77**	**64**	**0.426**	**0.213**
Catchment C	Roof	0.18	0.18	0.00	100		
	Lots	0.23	0.07	0.16	30		
Total		**0.41**	**0.24**	**0.16**	**60**	**0.082**	**0.041**
Catchment D	Roof	2.45	2.45	0.00	100		
	Lots area	3.61	1.19	2.42	33		
	Roads	3.42	2.39	1.03	70		
	Parkland	1.13	0.56	0.56	50		
Total		**10.61**	**6.60**	**4.01**	**62**	**1.563**	**0.782**

The Lot areas were split to 'Roofs' and 'Lots' subareas to represent an overall impervious area of 60%.

7.2.6 Rainwater Tank Details

The proposed subdivision is to incorporate water retention or reuse measures to reduce the demand on potable water.

As part of the stormwater management for the future development, there will be a requirement to install a rainwater tank to capture roof runoff. This tank will be connected to toilet cisterns and be used for laundry and landscaping to minimise the demand on potable water supply. In addition, future dwellings are to have AAA+ fixtures and appliances, dual flush toilets, water efficient gardens and rainwater tanks. These are BASIX requirements, imposed upon the proponent of the new dwellings on the lots.

To ensure the future development does adequately reduce the demand on potable water, the building consent should be conditioned with water saving requirements.

The input parameters of the MUSIC model are shown below in Table 7.5.

Table 7.5: MUSIC Model Rainwater Tank Parameters

Rainwater Tank Properties	
Volume below overflow pipe (kL)	3,000
High Flow Bypass (m^3/s/dwelling)	0.005
Annual Demand (kL/yr/dwelling)	143

Note: Annual demand based on 3 bedroom residential dwelling using water for toilet + laundry (50%) + gardens

7.2.9 Gross Pollutant Removal Details

Gross pollutant traps (GPTs) will be incorporated at the end of the street networks within catchments A2, A3 and D, before runoff is discharged into the basins for further quality treatment. GPTs are designed to capture and retain gross pollutants, litter, grit and sediments from stormwater. The GPTs have been modelled as a Humegard HG18 for Catchment A3 and as Humegard HG24s for Catchment A2 and D within the MUSIC model as shown in Figure 7.2. MUSIC nodes created by the manufacturer were used in the MUSIC model to ensure correct pollutant reduction efficiencies were modelled and high flow bypasses were adjusted to model specific treatable flow rates of the selected GPTs.

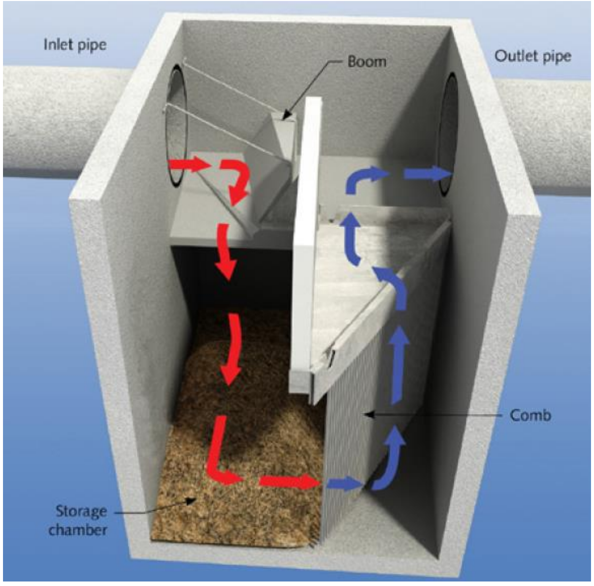

Figure 7.2: Humegard GPT
(Source: Humes HumeGard GPT Technical Manual)

For catchment B, where the basin is proposed is a temporary sediment basin to be utilised until development of future stages. The gross pollutant removal system proposed is the use of trash racks fixed to the headwall outlet on Road MC11.

7.2.10 Sediment Basin Details

Basins A3 and B have been modelled as 'Ponds' and 'Sediment Basins' respectively in the MUSIC model. The basin nodes are utilised as the end of line control to treats the stormwater water prior to discharging offsite.

Pollutant removal is achieved through the process of providing extended detention time to allow for sedimentation and some biological and chemical uptake within the macrophyte zone of the pond nodes. The characteristics of both basins can be seen in Table 7.6.

Table 7.6: MUSIC Model Basin Parameters

Inlet Storage Properties	Basin A3	Basin B
Surface Area (m^2)	2784	400
Extended Detention Depth (m)	1.5	1.5
Permanent Pool Volume (m^3)	2805	100
Initial Volume (m^3)	100	50
Exfiltration Rate (mm/hr)	0.15	0.2
Evaporative Loss as a % of PET	75	75

The inlet structures are overflow weirs as detailed in the previous section

6.2.11 Bioretention Basin Details

Basin A2 and D have been designed as both a bioretention and detention basin. Refer to Exhibit 003.

Bioretention basins allow infiltration of stormwater through suitable vegetation and a filter media to remove nitrogen, phosphorous and gross pollutants before discharging the stormwater from site.

The inlet structures are a series of pipes and headwalls at the discharge locations. The inlet pipes convey flows through the GPT, located upstream of the outlets, before discharging to the basin through a headwall outlet.

The bioretention basins have been sized based upon the pollutant removal efficiency for their respective catchments modelled in the MUSIC software.

The characteristics of both bioretention basins can be seen in Table 7.7.

Table 7.7: MUSIC Model Bioretention Parameters

	Retention Properties	Basin A2	Basin D
Storage Properties	Surface Area (m^2)	750	900
	Extended Detention Depth (m)	0.3	0.3
Filter and Media Properties	Filter Area (m^2)	50	50
	Unlined Filter Media Perimeter (m)	30	30
	Saturated Hydraulic Conductivity (mm/hr)	100	100
	Filter Depth (m)	0.45	0.45
	TN Content of Filter Media (mg/kg)	800	800
	Orthophosphate Content of Filter Media (mg/kg)	55	55

The lowest outlet structure in each basin has been set 300mm above the invert of the basin to enable retention of flows during a three (3) month storm event.

The inlet structures, outlet structures and overflow structures will be designed with scour protection to avoid scouring of the bioretention basin.

7.3 RESULTS

In accordance with MCC requirements, modelling has been undertaken to demonstrate compliance with water quality objectives for stormwater runoff from the proposed development prior to discharge of stormwater into the downstream waterways. The results of the modelling are shown in Table 7.8 to Table 7.10.

Table 7.8: Pollutant loads and Reductions Catchment A

Pollutant	Sources	Residual Load	% Reduction	% Reduction Required
Total Suspended Solids (kg/year)	21500	2950	86.3	80
Total Phosphorus (kg/year)	44.90	16.2	63.9	45
Total Nitrogen (kg/year)	317.00	165.00	48.1	45
Gross Pollutants > 5mm (kg/year)	4040.00	0.00	100.0	70

Table 7.9: Pollutant loads and Reductions Catchment B

Pollutant	Sources	Residual Load	% Reduction	% Reduction Required

Total Suspended Solids (kg/year)	2200	150	93.2	80
Total Phosphorus (kg/year)	4.59	1.32	71.3	45
Total Nitrogen (kg/year)	32.00	16.20	49.2	45
Gross Pollutants > 5mm (kg/year)	412.00	0.00	100.0	70

Table 7.10: Pollutant loads and Reductions Catchment C & D

Pollutant	Sources	Residual Load	% Reduction	% Reduction Required
Total Suspended Solids (kg/year)	10900	1750	83.8	80
Total Phosphorus (kg/year)	22.70	8.23	63.7	45
Total Nitrogen (kg/year)	162.00	79.40	51.0	45
Gross Pollutants > 5mm (kg/year)	2090.00	28.50	98.6	70

From the results it can be seen that the designed stormwater management infrastructure has achieved the required target reductions. It is noted that MUSIC does not have the capacity to route litter + oil/grease pollutants, however they are qualitatively addressed by the proposed treatment train.

8.0 Erosion and Sedimentation Control

Erosion and sedimentation control measures need to be implemented during any construction on the proposed subdivision to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the construction site to downstream waterways.

During the construction period, it is recommended that the detention basins are constructed early and used as temporary sediment basins. It is also recommended that an appropriate Erosion and Sedimentation Control Plan is implemented throughout the entire construction period to minimise the quantity of sediments being conveyed to the temporary sediment basin. A concept Erosion and Sediment Control Plan can be found within the concept engineering plans.

9.0 Conclusion

The Stormwater Management Strategy has been prepared to accompany the Development Application for a proposed residential subdivision along Cessnock Road, Gillieston Heights.

The preparation of this management plan has been undertaken to document the stormwater management facilities designed for the site and how they achieve the requirements of Maitland City Council's Guidelines.

Hydraulic modelling indicated that post-development peak median flows are attenuated within the site to pre-development peak median flow levels after provision is made for detention storage for stormwater up to the 1% AEP storm event.

Water quality treatment has been modelled and utilising the adopted treatment meets Council target pollutant removal objectives prior to discharge of stormwater from the site. This was achieved by a treatment train approach utilising rainwater tank, gross pollutant traps, ponds, sediment basins and a bioretention basins.

An erosion and sedimentation control plan will be implemented to minimise the risk of erosion to disturbed areas and limit the transport of sediments from the development site to the receiving waters during construction.

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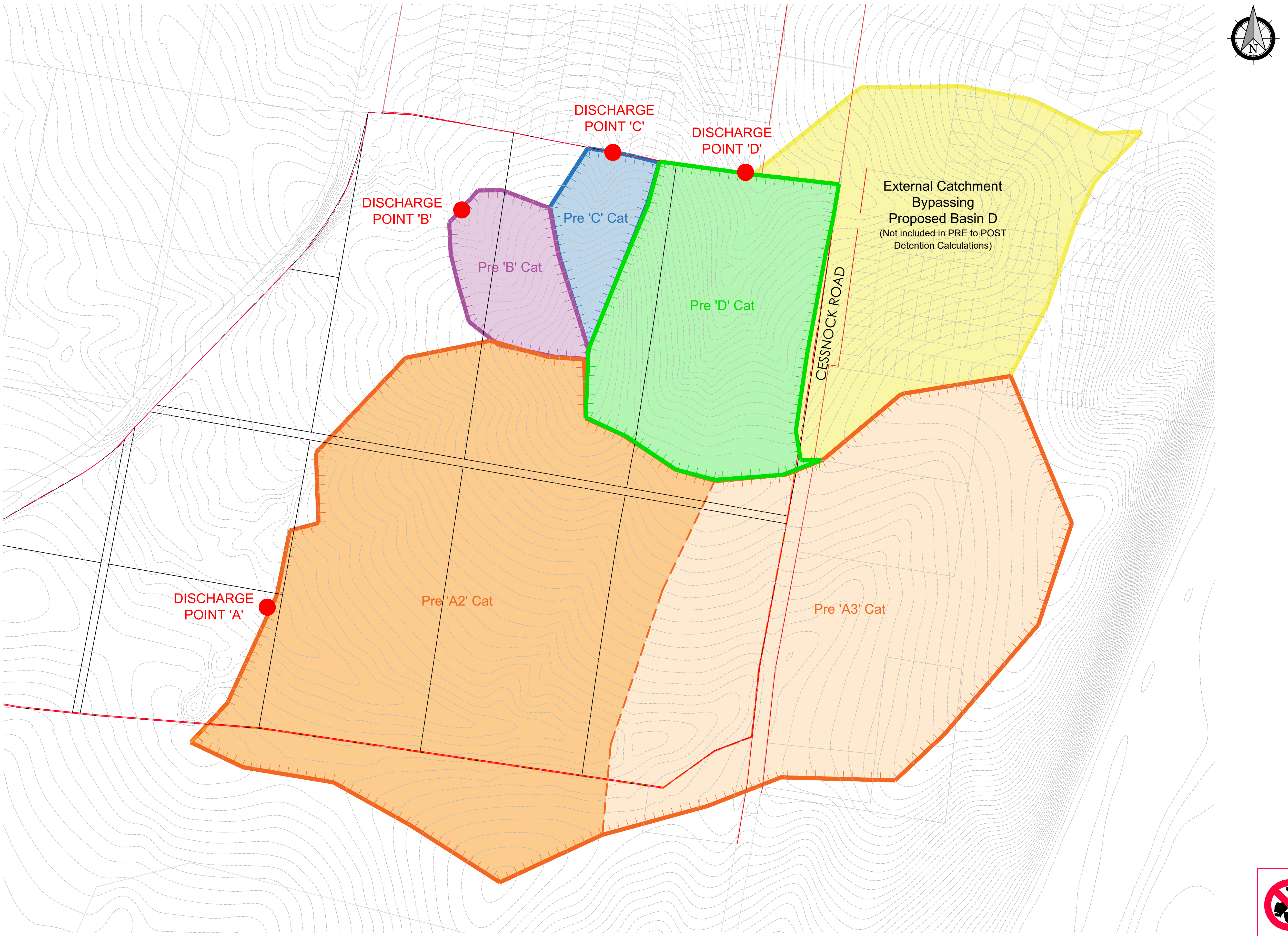
Exhibits

240289(1)-ESK-001 PRE-DEVELOPMENT CATCHMENT PLAN
240289(1)-ESK-002 POST-DEVELOPMENT CATCHMENT PLAN
240289(1)-ESK-003 PROPOSED BASIN DETAILS

240289(1)-ESK-001



LEGEND

- PRE A2 CATCHMENT (27.82 ha)
- PRE A3 CATCHMENT (21.68 ha)
- PRE B CATCHMENT (2.69 ha)
- PRE C CATCHMENT (1.94 ha)
- PRE D CATCHMENT (9.88 ha)
- D EXTERNAL CATCHMENT (13.08 ha)
- SITE DISCHARGE ANALYSIS POINT

DIAL 1100 BEFORE YOU DIG

NOT FOR CONSTRUCTION

ver.	date	comment	drawn	pm	level information	scale (A1 original size)	notes
A	22.02.2022	INITIAL ISSUE	RB	RK	DATUM: AHD CONTOUR INTERVAL: 1m	A1 1:2500 — 0, 50, 100, 125m — A3 1:5000	

drawing title:

PRE-DEVELOPMENT CATCHMENTS

location: 464 CESSNOCK ROAD, GILLIESTON HEIGHTS

council: MAITLAND CITY COUNCIL

dwg ref: 240289(1)-ESK-001

client: McCLOY GROUP

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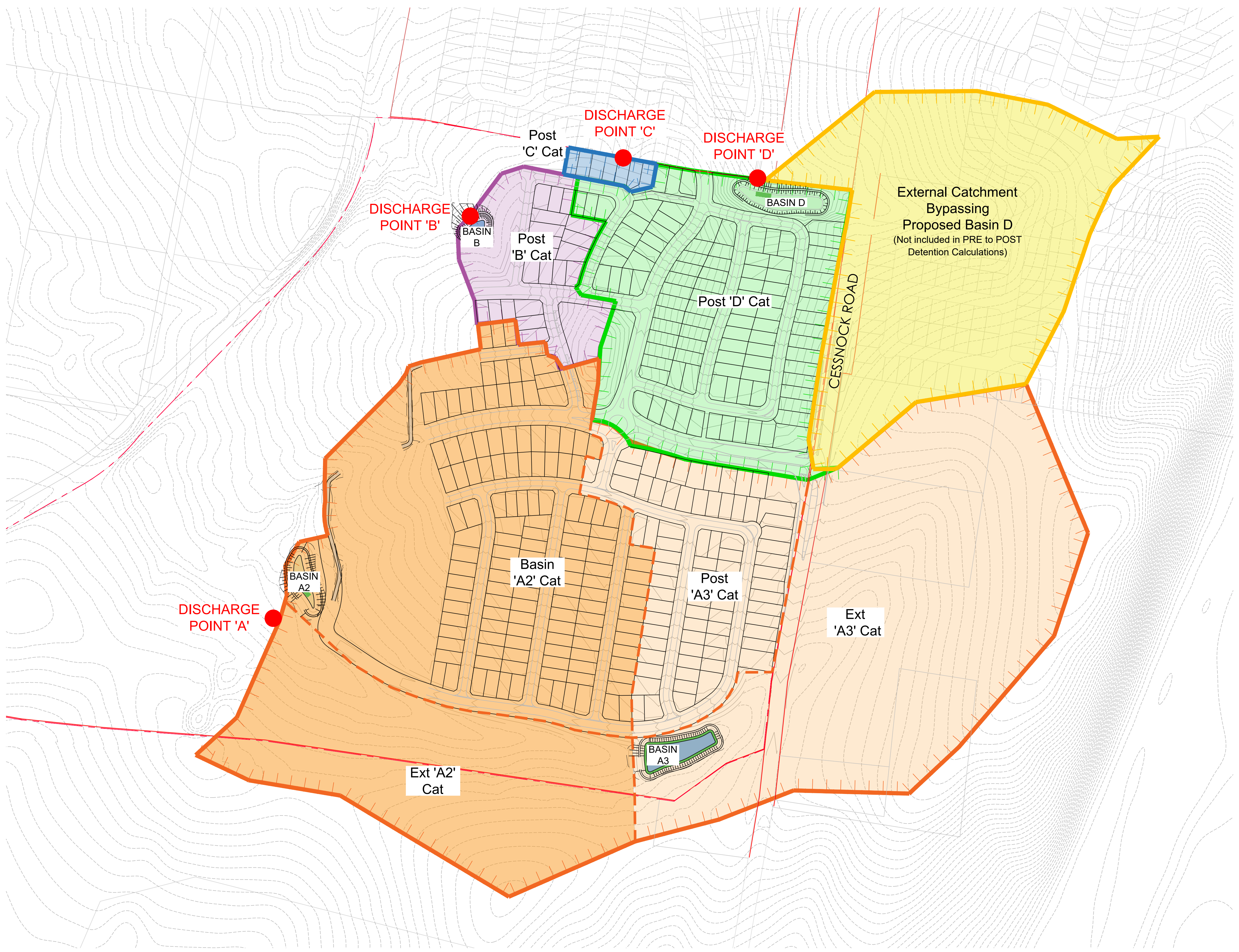
240289(1)-ESK-001



LEGEND

- POST A2 CATCHMENT (26.23 ha)
- POST A3 CATCHMENT (23.931 ha)
- POST B CATCHMENT (3.31 ha)
- POST C CATCHMENT (0.405 ha)
- POST D CATCHMENT (10.61 ha)
- D EXTERNAL CATCHMENT (13.08 ha)
- SITE DISCHARGE ANALYSIS POINT

DIAL 1100
BEFORE YOU DIG

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drawing title:

POST-DEVELOPMENT CATCHMENTS

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council:	MAITLAND CITY COUNCIL
dwg ref:	240289(1)-ESK-002
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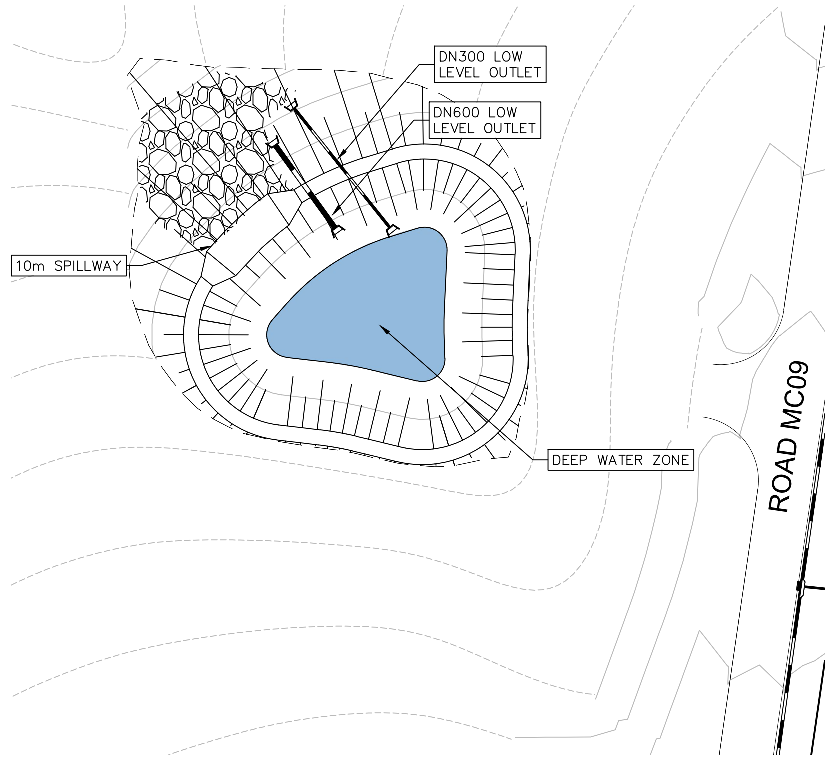
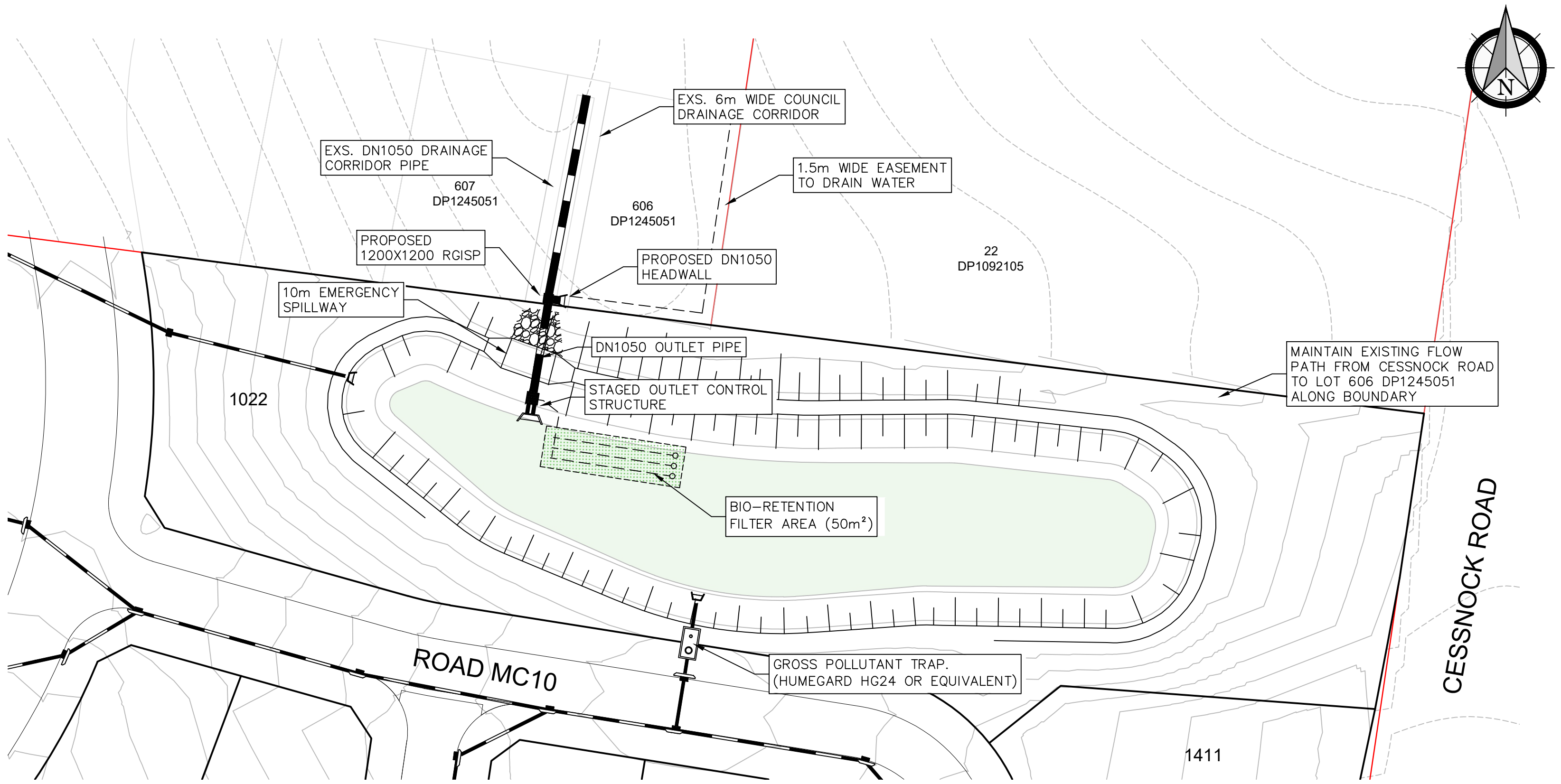
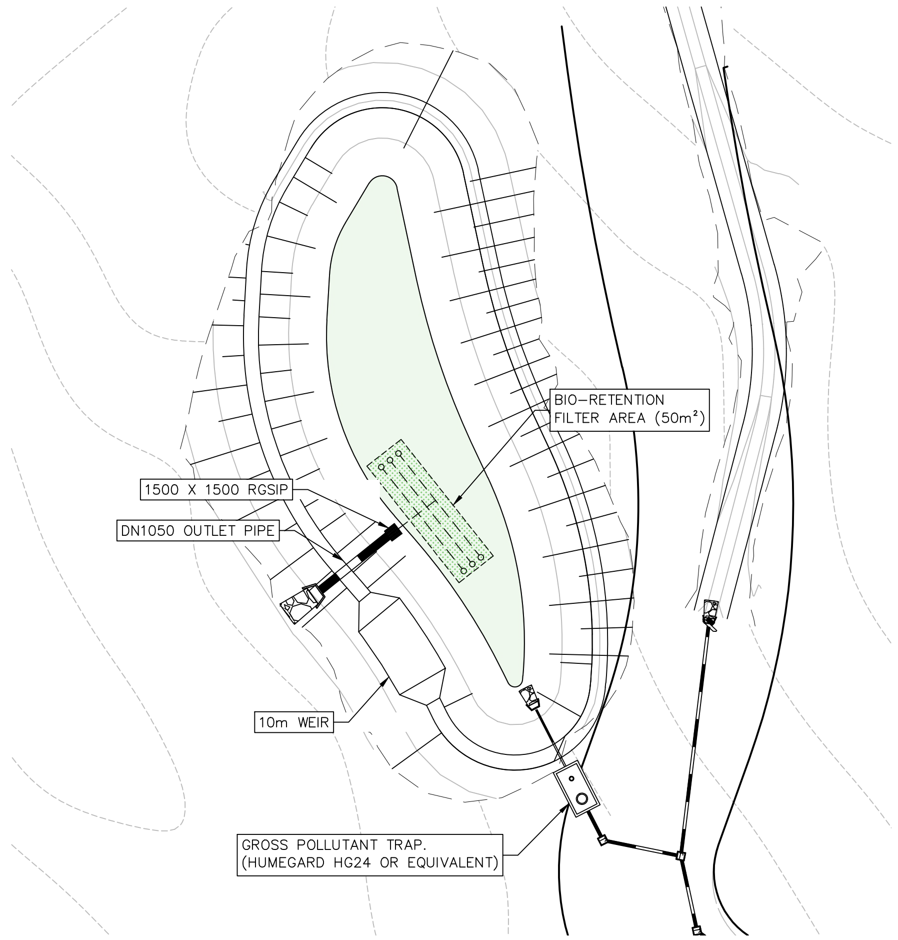


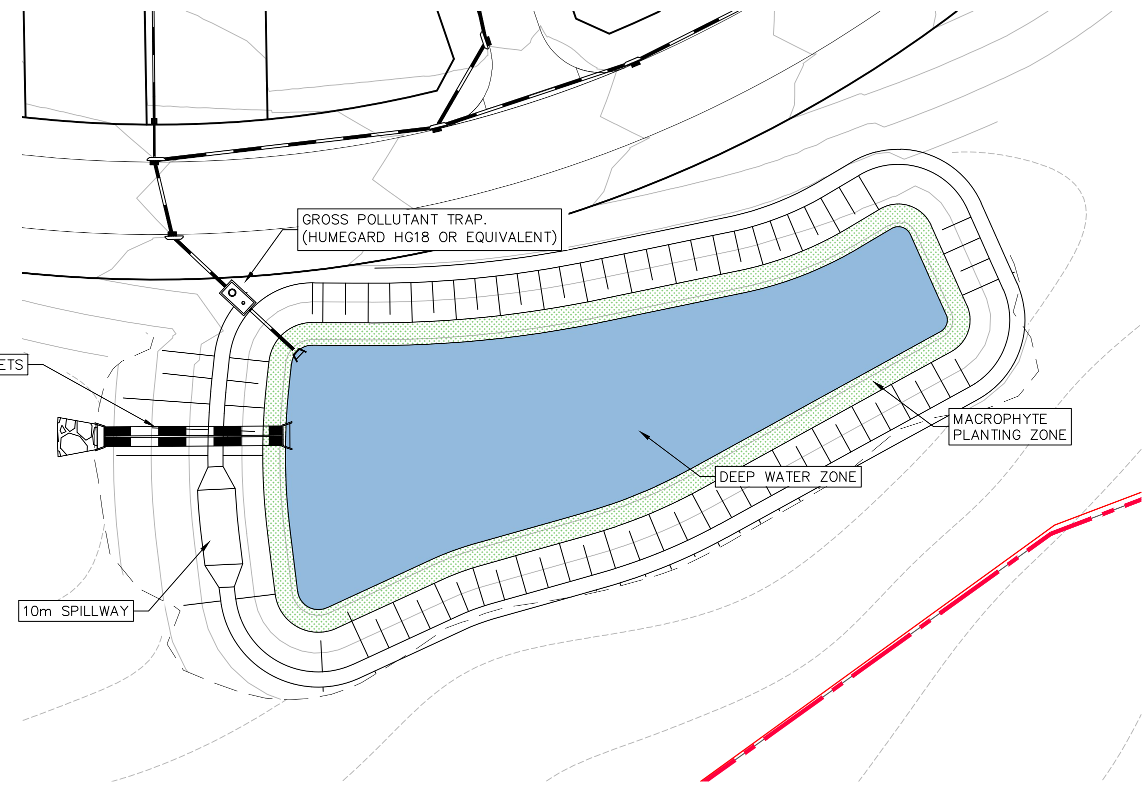
SEDIMENT BASIN BASIN B
SCALE 1:500



BIO-RETENTION/DETENTION BASIN D
SCALE 1:500



BIO-RETENTION/DETENTION BASIN A2
SCALE 1:500



NUTRIENT CONTROL POND/DETENTION BASIN A3
SCALE 1:500

DIAL 1100 BEFORE YOU DIG

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drawing title: BASIN DETAILS

location: 464 CESSNOCK ROAD, GILLIESTON HEIGHTS

council: MAITLAND CITY COUNCIL

dwg ref: 240289(1)-ESK-003

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STORMWATER DRAINAGE

1. RAINFALL INTENSITY FREQUENCY DURATION CHART – rainfall intensities

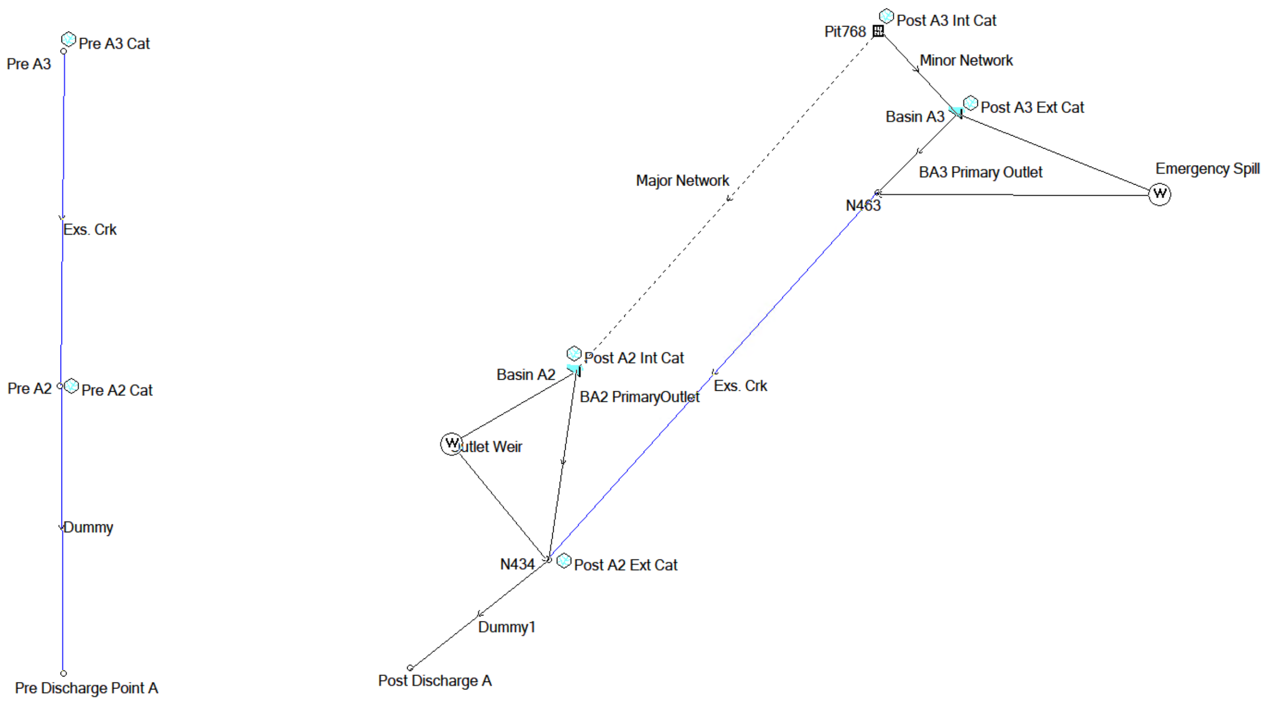
DURATION	1 YR	2 YR	5 YR	10 YR	20 YR	50 YR	100 YR	200 YR	500 YR
5 min	76.07	98.03	128.09	146.13	169.82	201.35	225.75	250.79	285.09
6 min	71.24	91.79	119.92	136.79	158.94	188.44	211.26	234.68	266.75
10 min	58.16	74.92	97.81	111.53	129.56	153.55	172.10	191.14	217.21
12 min	53.73	69.20	90.32	102.98	119.61	141.74	158.84	176.40	200.44
15 min	48.52	62.49	81.53	92.30	107.92	127.87	143.29	159.11	180.76
18 min	44.47	57.26	74.69	85.12	98.84	117.09	131.20	145.67	165.48
20 min	42.22	54.36	70.89	80.79	93.80	111.11	124.49	138.21	157.00
24 min	38.49	49.56	64.61	73.62	85.46	101.22	113.39	125.88	142.97
30 min	34.24	44.07	57.43	65.43	75.94	89.92	100.73	111.80	126.97
45 min	27.39	35.25	45.90	52.27	60.65	71.78	80.38	89.21	101.27
1.0 hr	23.22	29.88	38.89	44.27	51.35	60.77	68.03	75.49	85.68
1.5 hr	18.21	23.43	30.50	34.72	40.27	47.65	53.35	59.20	67.19
2.0 hr	15.27	19.65	25.57	29.11	33.77	39.96	44.74	49.65	56.35
3.0 hr	11.88	15.29	19.90	22.65	26.28	31.10	34.82	38.63	43.85
4.5 hr	9.24	11.88	15.47	17.61	20.42	24.17	27.06	30.02	34.08
6.0 hr	7.73	9.94	12.94	14.73	17.08	20.21	22.63	25.11	28.50
9.0 hr	6.01	7.73	10.06	11.46	13.29	15.73	17.61	19.54	22.18
12.0 hr	5.03	6.47	8.43	9.59	11.13	13.17	14.74	16.36	18.56
18.0 hr	4.01	5.14	6.64	7.52	8.69	10.24	11.44	12.66	14.32
24.0 hr	3.41	4.36	5.59	6.32	7.28	8.55	9.53	10.53	11.89
30.0 hr	2.99	3.82	4.88	5.50	6.33	7.42	8.25	9.10	10.26
36.0 hr	2.69	3.43	4.36	4.90	5.63	6.59	7.32	8.06	9.07
48.0 hr	2.25	2.87	3.63	4.06	4.65	5.42	6.01	6.61	7.42
72.0 hr	1.73	2.19	2.74	3.06	3.49	4.05	4.47	4.90	5.48

Source: Maitland City Council Manual of Engineering Standards, Appendix C

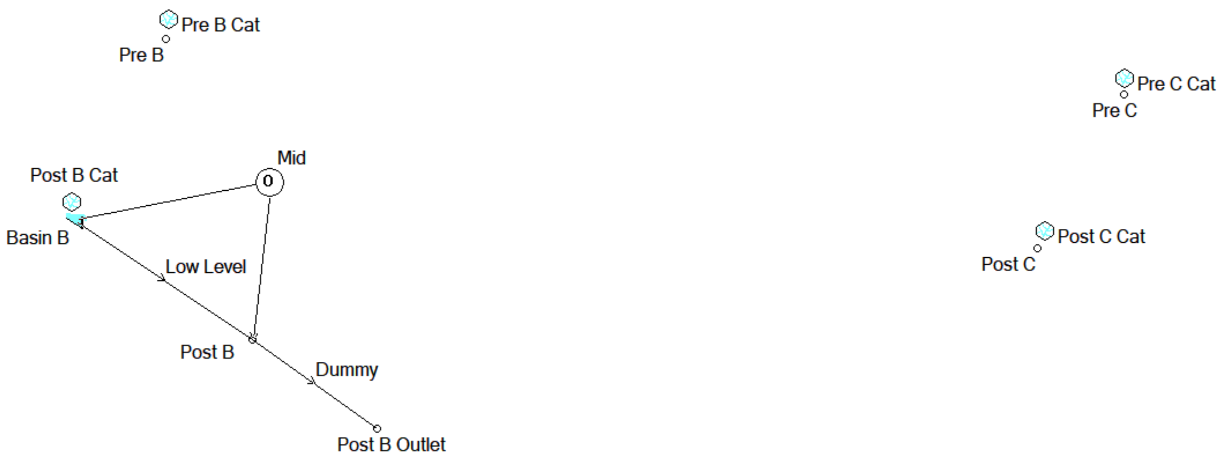
Appendix B

DRAINS MODEL DATA

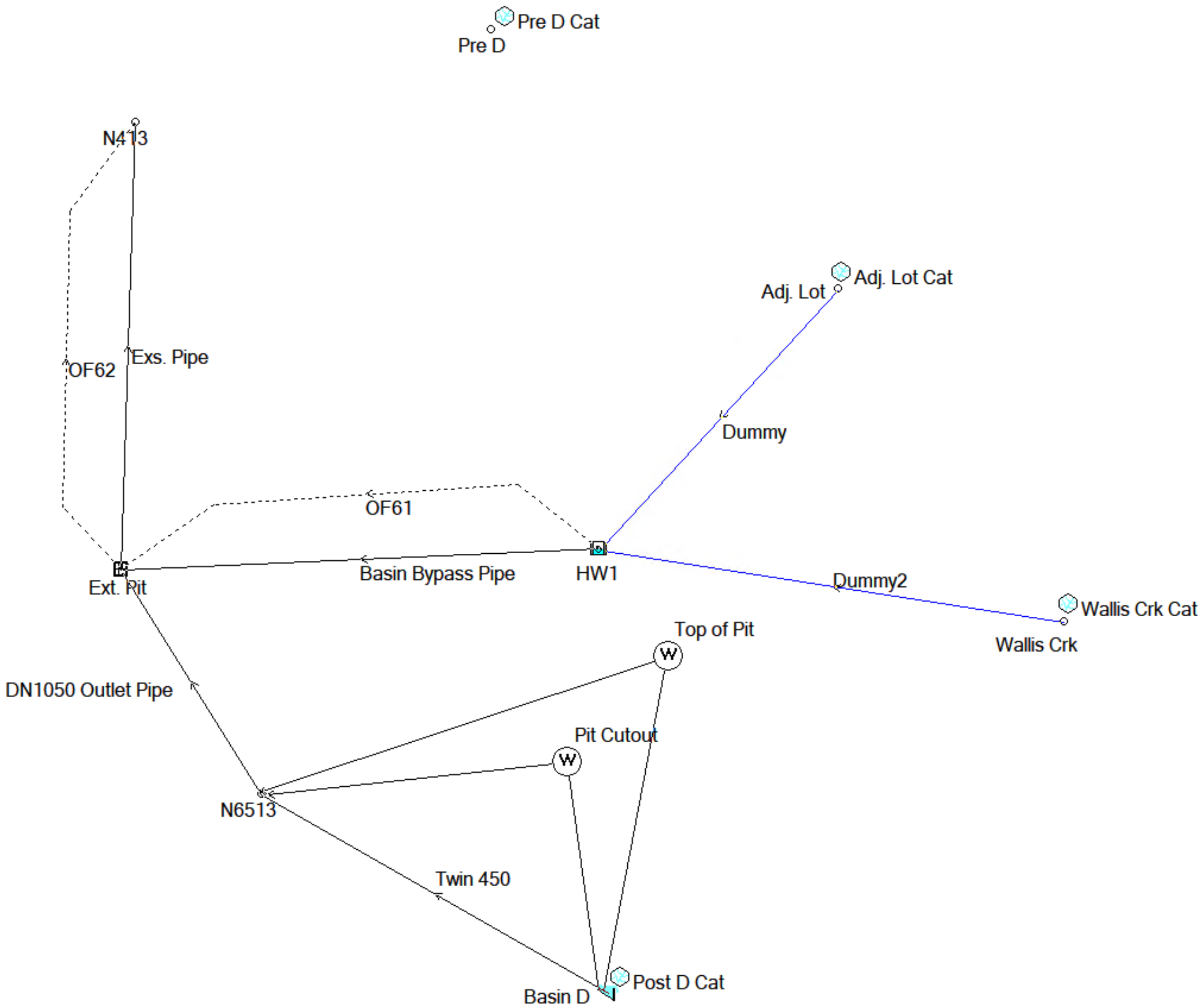
CATCHMENT A



CATCHMENT B & C



CATCHMENT D



Pre D Cat
Pre D
N413
OF62
Exs. Pipe
Adj. Lot Cat
Adj. Lot
Dummy
OF61
Ext. Pit
Basin Bypass Pipe
HW1
Dummy2
Wallis Crk Cat
Wallis Crk
Top of Pit
DN1050 Outlet Pipe
Pit Cutout
N6513
Twin 450
Post D Cat
Basin D

CATCHMENT A - 63.2% AEP

DRAINS results prepared from Version 2020.05

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving	Max Pond Volume	Min Freeboard	Overflow (cu.m/s)	Constraint
			(cu.m/s)	(cu.m)	(m)		
Pre A3	19.83		0.997				
Pre A2	12.07		2.325				
Pre Discharge Point A	11.97		2.293				
N434	12.61		1.426				
Post Discharge A	10.21		0				
Pit768	22.41		0.948		0.49	0	None
N463	19.83		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q	Paved Max Q	Grassed Max Q	Paved Tc	Grassed Tc	Supp. Tc	Due to Storm
	(cu.m/s)	(cu.m/s)	(cu.m/s)	(min)	(min)	(min)	
Pre A3 Cat	0.997	0.238	0.954	3.85	57.31	0	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
Pre A2 Cat	1.36	0	1.36	0	51.24	0	AR&R 1 year, 1.5 hours storm, average 18.2 mm/h, Zone 1
Post A2 Int Cat	1.809	1.278	0.662	8.7	22.05	0	AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1
Post A2 Ext Cat	0.472	0	0.472	0	51.24	0	AR&R 1 year, 1.5 hours storm, average 18.2 mm/h, Zone 1
Post A3 Int Cat	0.948	0.726	0.258	8.7	12.72	0	AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1
Post A3 Ext Cat	0.816	0.129	0.793	3.85	57.31	0	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1

Outflow Volumes for Total Catchment (12.9 impervious + 86.7 pervious = 99.7 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 76.07 mm/h, Zone 1	6317.82	884.06 (14.0%)	690.29 (84.2%)	193.76 (3.5%)
AR&R 1 year, 5 minutes storm, average 22.0 mm/h, Zone 1	1827.16	107.74 (5.9%)	107.74 (45.5%)	0.00 (0.0%)
AR&R 1 year, 5 minutes storm, average 76.1 mm/h, Zone 1	6317.82	884.06 (14.0%)	690.29 (84.2%)	193.76 (3.5%)
AR&R 1 year, 10 minutes storm, average 58.2 mm/h, Zone 1	9660.7	3527.05 (36.5%)	1123.95 (89.7%)	2403.11 (28.6%)
AR&R 1 year, 15 minutes storm, average 48.5 mm/h, Zone 1	12089.16	5655.74 (46.8%)	1438.98 (91.8%)	4216.76 (40.1%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	14025.95	7302.46 (52.1%)	1690.23 (92.9%)	5612.23 (46.0%)
AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1	15984.33	8851.46 (55.4%)	1944.29 (93.8%)	6907.17 (49.7%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	17063.19	9257.01 (54.3%)	2084.24 (94.2%)	7172.78 (48.3%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	20473.34	12167.35 (59.4%)	2526.62 (95.1%)	9640.73 (54.1%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	23140.16	14104.10 (61.0%)	2872.57 (95.7%)	11231.53 (55.8%)
AR&R 1 year, 1.5 hours storm, average 18.2 mm/h, Zone 1	27222.21	16527.17 (60.7%)	3402.11 (96.3%)	13125.06 (55.4%)
AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1	30435.51	17938.16 (58.9%)	3818.97 (96.7%)	14119.19 (53.3%)

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)	
BA2 PrimaryOutlet	1.614	6.21	13.601	12.754	AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1
Dummy1	2.171	10.87	12.606	10.206	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
Minor Network	0.947	2.83	22.227	22.228	AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1
BA3 Primary Outlet	0.964	3.21	21.928	19.828	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q	Max V	Due to Storm
	(cu.m/s)	(m/s)	
Exs. Crk	0.98	0	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
Dummy	2.293	1.66	AR&R 1 year, 1.5 hours storm, average 18.2 mm/h, Zone 1
Exs. Crk	0.96	0.71	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

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
Outlet Weir	0.002	-0.002						AR&R 1 year, 5 minutes storm, average 76.07 mm/h, Zone 1
Major Network	0	0	0.33	0	0	0	0	
Emergency Spill								

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin A2	14.45	291.5	1.614	1.614	0
Basin A3	22.23	1017.4	0.964	0.964	0

CONTINUITY CHECK for AR&R 1 year, 1.5 hours storm, average 18.2 mm/h, Zone 1

Node	Inflow	Outflow	Storage Change	Difference
	(cu.m)	(cu.m)	(cu.m)	%
Pre A3	3411.89	3345.94	0	1.9
Pre A2	7549.63	7405.78	0	1.9
Pre Discharge Point A	7405.78	7405.78	0	0
Basin A2	3313.24	3335.79	0.52	-0.7
N434	8610.56	8409.76	0	2.3
Post Discharge A	8409.76	8409.76	0	0
Pit768	1402.01	1401.74	0	0
Basin A3	4139.97	4008.97	131	0
N463	4008.97	3816.64	0	4.8

Run Log for Catchment A.drn run at 19:30:04 on 20/2/2022 using version 2020.05
No water upwelling from any pit. Freeboard was adequate at all pits.
Flows were safe in all overflow routes.

CATCHMENT A - 10% AEP

DRAINS results prepared from Version 2020.05

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pre A3	19.96		2.847				
Pre A2	12.13		6.832				
Pre Discharge Point A	12.03		6.71				
N434	12.75		4.125				
Post Discharge A	10.35		0				
Pit768	22.84		2.184		0.06	0	None
N463	19.96		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre A3 Cat	2.847	0.445	2.794	2.52	40.91	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Pre A2 Cat	4.092	0	4.092	0	37.41	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Post A2 Int Cat	4.331	2.492	2.135	7.86	17.01	0	AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1
Post A2 Ext Cat	1.42	0	1.42	0	37.41	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Post A3 Int Cat	2.184	1.417	0.768	7.86	9.82	0	AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1
Post A3 Ext Cat	2.352	0.242	2.323	2.52	40.91	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

Outflow Volumes for Total Catchment (12.9 impervious + 86.7 pervious = 99.7 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 146 mm/h, Zone 1	12136.5	6530.84 (53.8%)	1445.12 (91.8%)	5085.72 (48.2%)
AR&R 10 year, 10 minutes storm, average 112 mm/h, Zone 1	18525.75	12537.69 (67.7%)	2273.97 (94.6%)	10263.72 (63.7%)
AR&R 10 year, 15 minutes storm, average 92.3 mm/h, Zone 1	22997.3	16669.80 (72.5%)	2854.05 (95.7%)	13815.75 (69.0%)
AR&R 10 year, 20 minutes storm, average 80.8 mm/h, Zone 1	26839.33	20229.06 (75.4%)	3352.45 (96.3%)	16876.61 (72.3%)
AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1	30572.54	23599.13 (77.2%)	3836.76 (96.7%)	19762.38 (74.3%)
AR&R 10 year, 30 minutes storm, average 65.4 mm/h, Zone 1	32604.02	24985.14 (76.6%)	4100.26 (96.9%)	20884.88 (73.6%)
AR&R 10 year, 45 minutes storm, average 52.3 mm/h, Zone 1	39070.51	30790.87 (78.8%)	4939.14 (97.4%)	25851.73 (76.0%)
AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1	44121.78	34969.37 (79.3%)	5594.43 (97.7%)	29374.94 (76.5%)
AR&R 10 year, 1.5 hours storm, average 34.7 mm/h, Zone 1	51902.98	40894.80 (78.8%)	6603.80 (98.1%)	34291.00 (75.9%)
AR&R 10 year, 2 hours storm, average 29.1 mm/h, Zone 1	58023.97	45030.05 (77.6%)	7397.93 (98.3%)	37632.13 (74.5%)
AR&R 10 year, 3 hours storm, average 22.6 mm/h, Zone 1	67726.19	51316.79 (75.8%)	8656.50 (98.5%)	42660.29 (72.4%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
BA2 PrimaryOutlet	2.738	7.12	13.962	12.874	AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1
Dummy1	6.473	15.17	12.746	10.345	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Minor Network	2.179	2.98	22.612	22.612	AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1
BA3 Primary Outlet	2.721	4.82	22.057	19.957	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm
Exs. Crk	2.822	0			AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Dummy	6.71	0			AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Exs. Crk	2.717	0.89			AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

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
Outlet Weir	0.007	-0.007						AR&R 10 year, 5 minutes storm, average 146 mm/h, Zone 1
Major Network	0	0	0.33	0	0	0	0	
Emergency Spill								

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin A2	15.05	1108.6	2.738	2.738	0
Basin A3	22.61	2052.3	2.721	2.721	0

CONTINUITY CHECK for AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre A3	7441.18	7281.83	0	2.1
Pre A2	16697.32	16365.92	0	2
Pre Discharge Point A	16365.92	16365.92	0	0
Basin A2	6307.68	6296.39	0.47	0.2
N434	17202.85	16676.98	0	3.1
Post Discharge A	16676.98	16676.98	0	0
Pit768	2514.04	2512.29	0	0.1
Basin A3	8537.29	8094.75	442.54	0
N463	8094.75	7640.5	0	5.6

Run Log for Catchment A.drn run at 19:33:25 on 20/2/2022 using version 2020.05
No water upwelling from any pit.
Freeboard was less than 0.15m at Pit768
Flows were safe in all overflow routes.

CATCHMENT A - 1% AEP

DRAINS results prepared from Version 2020.05

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Pre A3	20.08		5.125				
Pre A2	12.18		11.959				
Pre Discharge Point A	12.08		11.693				
N434	12.84		6.789				
Post Discharge A	10.44		0				
Pit768	23.07		3.162		0	0.731	Outlet System
N463	20.06		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre A3 Cat	5.125	0.64	4.972	2.12	36.03	0	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Pre A2 Cat	7.241	0	7.241	0	32.29	0	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Post A2 Int Cat	6.988	3.518	3.734	7.4	14.31	0	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1
Post A2 Ext Cat	2.512	0	2.512	0	32.29	0	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Post A3 Int Cat	3.162	2.02	1.142	7.19	7.52	0	AR&R 100 year, 15 minutes storm, average 143 mm/h, Zone 1
Post A3 Ext Cat	4.217	0.347	4.134	2.12	36.03	0	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

Outflow Volumes for Total Catchment (12.9 impervious + 86.7 pervious = 99.7 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 226 mm/h, Zone 1	18749.16	13230.90 (70.6%)	2302.95 (94.7%)	10927.95 (67.0%)
AR&R 100 year, 10 minutes storm, average 172 mm/h, Zone 1	28586.76	22686.42 (79.4%)	3579.14 (96.5%)	19107.28 (76.8%)
AR&R 100 year, 15 minutes storm, average 143 mm/h, Zone 1	35701.88	29449.67 (82.5%)	4502.13 (97.2%)	24947.54 (80.3%)
AR&R 100 year, 20 minutes storm, average 124 mm/h, Zone 1	41356.94	34775.36 (84.1%)	5235.75 (97.6%)	29539.61 (82.1%)
AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1	47086.75	40133.91 (85.2%)	5979.07 (97.9%)	34154.84 (83.3%)
AR&R 100 year, 30 minutes storm, average 101 mm/h, Zone 1	50195.42	42576.50 (84.8%)	6382.33 (98.0%)	36194.16 (82.9%)
AR&R 100 year, 45 minutes storm, average 80.4 mm/h, Zone 1	60082.86	51818.51 (86.2%)	7664.97 (98.3%)	44153.55 (84.4%)
AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1	67800.12	58587.34 (86.4%)	8666.07 (98.5%)	49921.27 (84.6%)
AR&R 100 year, 1.5 hours storm, average 53.3 mm/h, Zone 1	79754.72	68612.63 (86.0%)	10216.86 (98.7%)	58395.77 (84.1%)
AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1	89179.55	76032.36 (85.3%)	11439.58 (98.9%)	64592.78 (83.2%)
AR&R 100 year, 3 hours storm, average 34.8 mm/h, Zone 1	104110.79	87290.78 (83.8%)	13376.57 (99.0%)	73914.21 (81.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
BA2 PrimaryOutlet	2.987	7.29	14.226	12.898	AR&R 100 year, 20 minutes storm, average 124 mm/h, Zone 1
Dummy1	10.512	17.46	12.837	10.438	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Minor Network	2.18	2.42	22.972	22.97	AR&R 100 year, 5 minutes storm, average 226 mm/h, Zone 1
BA3 Primary Outlet	4.592	5.82	22.156	20.056	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm
Exs. Crk	5.068	0			AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Dummy	11.693	3.12			AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Exs. Crk	4.576	0			AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

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
Outlet Weir	2.698	2.673						AR&R 100 year, 20 minutes storm, average 124 mm/h, Zone 1
Major Network	0.731	0.705	2.911	0.21	0.21	8.23	1.09	AR&R 100 year, 20 minutes storm, average 124 mm/h, Zone 1
Emergency Spill								

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin A2	15.55	2045.8	5.673	2.987	2.685
Basin A3	22.97	3181	4.592	4.592	0

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre A3	12574.53	12501.07	0	0.6
Pre A2	28508.87	28231.87	0	1
Pre Discharge Point A	28231.87	28231.87	0	0
Basin A2	10684.93	10680.89	22.08	-0.2
N434	29041.69	28561.09	0	1.7
Post Discharge A	28561.09	28561.09	0	0
Pit768	4005.93	3856.06	0	3.7
Basin A3	13775.91	13251.55	524.36	0
N463	13251.55	12808.16	0	3.3

Run Log for Catchment A.drn run at 19:34:25 on 20/2/2022 using version 2020.05
No water upwelling from any pit.
Freeboard was less than 0.15m at Pit768
Flows were safe in all overflow routes.

CATCHMENT B and C - 63.2% AEP

DRAINS results prepared from Version 2020.05

Version 8

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Post B	-0.02		0				
Post B Outlet	-0.42		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre B Cat	0.145	0	0.145	0	42.06	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
Pre C Cat	0.1	0	0.1	0	43.96	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
Post C Cat	0.082	0.051	0.032	5	5	2	AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1
Post B Cat	0.426	0.324	0.127	4.28	20.91	0	AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.80 impervious + 6.55 pervious = 8.35 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 76.07 mm/h, Zone 1	529	114.66 (21.7%)	96.04 (84.2%)	18.62 (4.5%)
AR&R 1 year, 5 minutes storm, average 22.0 mm/h, Zone 1	152.99	14.99 (9.8%)	14.99 (45.5%)	0.00 (0.0%)
AR&R 1 year, 5 minutes storm, average 76.1 mm/h, Zone 1	529	114.66 (21.7%)	96.04 (84.2%)	18.62 (4.5%)
AR&R 1 year, 10 minutes storm, average 58.2 mm/h, Zone 1	808.91	353.37 (43.7%)	156.37 (89.7%)	197.01 (31.0%)
AR&R 1 year, 15 minutes storm, average 48.5 mm/h, Zone 1	1012.25	533.42 (52.7%)	200.20 (91.8%)	333.22 (42.0%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	1174.42	674.81 (57.5%)	235.15 (92.9%)	439.66 (47.7%)
AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1	1338.4	815.63 (60.9%)	270.49 (93.8%)	545.14 (51.9%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	1428.73	873.65 (61.1%)	289.97 (94.2%)	583.68 (52.1%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	1714.27	1093.55 (63.8%)	351.51 (95.1%)	742.04 (55.2%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	1937.57	1258.81 (65.0%)	399.64 (95.7%)	859.17 (56.5%)
AR&R 1 year, 1.5 hours storm, average 18.2 mm/h, Zone 1	2279.37	1471.73 (64.6%)	473.31 (96.3%)	998.42 (55.8%)
AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1	2548.42	1602.10 (62.9%)	531.31 (96.7%)	1070.79 (53.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Low Level	0.129	1.96	0.645	0.165	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
Dummy	0.132	2.48	-0.016	-0.416	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
Mid	0.002	0.002						AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin B	0.64	324.9	0.132	0.129	0.002

CONTINUITY CHECK for AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre B	350.51	350.51	0	0
Pre C	251.95	251.95	0	0
Post C	76.08	76.08	0	0
Basin B	580.28	480.37	99.9	0
Post B	480.37	479.6	0	0.2
Post B Outlet	479.6	479.6	0	0

Run Log for Post Development B and D.drn run at 19:59:05 on 17/2/2022 using version 2020.05

CATCHMENT B and C - 10% AEP

DRAINS results prepared from Version 2020.05

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Post B	0.05		0				
Post B Outlet	-0.35		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre B Cat	0.435	0	0.435	0	32.95	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Pre C Cat	0.305	0	0.305	0	34.41	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Post C Cat	0.159	0.097	0.063	5	5	2	AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1
Post B Cat	0.966	0.62	0.398	3.76	16.59	0	AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.80 impervious + 6.55 pervious = 8.35 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 146 mm/h, Zone 1	1016.21	599.80 (59.0%)	201.05 (91.8%)	398.75 (50.0%)
AR&R 10 year, 10 minutes storm, average 112 mm/h, Zone 1	1551.2	1106.06 (71.3%)	316.36 (94.6%)	789.70 (64.9%)
AR&R 10 year, 15 minutes storm, average 92.3 mm/h, Zone 1	1925.61	1454.46 (75.5%)	397.06 (95.7%)	1057.40 (70.0%)
AR&R 10 year, 20 minutes storm, average 80.8 mm/h, Zone 1	2247.31	1753.75 (78.0%)	466.40 (96.3%)	1287.34 (73.0%)
AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1	2559.9	2039.92 (79.7%)	533.78 (96.7%)	1506.14 (75.0%)
AR&R 10 year, 30 minutes storm, average 65.4 mm/h, Zone 1	2730	2182.96 (80.0%)	570.44 (96.9%)	1612.52 (75.3%)
AR&R 10 year, 45 minutes storm, average 52.3 mm/h, Zone 1	3271.45	2652.23 (81.1%)	687.15 (97.4%)	1965.08 (76.6%)
AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1	3694.4	3007.41 (81.4%)	778.31 (97.7%)	2229.10 (76.9%)
AR&R 10 year, 1.5 hours storm, average 34.7 mm/h, Zone 1	4345.94	3516.84 (80.9%)	918.75 (98.1%)	2598.10 (76.2%)
AR&R 10 year, 2 hours storm, average 29.1 mm/h, Zone 1	4858.46	3878.65 (79.8%)	1029.22 (98.3%)	2849.43 (74.8%)
AR&R 10 year, 3 hours storm, average 22.6 mm/h, Zone 1	5670.84	4430.41 (78.1%)	1204.32 (98.5%)	3226.09 (72.5%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Low Level	0.17	2.44	0.997	0.187	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Dummy	0.432	3.58	0.046	-0.353	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
Mid	0.261	0.261						AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin B	1	584.7	0.432	0.17	0.261

CONTINUITY CHECK for AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre B	913.53	913.53	0	0
Pre C	658.08	658.08	0	0
Post C	161.22	161.22	0	0
Basin B	1274.59	1112.89	161.7	0
Post B	1112.89	1111.89	0	0.1
Post B Outlet	1111.89	1111.89	0	0

Run Log for Post Development B and D.drn run at 19:59:05 on 17/2/2022 using version 2020.05

CATCHMENT B and C - 1% AEP

DRAINS results prepared from Version 2020.05

Version 8

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Post B	0.07		0				
Post B Outlet	-0.33		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre B Cat	0.776	0	0.776	0	23.24	0	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1
Pre C Cat	0.537	0	0.537	0	24.25	0	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1
Post C Cat	0.225	0.136	0.089	5	5	2	AR&R 100 year, 15 minutes storm, average 143 mm/h, Zone 1
Post B Cat	1.495	0.857	0.684	3.48	14.28	0	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1

Outflow Volumes for Total Catchment (1.80 impervious + 6.55 pervious = 8.35 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 226 mm/h, Zone 1	1569.9	1159.49 (73.9%)	320.39 (94.7%)	839.10 (68.1%)
AR&R 100 year, 10 minutes storm, average 172 mm/h, Zone 1	2393.62	1954.70 (81.7%)	497.94 (96.5%)	1456.76 (77.6%)
AR&R 100 year, 15 minutes storm, average 143 mm/h, Zone 1	2989.39	2523.79 (84.4%)	626.35 (97.2%)	1897.43 (80.9%)
AR&R 100 year, 20 minutes storm, average 124 mm/h, Zone 1	3462.9	2972.02 (85.8%)	728.41 (97.6%)	2243.60 (82.6%)
AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1	3942.66	3424.89 (86.9%)	831.82 (97.9%)	2593.06 (83.8%)
AR&R 100 year, 30 minutes storm, average 101 mm/h, Zone 1	4202.96	3659.01 (87.1%)	887.93 (98.0%)	2771.08 (84.0%)
AR&R 100 year, 45 minutes storm, average 80.4 mm/h, Zone 1	5030.85	4412.64 (87.7%)	1066.37 (98.3%)	3346.27 (84.8%)
AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1	5677.03	4986.56 (87.8%)	1205.65 (98.5%)	3780.90 (84.9%)
AR&R 100 year, 1.5 hours storm, average 53.3 mm/h, Zone 1	6678.02	5840.67 (87.5%)	1421.41 (98.8%)	4419.26 (84.4%)
AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1	7467.18	6478.68 (86.8%)	1591.51 (98.9%)	4887.17 (83.4%)
AR&R 100 year, 3 hours storm, average 34.8 mm/h, Zone 1	8717.4	7448.94 (85.4%)	1860.98 (99.0%)	5587.96 (81.7%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Low Level	0.209	2.95	1.377	0.2	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Dummy	0.588	3.92	0.07	-0.33	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm

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
Mid	0.379	0.379						AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin B	1.38	940.7	0.588	0.209	0.379

CONTINUITY CHECK for AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre B	1063.13	1063.13	0	0
Pre C	766.05	766.05	0	0
Post C	177.44	177.44	0	0
Basin B	1418.27	1051.42	366.91	0
Post B	1051.42	1050.12	0	0.1
Post B Outlet	1050.12	1050.12	0	0

Run Log for Post Development B and D.drn run at 19:59:05 on 17/2/2022 using version 2020.05

CATCHMENT D - 63.2% AEP

DRAINS results prepared from Version 2020.05

Version 8

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Adj. Lot	1.03		0.035				
HW1	0.8		0.638		0.65	0	None
Ext. Pit	0.63		0		0.72	0	None
N413	-1.07		0				
Wallis Crk	1.06		0.609				
N6513	0.69		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre D Cat	0.563	0	0.563	0	39.63	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
Adj. Lot Cat	0.035	0	0.035	0	41.96	0	AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
Wallis Crk Cat	0.609	0	0.609	5	36	2	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
Post D Cat	1.563	1.149	0.483	8.7	12.72	0	AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1

Outflow Volumes for Total Catchment (6.26 impervious + 24.4 pervious = 30.6 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 1 year, 5 minutes storm, average 76.07 mm/h, Zone 1	1942.14	402.80 (20.7%)	334.23 (84.2%)	68.57 (4.4%)
AR&R 1 year, 5 minutes storm, average 22.0 mm/h, Zone 1	561.68	52.17 (9.3%)	52.17 (45.5%)	0.00 (0.0%)
AR&R 1 year, 5 minutes storm, average 76.1 mm/h, Zone 1	1942.14	402.80 (20.7%)	334.23 (84.2%)	68.57 (4.4%)
AR&R 1 year, 10 minutes storm, average 58.2 mm/h, Zone 1	2969.77	1261.99 (42.5%)	544.19 (89.7%)	717.80 (30.4%)
AR&R 1 year, 15 minutes storm, average 48.5 mm/h, Zone 1	3716.29	1929.52 (51.9%)	696.73 (91.8%)	1232.79 (41.7%)
AR&R 1 year, 20 minutes storm, average 42.2 mm/h, Zone 1	4311.68	2452.21 (56.9%)	818.38 (92.9%)	1633.83 (47.6%)
AR&R 1 year, 25 minutes storm, average 38.5 mm/h, Zone 1	4913.7	2972.25 (60.5%)	941.38 (93.8%)	2030.86 (51.9%)
AR&R 1 year, 30 minutes storm, average 34.2 mm/h, Zone 1	5245.34	3194.33 (60.9%)	1009.15 (94.2%)	2185.19 (52.4%)
AR&R 1 year, 45 minutes storm, average 27.4 mm/h, Zone 1	6293.65	4000.29 (63.6%)	1223.34 (95.1%)	2776.95 (55.5%)
AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1	7113.45	4606.56 (64.8%)	1390.85 (95.7%)	3215.71 (56.8%)
AR&R 1 year, 1.5 hours storm, average 18.2 mm/h, Zone 1	8368.3	5380.65 (64.3%)	1647.24 (96.3%)	3733.41 (56.1%)
AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1	9356.09	5845.90 (62.5%)	1849.07 (96.7%)	3996.82 (53.7%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Basin Bypass Pipe	0.628	1.15	0.727	0.627	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
Exs. Pipe	1.159	6.06	0.291	-1.07	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
Twin 450	0.547	4.14	0.895	0.695	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1
DN1050 Outlet Pipe	0.547	4.89	0.695	0.627	AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm
Dummy	0.035	0			AR&R 1 year, 1 hour storm, average 23.2 mm/h, Zone 1
Dummy2	0.608	0.95			AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1

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
OF61	0	0	1.265	0	0	0	0	
OF62	0	0	1.789	0	0	0	0	
Top of Pit								
Pit Cutout								

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin D	1.34	1039.4	0.547	0.547	0

CONTINUITY CHECK for AR&R 1 year, 2 hours storm, average 15.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre D	1615.28	1615.28	0	0
Adj. Lot	105.63	105.63	0	0
HW1	1663.78	1657.47	0	0.4
Ext. Pit	4194.51	4192.93	0	0
N413	4192.93	4192.93	0	0
Wallis Crk	1558.11	1558.15	0	0
Basin D	2566.86	2537.91	28.95	0
N6513	2537.91	2537.04	0	0

Run Log for Catchment D.drn run at 19:09:01 on 20/2/2022 using version 2020.05
No water upwelling from any pit. Freeboard was adequate at all pits.
Flows were safe in all overflow routes.

Run Log for Catchment A.drn run at 18:37:24 on 20/2/2022 using version 2020.05
No water upwelling from any pit.
Freeboard was less than 0.15m at Pit768
Flows were safe in all overflow routes.

CATCHMENT D - 10% AEP

DRAINS results prepared from Version 2020.05

Version 8

PIT / NODE DETAILS

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Adj. Lot	1.27		0.106				
HW1	1.27		1.54		0.18	0	None
Ext. Pit	1.08		0		0.27	0	None
N413	-0.87		0				
Wallis Crk	1.27		1.444				
N6513	1.1		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre D Cat	1.645	0	1.645	0	31.41	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Adj. Lot Cat	0.106	0	0.106	0	32.41	0	AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Wallis Crk Cat	1.444	0	1.444	5	36	2	AR&R 10 year, 1.5 hours storm, average 34.7 mm/h, Zone 1
Post D Cat	3.677	2.24	1.437	7.86	9.82	0	AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1

Outflow Volumes for Total Catchment (6.26 impervious + 24.4 pervious = 30.6 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 10 year, 5 minutes storm, average 146 mm/h, Zone 1	3730.85	2135.67 (57.2%)	699.70 (91.8%)	1435.97 (48.4%)
AR&R 10 year, 10 minutes storm, average 112 mm/h, Zone 1	5694.94	4001.79 (70.3%)	1101.01 (94.6%)	2900.78 (64.0%)
AR&R 10 year, 15 minutes storm, average 92.3 mm/h, Zone 1	7069.53	5287.26 (74.8%)	1381.87 (95.7%)	3905.39 (69.4%)
AR&R 10 year, 20 minutes storm, average 80.8 mm/h, Zone 1	8250.6	6391.23 (77.5%)	1623.19 (96.3%)	4768.04 (72.6%)
AR&R 10 year, 25 minutes storm, average 73.6 mm/h, Zone 1	9398.21	7439.32 (79.2%)	1857.68 (96.7%)	5581.65 (74.6%)
AR&R 10 year, 30 minutes storm, average 65.4 mm/h, Zone 1	10022.71	7924.37 (79.1%)	1985.27 (96.9%)	5939.10 (74.5%)
AR&R 10 year, 45 minutes storm, average 52.3 mm/h, Zone 1	12010.55	9698.25 (80.7%)	2391.44 (97.4%)	7306.81 (76.5%)
AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1	13563.35	11005.63 (81.1%)	2708.71 (97.7%)	8296.92 (76.9%)
AR&R 10 year, 1.5 hours storm, average 34.7 mm/h, Zone 1	15955.34	12876.54 (80.7%)	3197.45 (98.1%)	9679.10 (76.2%)
AR&R 10 year, 2 hours storm, average 29.1 mm/h, Zone 1	17836.98	14199.51 (79.6%)	3581.92 (98.3%)	10617.59 (74.8%)
AR&R 10 year, 3 hours storm, average 22.6 mm/h, Zone 1	20819.51	16213.31 (77.9%)	4191.32 (98.5%)	12022.00 (72.6%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Basin Bypass Pipe	1.541	1.71	1.199	1.076	AR&R 10 year, 1.5 hours storm, average 34.7 mm/h, Zone 1
Exs. Pipe	3.104	7.96	0.479	-0.875	AR&R 10 year, 2 hours storm, average 29.1 mm/h, Zone 1
Twin 450	0.741	2.33	1.301	1.101	AR&R 10 year, 2 hours storm, average 29.1 mm/h, Zone 1
DN1050 Outlet Pipe	1.616	3.11	1.101	1.076	AR&R 10 year, 2 hours storm, average 29.1 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)			Due to Storm
Dummy	0.106	1.12			AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1
Dummy2	1.442	1.11			AR&R 10 year, 1.5 hours storm, average 34.7 mm/h, Zone 1

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
OF61	0	0	1.265	0	0	0	0	
OF62	0	0	1.789	0	0	0	0	
Top of Pit								
Pit Cutout	0.871	0.871						AR&R 10 year, 2 hours storm, average 29.1 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin D	1.73	2041.2	1.612	0.741	0.871

CONTINUITY CHECK for AR&R 10 year, 1 hour storm, average 44.3 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre D	3359.02	3359.02	0	0
Adj. Lot	219.87	220.13	0	-0.1
HW1	3440.87	3417.18	0	0.7
Ext. Pit	7216.17	7214.68	0	0
N413	7214.68	7214.68	0	0
Wallis Crk	3218.89	3220.74	0	-0.1
Basin D	4207.84	3800.12	407.73	0
N6513	3800.12	3798.99	0	0

Run Log for Catchment D.drn run at 19:07:32 on 20/2/2022 using version 2020.05
No water upwelling from any pit. Freeboard was adequate at all pits.
Flows were safe in all overflow routes.

N463	13251.55	12808.16	0	3.3

Run Log for Catchment A.drn run at 18:37:24 on 20/2/2022 using version 2020.05
No water upwelling from any pit.
Freeboard was less than 0.15m at Pit768
Flows were safe in all overflow routes.

CATCHMENT D - 1% AEP

DRAINS results prepared from Version 2020.05

PIT / NODE DETAILS

Version 8

Name	Max HGL	Max Pond HGL	Max Surface Flow Arriving (cu.m/s)	Max Pond Volume (cu.m)	Min Freeboard (m)	Overflow (cu.m/s)	Constraint
Adj. Lot	1.75		0.195				
HW1	1.75		2.478		-0.3	0.826	Headwall height/system capacity
Ext. Pit	1.59		0.826		0	1.038	Outlet System
N413	-0.8		1.038				
Wallis Crk	1.75		2.321				
N6513	1.66		0				

SUB-CATCHMENT DETAILS

Name	Max Flow Q (cu.m/s)	Paved Max Q (cu.m/s)	Grassed Max Q (cu.m/s)	Paved Tc (min)	Grassed Tc (min)	Supp. Tc (min)	Due to Storm
Pre D Cat	2.926	0	2.926	0	22.66	0	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1
Adj. Lot Cat	0.195	0	0.195	0	22.25	0	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1
Wallis Crk Cat	2.321	0	2.321	5	36	2	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1
Post D Cat	5.332	3.195	2.137	7.19	7.52	0	AR&R 100 year, 15 minutes storm, average 143 mm/h, Zone 1

Outflow Volumes for Total Catchment (6.26 impervious + 24.4 pervious = 30.6 total ha)

Storm	Total Rainfall cu.m	Total Runoff cu.m (Runoff %)	Impervious Runoff cu.m (Runoff %)	Pervious Runoff cu.m (Runoff %)
AR&R 100 year, 5 minutes storm, average 226 mm/h, Zone 1	5763.62	4179.05 (72.5%)	1115.05 (94.7%)	3064.01 (66.8%)
AR&R 100 year, 10 minutes storm, average 172 mm/h, Zone 1	8787.77	7104.26 (80.8%)	1732.95 (96.5%)	5371.31 (76.8%)
AR&R 100 year, 15 minutes storm, average 143 mm/h, Zone 1	10975.01	9198.60 (83.8%)	2179.85 (97.2%)	7018.74 (80.4%)
AR&R 100 year, 20 minutes storm, average 124 mm/h, Zone 1	12713.42	10848.84 (85.3%)	2535.05 (97.6%)	8313.79 (82.2%)
AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1	14474.8	12470.75 (86.2%)	2894.94 (97.9%)	9575.80 (83.1%)
AR&R 100 year, 30 minutes storm, average 101 mm/h, Zone 1	15430.43	13229.59 (85.7%)	3090.20 (98.0%)	10139.39 (82.6%)
AR&R 100 year, 45 minutes storm, average 80.4 mm/h, Zone 1	18469.89	16146.41 (87.4%)	3711.23 (98.3%)	12435.18 (84.6%)
AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1	20842.23	18256.33 (87.6%)	4195.96 (98.5%)	14060.37 (84.8%)
AR&R 100 year, 1.5 hours storm, average 53.3 mm/h, Zone 1	24517.16	21393.91 (87.3%)	4946.84 (98.8%)	16447.07 (84.3%)
AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1	27414.42	23734.34 (86.6%)	5538.81 (98.9%)	18195.53 (83.4%)
AR&R 100 year, 3 hours storm, average 34.8 mm/h, Zone 1	32004.39	27288.72 (85.3%)	6476.65 (99.0%)	20812.07 (81.7%)

PIPE DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Max U/S HGL (m)	Max D/S HGL (m)	Due to Storm
Basin Bypass Pipe	2.103	2.34	1.679	1.595	AR&R 100 year, 30 minutes storm, average 101 mm/h, Zone 1
Exs. Pipe	3.968	8.47	0.629	-0.802	AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1
Twin 450	0.813	2.56	1.824	1.66	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1
DN1050 Outlet Pipe	2.754	3.06	1.66	1.595	AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1

CHANNEL DETAILS

Name	Max Q (cu.m/s)	Max V (m/s)	Due to Storm
Dummy	0.201	1.11	AR&R 100 year, 25 minutes storm, average 113 mm/h, Zone 1
Dummy2	2.326	0.94	AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

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
OF61	0.826	0.826	1.265	0.237	0.22	5.25	0.97	AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1
OF62	1.038	1.038	1.789	0.227	0.28	5.12	1.22	AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1
Top of Pit	0.477	0.477						AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1
Pit Cutout	1.635	1.635						AR&R 100 year, 2 hours storm, average 44.7 mm/h, Zone 1

DETENTION BASIN DETAILS

Name	Max WL	MaxVol	Max Q Total	Max Q Low Level	Max Q High Level
Basin D	1.99	2798.5	2.925	0.813	2.112

CONTINUITY CHECK for AR&R 100 year, 1 hour storm, average 68.0 mm/h, Zone 1

Node	Inflow (cu.m)	Outflow (cu.m)	Storage Change (cu.m)	Difference %
Pre D	5700.24	5700.24	0	0
Adj. Lot	373.36	373.28	0	0
HW1	5827.99	5795.38	0	0.6
Ext. Pit	12004.11	12000.35	0	0
N413	12000.35	12000.35	0	0
Wallis Crk	5455.86	5454.71	0	0
Basin D	6726.87	6210.61	516.26	0
N6513	6210.61	6208.73	0	0

Run Log for Catchment D.drn run at 18:56:40 on 20/2/2022 using version 2020.05
Upwelling occurred at: Ext. Pit
Flows were safe in all overflow routes.

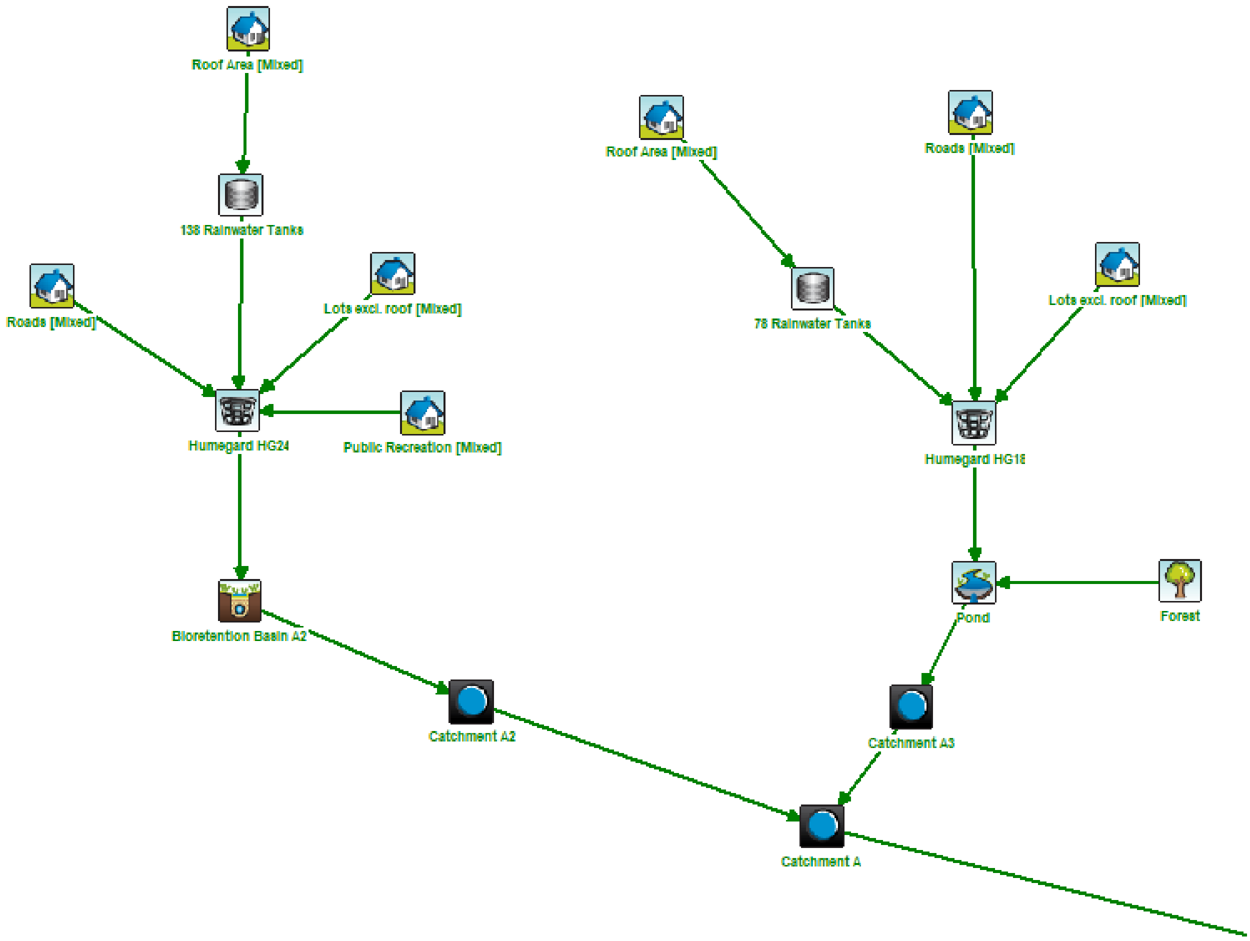
N463	13251.55	12808.16	0	3.3

Run Log for Catchment A.drn run at 18:37:24 on 20/2/2022 using version 2020.05
No water upwelling from any pit.
Freeboard was less than 0.15m at Pit768
Flows were safe in all overflow routes.

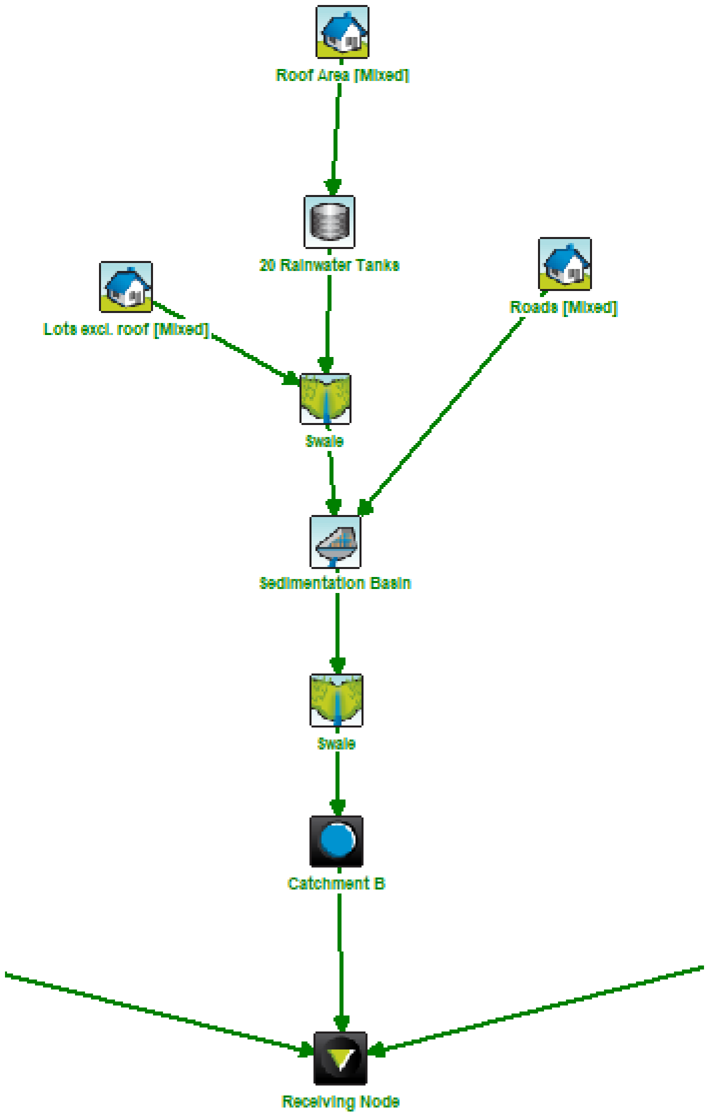
Appendix C

MUSIC TREATMENT TRAIN DIAGRAMS

Catchment A:



Catchment B:


Roof Area [Mixed]
20 Rainwater Tanks
Lots excl. roof [Mixed]
Roads [Mixed]
Swale
Sedimentation Basin
Swale
Catchment B
Receiving Node

Catchment C & D: