ENGINEERING REPORT

FOR

559 ANAMBAH ROAD, GOSFORTH CONCEPT DEVELOPMENT APPLICATION

Project Number: MKR00884

December 2024

Third.i COMMUNITIES

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1 INTRODUCTION

1.1 OVERVIEW

Maker ENG Pty Ltd (Maker) have been engaged by Thirdi Group (Thirdi) to undertake the civil design and documentation including the preparation of an Engineering Report for the proposed development at 559 Anambah Road, Gosforth NSW 2320, being Lot 117 DP 874171.

The lot is distinctly split into two parts with the eastern portion being zoned as General Residential (R1) and the western portion being zoned as Rural Landscape (RU2). This report and the associated development will be focused on the Western RU2 portion of Lot 117 DP 874171 and will be hereon to be referred to as “the site”.

Thirdi proposes the development of a Manufactured Home Estate (MHE) comprising 291 MHE sites as part of Stage 1. This stage will include associated private roads and services, open spaces, community facilities, and drainage reserves. It is noted that the Southern Precinct does not form part of the Stage 1 detailed proposal and will be addressed as part of a future detailed development application. This future stage will encompass additional future MHE sites, private roads and services, open spaces, a community garden, and a drainage reserve. For further details on staging, refer to Section 1.3.

This report summarises the civil design rationale and water cycle management strategy (WCMS) for the proposed development and highlights the designs relationship with the relevant standards and best practice principles.

1.2 ADJOINING DEVELOPMENT

The R1-zoned portion of Lot 117 DP 874171, located east of the site, along with part of Lot 55 DP 8741070, is within the Anambah Urban Release Area and is subject to a concept master plan for approximately 900 residential lots, currently under assessment by Maitland City Council. The proposed adjoining residential subdivision will hereon be referred to as the "neighbouring development" and can be seen below in **Figure 1.1**.

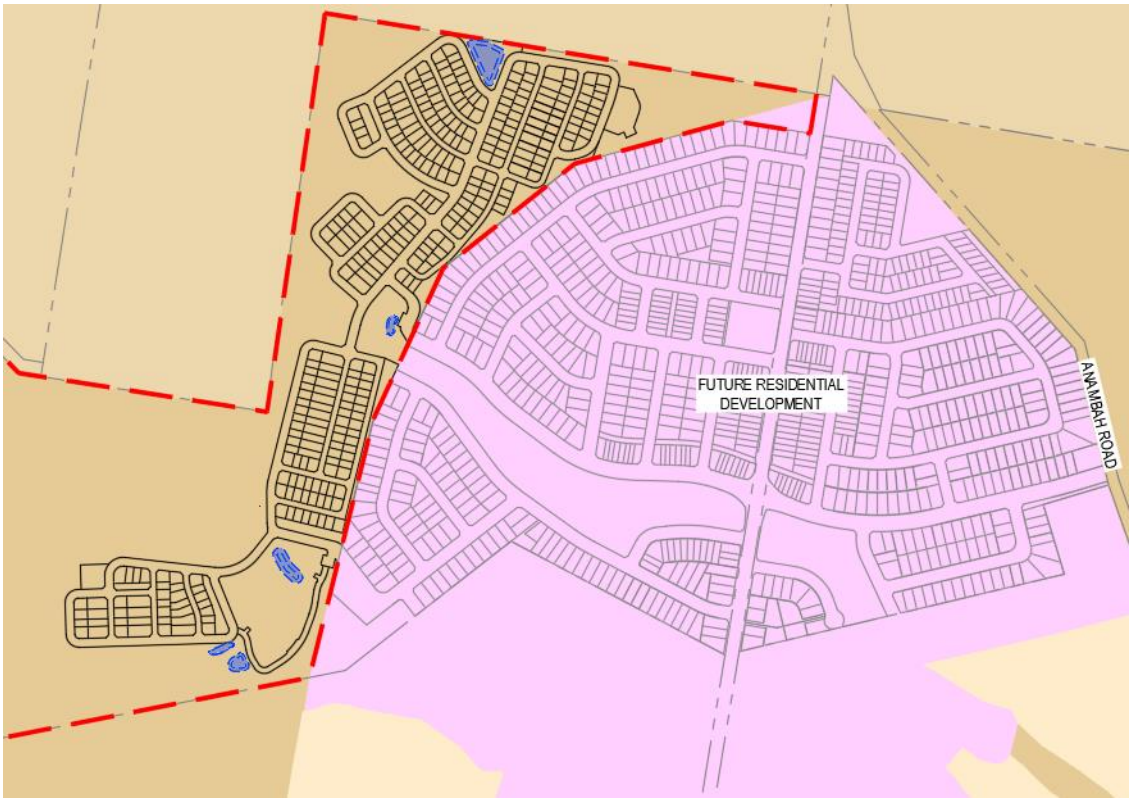

Figure 1.1 – Neighbouring Development

The overarching design intent and decisions throughout the subject site have been developed in conjunction with the neighbouring development. Specifically, the development has been designed to maximise the use of infrastructure that is proposed to be constructed as part of the adjoining development, including the collector road network and lead-in infrastructure in the form of sewer, water and utilities.

The neighbouring development, which borders the site to the east, will provide ingress and egress access points, essential infrastructure, and connections to Anambah Road and River Road to the south. It should be noted that the WCMS for the site is completely independent from that of the neighbouring development and will not rely on any form of downstream water quality treatment or stormwater detention in order to meet the sites targets.

1.3 SITE DESCRIPTION

Site Locality

The subject site is approximately 59 ha in area and is located within the Maitland City Council (MCC) municipality, roughly 10km north-west of Maitland town centre. The site extents can be seen below in **Figure 1.2**.

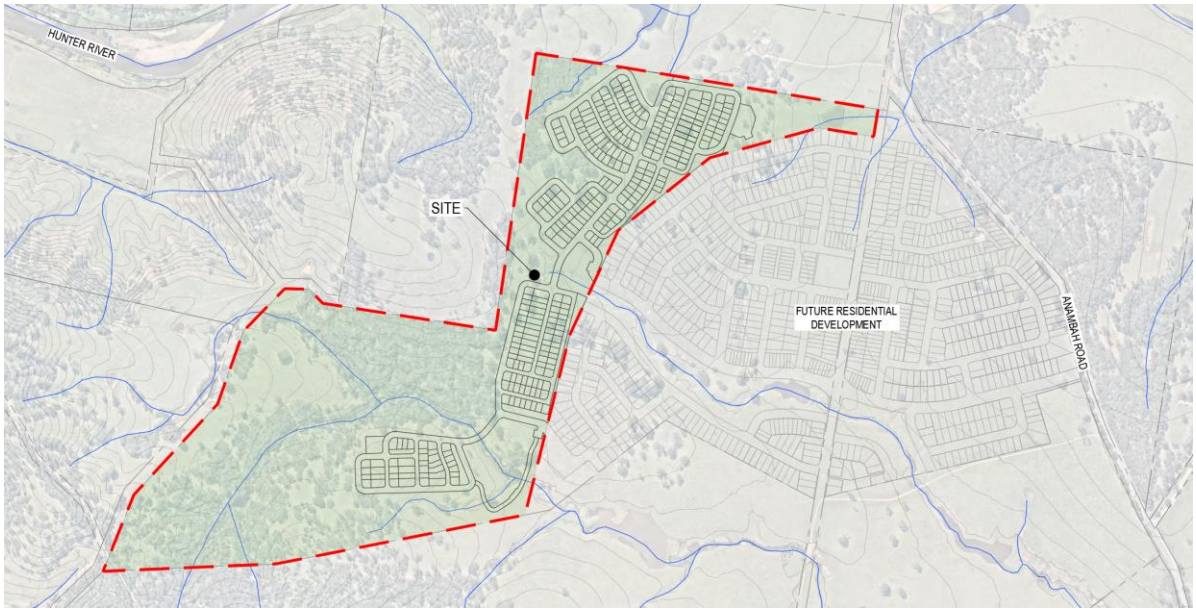

Figure 1.2 – Site Locality ('the site' outlined in red)

The site is predominantly characterized by large areas of short grass prairie with undulating terrain and sporadically scattered trees. A denser forested area is located to the west, adjacent to the proposed development.

The site is divided into four distinct catchment areas:

- The northern section has slopes ranging from 7% to 14%, draining northward to a first-order stream.
- The central section has slopes between 10% and 16%, draining eastward toward the neighbouring development via a separate first-order stream.
- The two southern catchments have slopes varying from 5% to 20%, draining to a third-order watercourse that also flows east, towards the boundary of the neighbouring development.

Site Staging

The development site is divided into two stages: **Stage 1** and an additional **Future Stage.**

- **Stage 1**: This stage is the focus of the detailed development application and encompasses the northern and central portions of the site, as well as the lead-in roads servicing the proposed development. Stage 1 has a total of 291 MHE sites.
- **Future Stage**: This stage is part of the concept development application and includes the southern portion of the site, along with a planned future exit-only access point for the development to the North. The Future Stage has planned total of roughly 41 MHE sites bringing the developments total up to approximately 332 sites.

Figure 1.3 below illustrates the division of the site into these stages. Further details can be found in the Concept Masterplan provided in Maker Engineering Civil Works Plans.

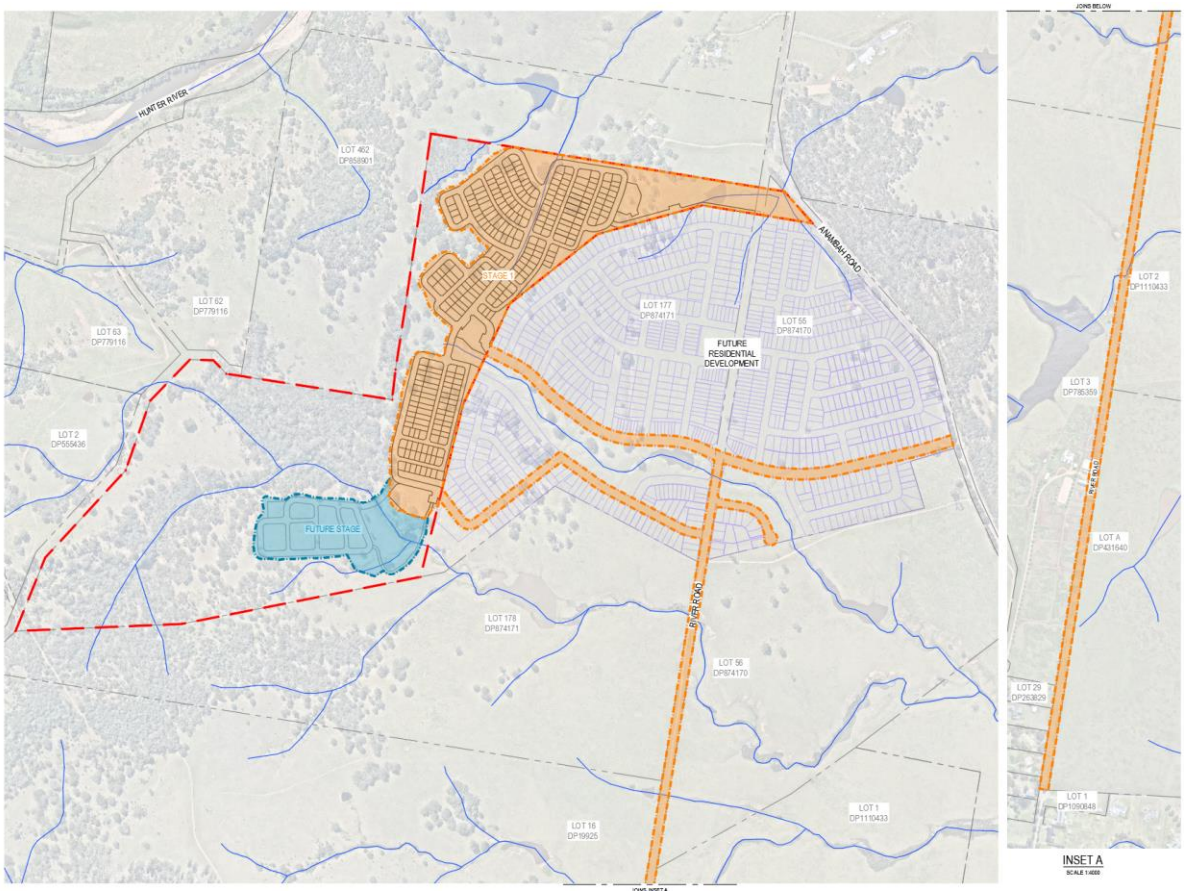

Figure 1.3 – Site Staging

1.4 PROPOSED WORKS

The proposed development is a private, gated Manufactured Home Estate (MHE) community, featuring 332 individual residential sites along with communal open spaces integrated within a central clubhouse and associated community facilities. The development includes an internal road network designed to ensure efficient circulation throughout the site with bushfire-compliant roads to form the perimeter of the site, enhancing safety and accessibility.

A shared pathway network is planned along the perimeter roads, creating a continuous loop around the development to support pedestrian and cycling access, link key communal areas and provide a buffer to the surrounding bushfire hazards.

The design also incorporates four bioretention basins to manage stormwater runoff and improve water quality.

The site will be accessed via two ingress/egress points connecting to the neighbouring development. These access points are strategically located to facilitate the movement of both vehicles and pedestrians.

1.5 RELEVANT GUIDELINES

This report and the associated design has been prepared in accordance with the following guidelines:

- Maitland City Council Manual of Engineering Standards
- Maitland City Council Development Control Plan 2011 (DCP)
- NSW Government: Local Government (Manufactured Home Estates, Caravan Parks, Camping Grounds and Moveable Dwellings) Regulation 2021
- NSW MUSIC Modelling Guidelines 2015
- Australian Rainfall and Runoff 2019 (ARR 2019)
- NSW RFS: Planning for Bushfire Protection (2019)
- All Relevant Australian Standards

2 CIVIL ENGINEERING

2.1 CONSTRAINTS

The proposed layout has been designed with consideration to the following key constraints:

- Existing topography
- Proximity to adjacent properties
- Retention of vegetation and high-value trees
- Matching neighbouring developments levels
- Servicing requirements
- Riparian corridors of the Hunter River tributaries
- Bushfire Asset Protection Zones (APZ)
- Environmentally sensitive areas
- Rural Landscape Objectives

2.2 SITE PREPERATION

Site preparation for the proposed development will require the removal of all existing vegetation and trees within the civil extent of works. Tree felling will be undertaken in accordance with all relevant regulations.

In addition, existing farm dams within the extent of works will be decommissioned and drained with all resulting voids backfilled and compacted to provide a stable and level base for future construction activities.

2.3 EARTHWORKS

The existing site features varying topography with grades averaging 7 – 10% and exceeding 15% in some areas.

The proposed grading strategy utilises a combination of vegetated batters and retaining walls to balance cut and fill throughout the site and produce a relatively flat sites for the future manufactured homes.

The grading constraints that have influenced earthworks throughout the development include:

- Matching into the existing surface at boundaries of neighbouring properties
- Meeting design levels of the neighbouring development
- Stormwater runoff and overland flow
- Stormwater drainage and discharge of treated flow to watercourses
- Minimising grade across lots
- Pedestrian and cyclist accessibility

Based on the above restrictions, the earthworks volumes for Stage 1 are as follows in **Table 2.1**.

Table 2.1 – Earthworks Volumes

Stage 1 - Earthworks Volumes	
Cut Volume	123,600 m^3
Fill Volume	94,200 m^3
Balance	29,900 m^3 (Cut)

The volumes are taken from existing surface to finished design surface including detention/water quality basins. There have been no allowances made for stripping of topsoil, trenching of services and the box out of road pavements within the calculations.

A bulk earthworks plan can be found in the Maker Engineering Civil Works Plans.

2.4 SITE GRADING AND RETAINING

The typical grading for the site achieves a minimum of 1% and a maximum of 3% across proposed site frontages, with a consistent 1% grade from front to back. Retaining walls are proposed where required at the back of lots, with a maximum height of 1.0m. Where a height difference exceeds 1.0m vegetated batters are typically proposed to be utilized in place of retaining walls. Exceptions to this typical design are addressed in the civil works plans.

2.5 ROAD GRADING

The proposed road grading for the development has been designed in accordance with the MCC Manual of Engineering Standards – Part 4 Road Design, adopting the following criteria:

Road Grading

- Min Grade: 0.5%
- Max Grade: 16% Flexible Pavement, 25% Rigid Pavement

The typical grading for roads fronting residential lots range between 1% and 3% reducing the requirement for side retaining walls, enhancing accessibility for residents and providing suitable on-street parking locations.

Interface Batters

- Desired interface: 1 in 4 vegetated batters
- Max interface: 1 in 2 vegetated batters

1 in 4 vegetated batters were opted for in less constrained areas with 1 in 2 vegetated batters and retaining walls utilised to minimise vegetation removal, avoid significant trees and prevent encroachment into neighbouring properties.
Road Typologies

The road reserve types and width that are proposed for the development can be seen in the **Table 2.2** below.

Typical road details are provided in Maker Engineering Civil Works Plans.

Table 2.2 – Road Cross Sections

Road Type	Road Reserve Width	Carriageway Width	Verge Width	Comment
Entry Road	Varies	Varies	1.50m / 1.50m	-Two way in, one way out with gated entry - 4.0m Travel Lanes
Boulevard	14.75m	8.50m	1.50m / 4.75m	- 2.5m Shared Path - Centralised Median
Perimeter Road	13.50m	10.50m	1.50m / 1.50m	- 2.5m External Shared Path - 2.5m Parking
Modified Access Road	11.00m	8.00m	1.50m / 1.50m	- Centrally Drained - Edge Restraint Kerb -8.0m Carriageway for internal transition between perimeter roads
Access Road	9.00m	6.00m	1.50m / 1.50m	- Centrally Drained - Edge Restraint Kerb
Access Trail One Way	6.00m	-	-	- 4.0m Travel Lane
Access Trail Two Way	11.00m	-	-	- 4.0m Travel Lanes

2.6 PARKING

The Local Government (Manufactured Home Estates, Caravan Parks, Camping Grounds and Moveable Dwellings) Regulation requires MHE's with more than 105 sites to have 20 visitor spaces, plus 1 additional space for every 7 sites above 140. This requirement equates to a total of 42 visitor spaces required for Stage 1 and an additional 6 spaces for the Future Stage bringing the total up to 48 spaces for this development.

In addition to this requirement, MHE sites are required to have 1 disabled parking space for every 100 sites plus an additional disabled space for any remaining sites. This requirement equates to a total of 4 disabled spaces for the development.

The proposed development includes a combination of on-street parking along the perimeter roads of the site and off-street parking located at the community areas/entry of the site to meet these parking requirements.

In addition to these requirements, there has also been the inclusion of a caravan parking area for the development.

A summary of parking provisions can be seen in **Table 2.3** below.

Table 2.3 – Parking Provisions

STAGE 1		
Type	**Dimensions**	**Number**
On-Street - Parallel	2.5 m x 6.1 m	78
On-Street – 45 Degree	2.6 m x 5.4 m	5
On-Street – 45 Degree (Disabled)	3.2 m x 5.4 m	2
On-Street – 90 Degree	2.6 m x 5.4 m	4
On-Street – 90 Degree (Disabled)	2.5 m x 5.4 m (With 2.4m x 5.4m Shared Area)	2
Off-Street – 90 Degree	2.6 m x 5.4 m	7
Off-Street – 90 Degree (Disabled)	2.5 m x 5.4 m (With 2.4m x 5.4m Shared Area)	2
Off-Street – Caravan Parking	3.6 m x 8.9 m	31
FUTURE STAGE		
On-Street - Parallel	2.5 m x 6.1 m	45
	Total	**176**

2.7 CYCLING AND PEDESTRIAN ACCESS

A 2.5m shared path for both pedestrian and cyclist access is proposed along the perimeter of the development, as well as a shared path along the access track linking the southern module to the rest of the site.

In addition to this, a network of footpaths is proposed throughout the community areas, linking the 2.5m shared path along the site perimeter. This pedestrian network will provide connectivity throughout the site and link into the neighbouring development.

2.8 WASTE MANAGEMENT

Waste management for the development has been allowed for through the provision of dedicated bin bays along the perimeter and internal roads. These bin bays are located between parking bays and within the verge to facilitate convenient bin collection. The road network has been designed to allow for the waste collection vehicles movements. Refer to the Landscape Architects plans for additional information.

2.9 BUS ROUTE

There is no provision for internal public bus servicing. Bus access will be provided through the neighbouring development, where the necessary infrastructure and transport connectivity have been planned to accommodate public transport services. We note that the proponent intends to include a community bus as part of the development that may be utilised for weekly trips to the Maitland CBD and resident excursions.

3 ON-SITE DETENTION

On-site detention (OSD) is proposed to ensure runoff is maintained at a comparable level to existing conditions to reduce any potential strain upon downstream stormwater infrastructure.

It should be noted that the flood impacts and risk assessment for this site has been undertaken by Northrop Consulting and does not form part of this report. Please refer to Northrop's Flood Impact and Risk Assessment report for more information.

3.1 HYDROLOGIC MODELLING

Hydrological modelling has been undertaken in DRAINS using Horton/ILSAX hydrology to assess the runoff of each catchment within the site for both pre and post-developed scenarios. DRAINS was then used to size onsite detention to ensure the post-developed flows remain less than or equal to the existing pre-development flows for a range of storms.

IFD and Loss Data

Modelling was completed using DRAINS with IFD and loss data sourced from the ARR 2019 Data Hub for the local area. The adopted hydrological parameters used within DRAINS are summarised below in **Table 3.1**.

Table 3.1 – Hydrological Parameter for DRAINS

Parameter	Value
Paved (impervious) area depression storage	1mm
Supplementary area depression storage	1mm
Grassed (pervious) area depression storage	5mm
Soil Type	3
Overland Flow Calculation	Kinematic Wave Equation

Storm Selection

A range of storm durations were run to determine the critical duration and temporal patterns for each storm event. In accordance with council's stormwater drainage manual, the 1EY, 10% AEP and 1% AEP storm events have been adopted in the analysis to ensure the post-developed flows do not exceed the existing pre-developed flows for each catchment.

Catchment Delineation

In the existing scenario, the site consists of 4 primary catchments each considered 100% pervious. These existing catchments can be seen in the Maker Engineering Civil Works Plans.

Similarly to existing, the developed scenario consists of 4 primary catchments. Impervious percentages for these catchments have been individually calculated using the assumptions outlined below.

A plan showing these developed catchments can be seen in the Maker Engineering Civil Works Plans.

Pervious and Impervious Assumptions

Existing pre-developed catchments have been modelled as 0% impervious due to the vegetated nature of the existing surface with little to no pervious surfaces

The post-developed catchments have been modelled using an average impervious percentage for each individual catchment. This has been calculated assuming 70% impervious for road reserves, 70% impervious for residential lots and 50% impervious for recreation areas. These values align with Maitland City Council's stormwater drainage standards, except for the impervious percentage applied to residential lots. A 70% imperviousness has been adopted for residential lots, as it more accurately reflects the proposed sites within the development, compared to the council's standard of 60%.

Time of Concentration

Time of concentration for the pre-developed catchments was determined using the Kinematic Wave Equation in conjunction with shallow concentrated flow. As outlined within the Australian Rainfall and Runoff (ARR) Guidelines and the Queensland Urban Drainage Manual (QUDM) overland flow typically consists of a combination of sheet flow (occurring at the top of the catchment) and concentrated flow, with the travel times for each component being determined separately.

The Kinematic Wave Equation has only been used for calculating overland flow when stormwater exhibits 'sheet flow' qualities before it concentrates and develops into 'concentrated flow'. Appropriate consideration has been given to determine the point at which sheet flow becomes concentrated flow. The maximum sheet flow travel length that has been used for these catchments is 50 metres given the relatively steep gradient of the existing topography.

Time of concentration for post-developed catchments was set at 5 minutes for the paved (impervious) catchments and 10 minutes for the grassed (pervious) catchments. These times of concentrations were determined using the standard modelling approach for runoff in urban areas outlined in Book 9 of the Australian Rainfall and Runoff Guidelines.

Catchment Parameters

Existing and developed catchment properties are summarised in **Tables 3.2** and **3.3** respectively below.

Table 3.2 – Existing Catchment Properties

Catchment	Pre-Dev North (Stage 1)	Pre-Dev Central (Stage 1)	Pre-Dev South A (Stage 1)	Pre-Dev South B (Future)
Area	8.950 Ha	3.906 Ha	3.843 Ha	8.472 Ha
Impervious Percentage	0%	0%	0%	0%
Pervious Flow Path Length	50 m	50 m	50 m	50 m
Pervious Flow Path Grade	9%	7%	6%	7.5%
Previous Retardance Coefficient (n)	0.15	0.15	0.15	0.15
Additional Time (Pervious) – Calculated using shallow concentrated flow manning's equation	5 mins	3 mins	3 mins	5 mins
Pervious Calibrated Time of Concentration	11 mins	9 mins	9 mins	11 mins

Table 3.3 – Developed Catchment Properties

Catchment	Dev North (Stage 1)	Dev Central (Stage 1)	Dev South A (Stage 1)	Dev South B (Future)
Area - Lot	5.560 Ha	0.741 Ha	2.095 Ha	1.596 Ha
Area - Road	3.221 Ha	0.747 Ha	1.170 Ha	1.214 Ha
Area – Recreation	0.822 Ha	0.301 Ha	0.745 Ha	0.240 Ha
Area – Undeveloped	0.971 Ha	0.485 Ha	0.562 Ha	5.051 Ha
Area – Bypass*	0.180 Ha	0.295 Ha	0.088 Ha	0.371 Ha
Area – Total	10.754 Ha	2.569 Ha	4.660 Ha	8.472 Ha
Catchment % Impervious	65%	58%	65%	54%
Time of Concentration (Impervious)	5 mins	5 mins	5 mins	5 mins
Time of Concentration (Pervious)	10 mins	10 mins	10 mins	10 mins

*Bypass area refers to the portion of the site that was not able to be captured by the developments stormwater network and thus bypasses the proposed OSD basins.

3.2 RESULTS

Pre-developed and undetained post-developed catchments were assessed in DRAINS. The resulting flows are summarised in **Table 3.4** below.

Table 3.4 – Pre-developed and undetained post-developed flows

Catchment	Average Recurrence Interval	Pre-Developed Flow	Post-Developed Flow	Detention Requirement?
North (Stage 1)	1 EY	0.338 m^3/s	1.390 m^3/s	Yes
	10 ARI	1.810 m^3/s	3.300 m^3/s	Yes
	100 ARI	3.580 m^3/s	5.430 m^3/s	Yes
Central (Stage 1)	1 EY	0.176 m^3/s	0.300 m^3/s	Yes*
	10 ARI	0.858 m^3/s	0.756 m^3/s	No*
	100 ARI	1.700 m^3/s	1.260 m^3/s	No*
South A (Stage 1)	1 EY	0.173 m^3/s	0.604 m^3/s	Yes
	10 ARI	0.844 m^3/s	1.430 m^3/s	Yes
	100 ARI	1.670 m^3/s	2.350 m^3/s	Yes
South B (Future)	1 EY	0.320 m^3/s	0.926 m^3/s	Yes
	10 ARI	1.710 m^3/s	2.380 m^3/s	Yes
	100 ARI	3.390 m^3/s	4.080 m^3/s	Yes

*Catchment size has been reduced to decrease the post-developed flow. Detention will still be required for the 1 EY storm event.

Based on the analysis and data presented in the preceding table, it is evident that stormwater detention measures are necessary to comply with MCC's stormwater

management regulations. To meet these regulatory requirements, a combination of detention basins will be implemented across the site. Specifically, three offline detention basins and one online detention basin are proposed. The locality of these detention basins are illustrated in the pre-developed catchment plan provided in Maker Engineering Civil Works Plans.

3.2.1 Basin Sizing

Further detailed hydraulic modelling has been conducted using DRAINS to ensure appropriate sizing of the proposed basins. This modelling accounts for the hydrological characteristics of the site and provides the necessary parameters for basin design. Characteristics of each proposed detention basin are summarised in **Table 3.5**. Additionally, **Table 3.6** outlines the modelled attenuated flow rates that have resulted from the implementation of these proposed detention measures.

Table 3.5 – Proposed Basin Characteristics

Basin – North (Stage 1)	
Type	On-site Detention/Bio Retention Basin (Offline)
Low Flow Outlet	Outlet pipe with DN 390mm Orifice at CL 41.05 AHD
High Flow Weir Outlet	Grated inlet pit with 3.6m long weir at RL 42.64 AHD
Emergency Overflow	4.0m long concrete weir at RL 43.3 AHD. Modelling indicates that this weir will not be activated in the 1% AEP event.
Bottom of Basin	RL 41.90 AHD
Top of Basin / Top of Bank	RL 43.70 AHD
Basin – Central (Stage 1)	
Type	On-site Detention/Bio Retention Basin (Offline)
Low Flow Outlet	Outlet pipe with DN 235mm Orifice at CL 47.55 AHD
High Flow Weir Outlet	Grated inlet pit with 4.8m long weir at RL 48.65 AHD
Emergency Overflow	4.0m long concrete weir at RL 48.90 AHD. Modelling indicates that this weir will not be activated in the 1% AEP event.
Bottom of Basin	RL 48.40 AHD
Top of Basin / Top of Bank	RL 49.20 AHD
Basin - South A (Stage 1)	
Type	On-site Detention/Bio Retention Basin (Offline)
Low Flow Outlet	Outlet pipe with DN 265mm Orifice at CL 39.15 AHD
High Flow Weir Outlet	Grated inlet pit with 3.6m long weir at RL 40.95 AHD
Emergency Overflow	4.0m long concrete weir at RL 41.40 AHD. Modelling indicates that this weir will not be activated in the 1% AEP event.
Bottom of Basin	RL 40.00 AHD
Top of Basin / Top of Bank	RL 41.70 AHD

Basin - South B (Future)	
Type	On-site Detention (Online)
Low Flow Outlet	Outlet pipe with DN 395mm Orifice at CL 37.95 AHD
High Flow Weir Outlet	Grated inlet pit with 2.4m long weir at RL 39.43 AHD
Emergency Overflow	4.0m long concrete weir at RL 40.20 AHD. Modelling indicates that this weir will not be activated in the 1% AEP event.
Bottom of Basin	RL 38.80 AHD
Top of Basin / Top of Bank	RL 40.50 AHD

Table 3.6 – Comparison of pre-developed and detained post-developed flows

Catchment	Average Recurrence Interval	Pre-Developed Flow	Post-Developed Detained Flow	Critical Storm Duration	Peak Detention Volume
North (Stage 1)	1 EY	0.338 m^3/s	0.332 m^3/s	45 min	682 m^3
	10 ARI	1.810 m^3/s	1.630 m^3/s	1 hour	1632 m^3
	100 ARI	3.580 m^3/s	3.530 m^3/s	20 min	2224 m^3
Central (Stage 1)	1 EY	0.176 m^3/s	0.143 m^3/s	20 min	52 m^3
	10 ARI	0.858 m^3/s	0.615 m^3/s	30 min	-
	100 ARI	1.700 m^3/s	1.100 m^3/s	30 min	-
South A (Stage 1)	1 EY	0.173 m^3/s	0.169 m^3/s	45 min	33 m^3
	10 ARI	0.844 m^3/s	0.714 m^3/s	1 hour	692 m^3
	100 ARI	1.670 m^3/s	1.660 m^3/s	20 min	875 m^3
South B (Future)	1 EY	0.320 m^3/s	0.318 m^3/s	20 min	62 m^3
	10 ARI	1.710 m^3/s	1.710 m^3/s	15 min	352 m^3
	100 ARI	3.390 m^3/s	3.350 m^3/s	15 min	537 m^3

3.3 SUMMARY

The stormwater management strategy for the site has been designed to ensure that a comparable level to existing conditions has been maintained in order to reduce any potential strain upon downstream stormwater infrastructure.

As general commentary regarding the above, we note the following key points:

- The post-developed flows remain less than or equal to the existing pre-development flows for the site.
- A combination of three offline detention basins and one online detention basin has been proposed to meet this criteria.
- Due to a reduced post-developed catchment area, the central catchment does not require stormwater detention for storms between the 10 year and 100 year ARI.

4 WATER SENSITIVE URBAN DESIGN

Water sensitive Urban Design (WSUD) is the consideration of the natural water cycle in urban design and planning. This holistic approach to the planning and design of urban development aims to minimise negative impacts on the natural water cycle and protect the health of aquatic ecosystems.

4.1 REDUCTION CRITERIA

The Maitland City Council Stormwater Manual of Engineering standards requires the employment of water sensitive urban design and the provision of pollution controlling facilities in order to meet the prescribed pollution reduction targets. These targets can be seen below in **Table 4.1**.

Table 4.1 – Council Pollutant Reduction Targets

Pollutant	Reduction Criteria (Reduction of Average Annual Load)
Total Suspended Solids (TSS)	80% yearly reduction
Total Phosphorus (TP)	45% yearly reduction
Total Nitrogen (TN)	45% yearly reduction
Gross Pollutants >5mm (GP)	70% yearly reduction
Litter > 50mm	Retention up to the 3-month ARI peak flow
Oil and Grease	90% yearly reduction

4.2 MODELLING APPROACH

The proposed WSUD approach has been designed and optimised with the assistance of the water quality software package MUSIC (Version 6.3). In the absence of Maitland City Council specific MUSIC modelling parameters, the Lake Macquarie City Council Music-Link was utilised. This was simulated with a continuous 6-minute time-step within MUSIC.

The proposed treatment train layout within MUSIC can be seen in the **Figure 4.1** below.

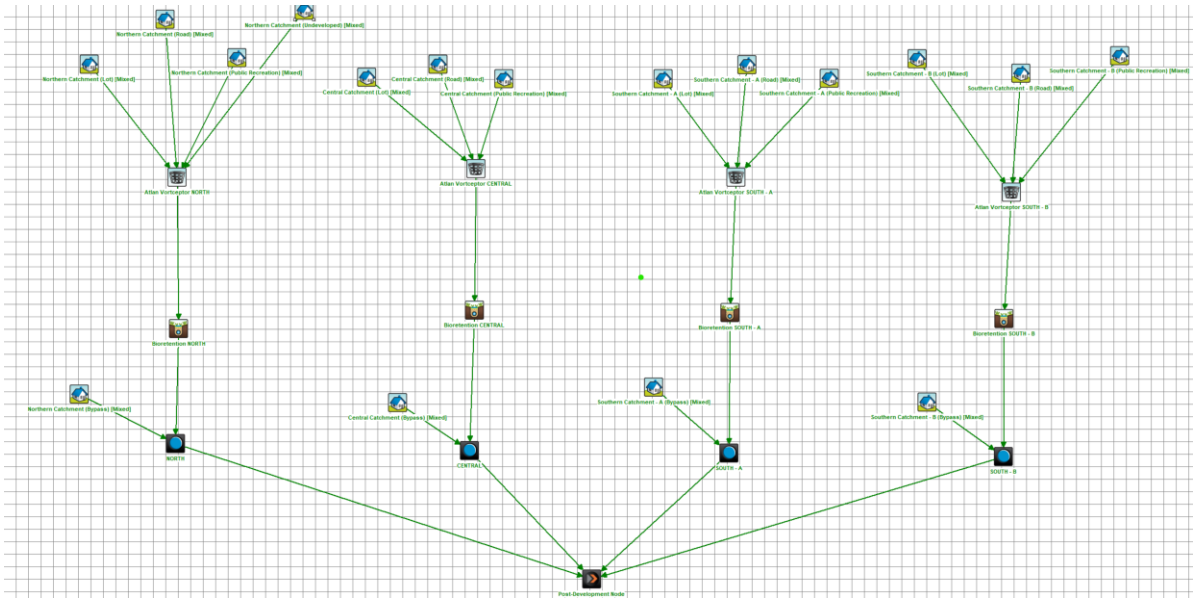

Figure 4.1 – Music Model Diagram

4.2.1 Catchments and Source Nodes

The developed portion of the site has been broken up into its individual catchments and then again into land use types. These have then been represented with the relevant source node within MUSIC. These sources are, Roads, Residential Lots, Recreational areas and Undeveloped Areas. These were modelled in line with the impervious percentages outlined in Section 2.1.

The stochastically generated pollutant export estimation method was used. Pollutant concentration parameters and impervious area rainfall thresholds were set based on surface type to the values suggested in the NSW MUSIC modelling guidelines (2015).

4.3 PROPOSED WSUD TREATEMENT MEASURES

The WSUD treatment measures included in the model are described below:

4.3.1 Gross Pollutant Traps (GPTs)

GPT's have been proposed for all four catchments to manage gross pollutants, coarse sediments and hydrocarbons. The GPT was included in the MUSIC model using nodes provided by Atlan for their 'Vorceptor' series. The unit was chosen based on mass balance considerations so that each unit had a sump capacity sufficient to contain the average annual load of captured pollutants. The high flow bypass in the model was adjusted for the chosen unit.

4.3.2 Bioretention Basin

Bioretention basins have been proposed for each of the 4 catchment areas within the project site. These bioretention systems are designed to provide tertiary treatment to stormwater runoff, further enhancing water quality beyond the GPT's.

Each bioretention basin utilises vegetated filter media combined with fine filtration layers, effectively removing pollutants. The vegetation not only aids in filtration but also facilitates the breakdown of organic matter and the uptake of nutrients, contributing to the overall reduction of pollutant loads before the water re-enters natural waterways.

The design values for each basin, including size and filter media depth are presented in **Table 4.2**. These parameters are tailored to meet councils required pollution reduction targets.

Table 4.2 – Bioretention Basin Properties

Basin – North (Stage 1)	
Filter Media Area	780 m^2
Filter Media Depth	500 mm
Extended Detention Depth	300 mm
Extended Detention Area	860 m^2
Saturated Conductivity	100 mm/hour
Filter Media TN	400 mg/kg
Filter Media Orthophosphate	40 mg/kg

Basin – Central (Stage 1)	
Filter Media Area	200 m^2
Filter Media Depth	500 mm
Extended Detention Depth	300 mm
Extended Detention Area	250 m^2
Saturated Conductivity	100 mm/hour
Filter Media TN	400 mg/kg
Filter Media Orthophosphate	40 mg/kg
Basin - South A (Stage 1)	
Filter Media Area	320 m^2
Filter Media Depth	500 mm
Extended Detention Depth	300 mm
Extended Detention Area	390 m^2
Saturated Conductivity	100 mm/hour
Filter Media TN	400 mg/kg
Filter Media Orthophosphate	40 mg/kg
Basin - South B (Future)	
Filter Media Area	290 m^2
Filter Media Depth	500 mm
Extended Detention Depth	300 mm
Extended Detention Area	370 m^2
Saturated Conductivity	100 mm/hour
Filter Media TN	400 mg/kg
Filter Media Orthophosphate	40 mg/kg

4.4 WSUD RESULTS

The table below illustrates the effectiveness of the proposed treatment train for each catchment demonstrating the site in its entirety is compliant with council's controls.

Table 4.3: MUSIC model treatment train effectiveness

Basin – North (Stage 1)				
Pollutant	**Source Load (kg/year)**	**Residual Load (kg/year)**	**Load Reduction (%)**	**Reduction Targets (%)**
TSS	10600	1300	87.8	80
TP	17.00	6.18	63.7	45
TN	126	69	45.0	45
GP	1630.0	27.1	98.3	70
Basin – Central (Stage 1)				
Pollutant	**Source Load (kg/year)**	**Residual Load (kg/year)**	**Load Reduction (%)**	**Reduction Targets (%)**
TSS	2280	456	80.0	80
TP	3.69	1.50	59.4	45
TN	27.2	14.6	46.3	45
GP	367	49.5	86.5	70
Basin - South A (Stage 1)				
Pollutant	**Source Load (kg/year)**	**Residual Load (kg/year)**	**Load Reduction (%)**	**Reduction Targets (%)**
TSS	4590	601	86.9	80
TP	7.46	2.78	62.8	45
TN	54.2	29.6	45.3	45
GP	726	16.1	97.8	70
Basin - South B (Future)				
Pollutant	**Source Load (kg/year)**	**Residual Load (kg/year)**	**Load Reduction (%)**	**Reduction Targets (%)**
TSS	3860	682	82.3	80
TP	6.1	2.39	60.9	45
TN	45.2	24.8	45.2	45
GP	607	56.2	90.7	70

Site - Overall				
Pollutant	**Source Load (kg/year)**	**Residual Load (kg/year)**	**Load Reduction (%)**	**Reduction Targets (%)**
TSS	21400	3040	85.8	80
TP	34.3	12.8	62.6	45
TN	252	138	45.3	45
GP	3330	149	95.5	70

The results presented in **Table 4.3** confirm that the reduction targets are achieved for each individual catchment as well as for the overall site. This demonstrates that the proposed stormwater management measures are effective in meeting the required performance criteria.

4.5 SOIL AND WATER MANAGEMENT

To mitigate the potential impacts of erosion and sediment runoff on downstream waterways during construction, a range of control measures and best-practice construction methods will be implemented. These measures include, but are not limited to, the following:

- Minimizing vegetation removal and limiting the disturbed area through the use of temporary fencing and designated no-go zones
- Diverting clean upstream overland flow to bypass disturbed areas
- Installing dirty water diversion drains to direct overland flow into sediment basins before discharge into watercourses
- Utilizing rock check dams within diversion drains
- Providing a stabilized site entry
- Erecting sediment fencing
- Managing stockpiles in accordance with Managing Urban Stormwater: Soils and Construction Volume 1
- Progressively and promptly rehabilitating disturbed land

The Soil and Water Management Plan, provided in Maker Engineering Civil Works Plans should be treated as a live document. It must be regularly reviewed and updated throughout the construction process to address changing site conditions and ensure ongoing effectiveness in controlling erosion, sediment, and water quality.

5 UTILITY SERVICING

5.1 SEWER RETICULATION

A gravity sewer network is proposed to service the development, along with three private sewer pump stations.

A lead-in connection is planned via the neighbouring residential development, linking to WWPS 1, which then subsequently feeds into a proposed sewer rising main connected to the New England Highway. For further details about the lead-in rising main from the New England Highway, refer to Northrop Engineering's Sewer Servicing drawing CSK06.01

All sewer works will be to the requirements of Hunter Water with a detailed sewer reticulation design to be undertaken as part of the Construction Certificate. Refer to the Maker Engineering Civil Works Plans for a conceptual servicing allocation plan.

5.2 POTABLE WATER RETICULATION

It is proposed to service the development with a privately metered potable water reticulation network that connects into the lead in infrastructure along river road.

Refer to Northrop Engineering Report Proposed Sewer Servicing Drawing CSK07.01 for additional information on the connection with the existing network along New England Highway.

All potable water works will be to the requirements of Hunter Water with a detailed water reticulation design to be undertaken as part of the Construction Certificate.

Fire Fighting

Under Section 34 of the Local Government MHE Regulation, all dwelling sites and community buildings within MHE developments must be located within 90 meters of a fire hydrant. It is proposed that potable water will be located along all streets within the development, with connections to all sites and community buildings, ensuring compliance with this regulation. The detailed design phase will evaluate the required firefighting flows, pressures, and optimal hydrant locations.

5.3 ELECTRICAL AND TELECOMMUNCATIONS

Electrical and telecommunications reticulation including NBN is proposed throughout the site by extension of the lead in network.

A detailed electrical and telecommunications reticulation design including connection into the existing network will be provided during at Construction Certificate stage.

5.4 GAS RETICULATION

Gas servicing for the site is not proposed.

6 CONCLUSION

This engineering report has been prepared on behalf of Thirdi for the proposed Manufactured Home Estate at 559 Anambah Road, Gosforth NSW. The development consists of 332 MHE sites, multiple recreational areas, a road network and 4 stormwater basins.

Grading and retaining work have been designed to be sympathetic to nearby properties, waterways, and vegetation while ensuring accessible sites. Road designs have been developed to meet relevant standards, incorporating appropriate cross-sections and batter interfaces. Connectivity is improved through a network of pedestrian and cyclist paths that link internal areas with the neighbouring development.

The stormwater management strategy for the site has been considered to ensure that a comparable level to existing conditions has been maintained to reduce any potential strain upon downstream stormwater infrastructure. Post-development flows are less than or equal to pre-development flows through the utilisation of 4 detention basins and catchment delineation.

The proposed Water Sensitive Urban Design (WSUD) measures for the development have meet the Maitland City Council's stormwater management and pollution reduction targets. The implementation of gross pollutant traps (GPTs) and bioretention basins have been utilised to achieve the required reductions in Total Suspended Solids (TSS), Total Phosphorus (TP), Total Nitrogen (TN) and Gross Pollutants (GP).

The site can be serviced in terms of sewer, water, electrical and telecommunications through connection into the neighbouring developments network. Natural gas reticulation is not proposed.

The provision of earthworks, road and stormwater drainage for the development at 559 Anambah Road is planned to be provided in accordance with the Maitland City Council manual of engineering standards, Development Control Plan and all other relevant standards.