

infrastructure & development consulting

Omayya Gilead

Civil Engineering, Infrastructure & Water Cycle Management Review

Planning Proposal

September 2025

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1 Introduction

Infrastructure & Development Consulting (IDC) have been engaged by Meadowvale Developments to undertake a civil engineering, infrastructure, and water cycle management review for a Planning Proposal of a site in Gilead, NSW. The purpose of the study is to identify the likely scope of infrastructure required to support the development of the site. It has investigated the following:

- Utilities;
- Road and lot grading;
- Earthworks; and
- Stormwater management, including water sensitive urban design (WSUD).

The above analyses have been undertaken to provide an overview of the engineering strategy for servicing the site and to guide future detailed design through the implementation of appropriate authority controls and best management practices.

We note that the proposed servicing measures are strategic in nature and further refinement may be required during subsequent design phases of the proposal.

Parts of this document may also form the basis of future discussions with external service authorities, state agencies, and other stakeholders.

The designs are schematic in nature, and it is recommended that appropriate contingencies be applied until site-specific surveys and detailed design can be undertaken and approved by Council and any relevant authorities.

2 Purpose of the Report

This report summarises the key technical aspects of the development, including utilities, road network design, earthworks, and stormwater management. The findings and recommendations within this report aim to demonstrate the feasibility and compliance of the proposed development with relevant planning, engineering, and environmental guidelines.

The scope of this report focuses on providing detailed assessments and preliminary designs for the following critical components:

- **Utilities:** Assessment of existing utilities available and proposed utilities required to service the development;
- **Road Network:** Preliminary design of the internal road network, including layout, connectivity, and alignment with local and state government standards;
- **Earthworks:** Assessment of proposed cut and fill requirements to optimize site grading, ensure stability, and minimise environmental impacts; and
- **Stormwater Management:** Analysis of water quality and quantity controls to mitigate impacts on downstream catchments and ensure compliance with best practice guidelines.

3 Site Context

The site is located at 717 Appin Road, Gilead and encompasses Lot 1, DP 602888. It is situated within the Campbelltown Local Government Area (LGA) and is located approximately 67.8km southwest of the Sydney CBD. The site is bounded by Appin Rd to the east, the Upper Canal to the west, and rural lots to the north and south.

In its existing state, the site is primarily comprised of grassed surfaces. There are two (2) first-order streams that traverse through the site: Nepean Creek and Woodhouse Creek. The eastern portion of the site primarily grades down towards the west, with overland flows discharging to Woodhouse Creek. The western portion of the site primarily grades down towards the southwest, with overland flows discharging to Nepean Creek. There is a crest located at the centre of the site, which has a maximum elevation of RL 195m, and another crest located closer towards the western side of the site, which has a maximum elevation of RL 171m.

The eastern and western sides of the site encompass land that is part of the Cumberland Plain Conservation Plan (CPCP) area. There are also 2 other land restrictions on the eastern side of the site: a right of carriageway from the northeast corner of the site and an area reserved for the widening of Appin Road at the eastern site boundary. A Meadowvale Heritage item has been identified towards the western side of the development site. Multiple utilities and associated easements also intersect the western side of the site. These are detailed in the table below:

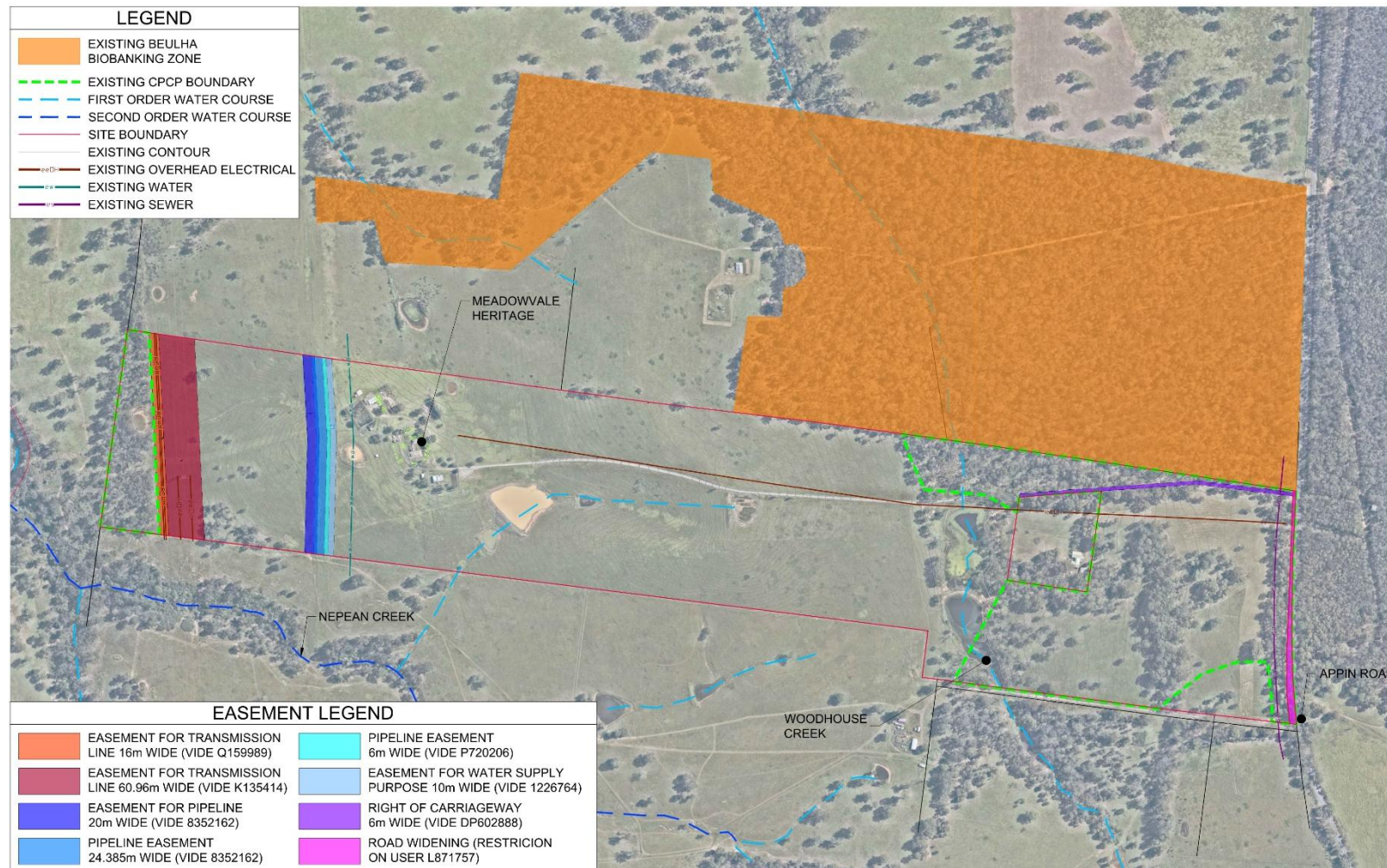
Table 1 Utilities & Associated Easements

Utility Type	Asset	Easement Width (m)
Electrical	Overhead Transmission Line	16.0
Electrical	Overhead Transmission Line	61.0
Potable Water	Main	20.0
		24.4
		6.0
Potable Water	Water Supply	10.0
Sewer	Pressure Main	-

The land directly north of the site has also been identified as a Beulha biobanking zone.

The existing site is shown in the figure below:

Figure 1 Site Context



4 Proposed Masterplan & Constraints

The Planning Proposal seeks to rezone the site to allow for a mix of low density, medium density, and environmental living residential areas. To support this development, the proposal will also deliver local roads, a transit corridor, parkland open space (POS), as well as drainage areas dedicated to achieving Council water quantity and quality targets.

The proposed masterplan is shown in the figure below:

Figure 2 Proposed Masterplan



The residential lot yield for the development is shown below:

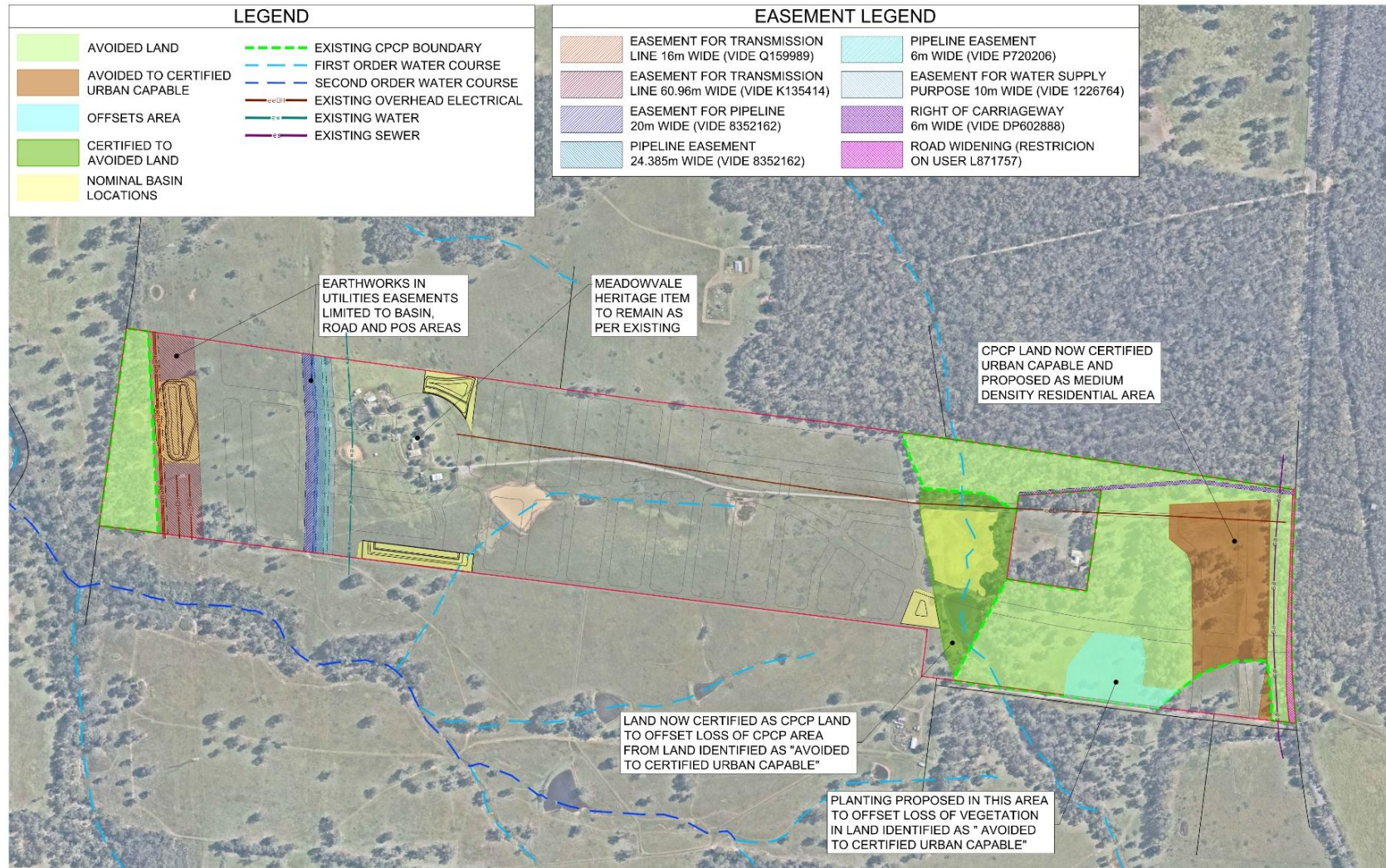
Table 2 Residential Lot Yield

Lot Type	No. of Lots
Low Density	375
Environmental Living	6
Medium Density	413
Total	794

Source: Inspire Planning, *Meadowvale Indicative Concept Master Plan* (Date: 01/09/25)

To minimise the effect of the development on existing easements and CPCP land, the layout of the masterplan has accounted for the various site constraints, as shown below:

Figure 3 Masterplan Constraint Considerations



5 Methodology

The methodology for this Civil Engineering, Infrastructure & Water Cycle Management Review has been tailored to reflect the stage and the scale of development proposed. It incorporates a combination of desktop assessments, modelling, and alignment with local and state planning frameworks.

The following assessments have been undertaken to inform this strategy:

1. Utilities Assessment
A desktop assessment of the existing utilities infrastructure was completed to determine the extent of servicing available to support the proposed development. Demand calculations were also completed to provide preliminary sizing of proposed utilities.
2. Civil Engineering Assessment
A preliminary design of the internal road network was completed in accordance with local and state government standards. The proposed cut and fill requirements were also assessed to optimise site grading, ensure stability, and minimise environmental impacts.
3. Stormwater Quantity
A hydrologic and hydraulic assessment was completed using DRAINS modelling tools, which were used to estimate peak flows under pre- and post-development conditions, and to test the effectiveness of detention strategies to match pre-development discharge rates.
4. Stormwater Quality:
MUSIC modelling was undertaken to assess the performance of a proposed WSUD treatment train in reducing pollutant loads in accordance with Council's water quality targets.

All works were undertaken in accordance with Campbelltown Council guidelines and industry best practice standards.

6 Utilities Infrastructure

6.1 Potable Water

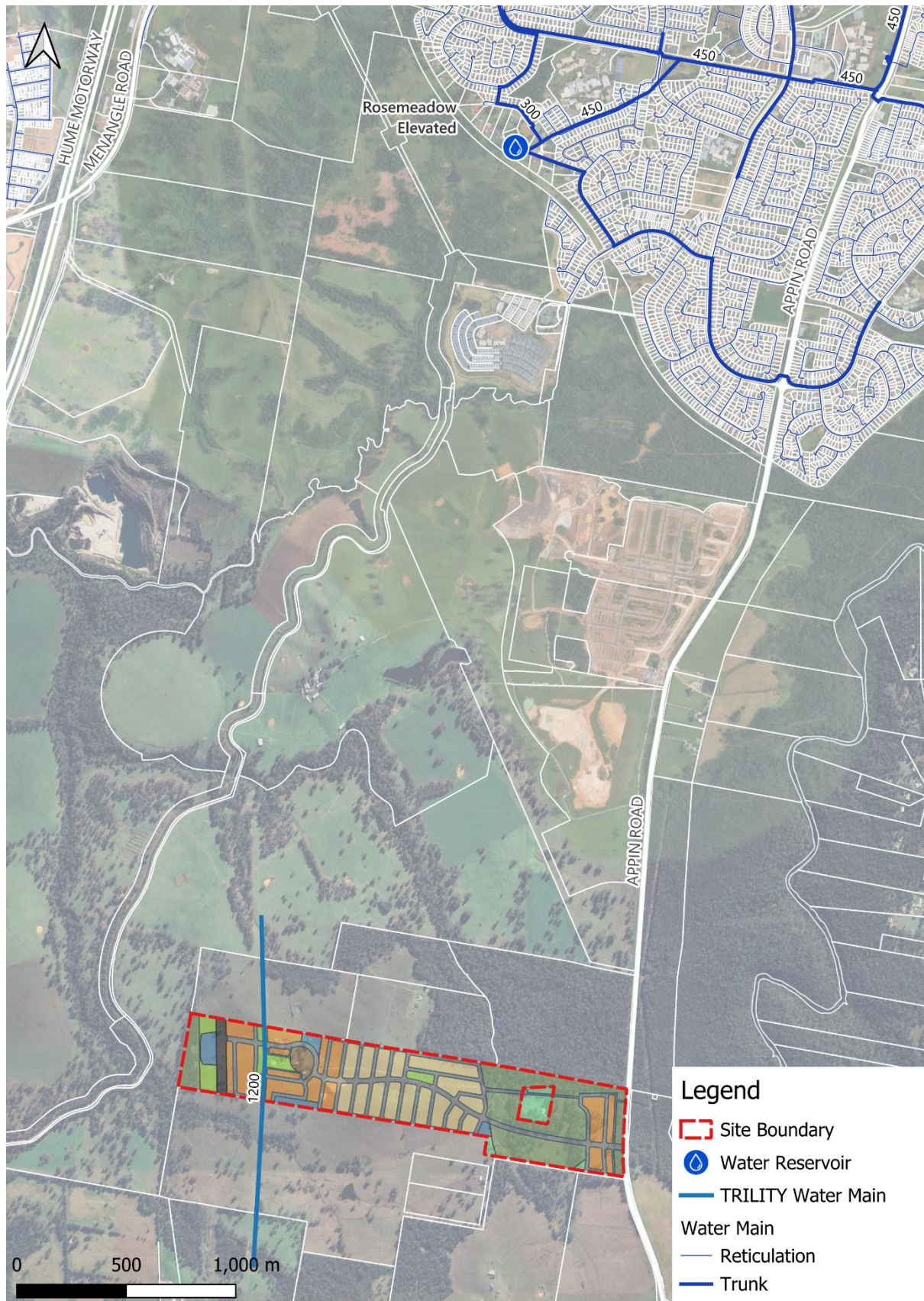
6.1.1 Existing Infrastructure

The site is not currently serviced by the Sydney Water potable water network. The closest infrastructure to the site supplies development within Rosemeadow, located to the north. The closest reservoir to the site is the Rosemeadow Elevated Reservoir, which is located approximately 4.3km north of the site.

Before You Dig Australia (BYDA) records indicate that the only existing potable water asset on site is a DN1200 SCL trunk main, which traverses through the western side of the site. This main is owned by TRILITY and is leased to Sydney Water. It extends from the Macarthur Water Filtration Plant, which is also operated by TRILITY, and connects into the Sydney Water network at Sugarloaf. This main is located within a 24.4m wide easement – see Section 3 for further information.

The existing potable water infrastructure is shown in the figure below.

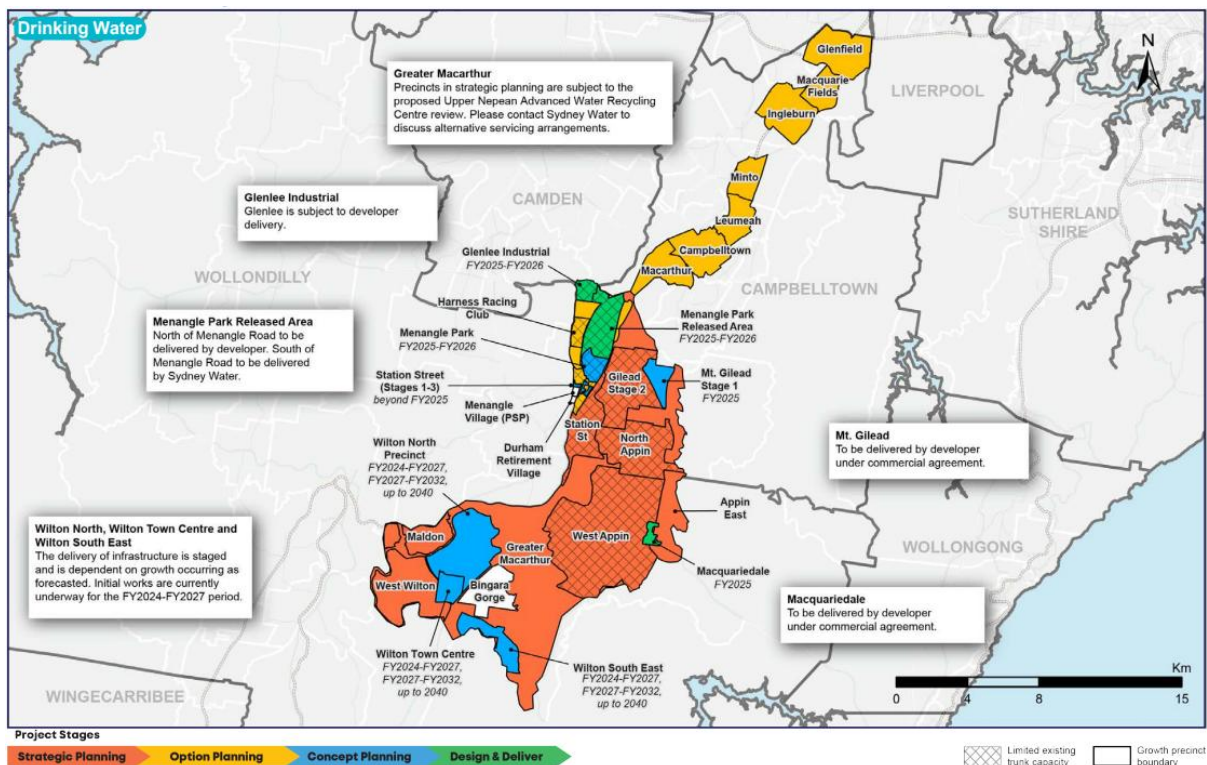
Figure 4 Water Infrastructure



6.1.2 Sydney Water Growth Servicing Plan

Sydney Water's Growth Servicing Plan (GSP) outlines the servicing strategy to support planned growth in Sydney from 2024 - 2029. The site falls within the North Appin precinct. Trunk water infrastructure for the North Appin precinct is currently within the strategic planning stage and no date is provided for the delivery of the ultimate trunk infrastructure required. The GSP also notes that the North Appin precinct has limited existing trunk capacity available.

Figure 5 Sydney Water GSP - Potable Water



Source: Sydney Water Growth Servicing Plan 2024-2029 (accessed 26/08/25)

6.1.3 Demand Calculations

To determine the potential servicing requirements for the site, a high-level assessment was undertaken using the Water Supply Code of Australia (WSA) to calculate the potential demand generated by the proposed development. This involved calculating the peak hour demand by extracting the maximum water demand rates from the WSA. These rates were used to determine the peak hour demand for the development.

Calculations for the various dwelling types for the development were separated into low density, environmental living, and medium density residential. The results of the water demand calculations are provided in the table below.

Table 3 Water Demand

Dwelling Type	Land Use	Average Day Demand Rate (L/dwelling/day)	Peak demand (L/s)
Low Density	Single Lot	623	9.44
Environmental Living	Single Lot	623	0.22
Medium Density	Single Lot	623	20.60
Total			30.27

Based on the above assessment and a target velocity of 1.2m/s, a single directional minimum 200mm-250mm diameter main could supply the entire development.

6.1.4 Proposed Servicing Strategy

The trunk water supply may emanate from either the Rosemeadow Elevated Reservoir to the north of the site, or the Appin Reservoir to the south of the site. The suitability of these options and the preferred solution will be determined in detail with Sydney Water as feedback on the Feasibility Application is received.

The Rosemeadow Elevated Reservoir services the nearby Fig Tree Hill development site (which is currently under construction) and will be the closest trunk water mains to the site. This trunk main would need to be extended to the development site, along Appin Road, which sits some 1.1km from the north-eastern corner of the Subject Site. This is shown in Figure 6 below.

If this is determined to not be the preferred option by Sydney Water, an alternative option is to be serviced from the Appin Reservoir. Sydney Water are currently upgrading the Appin Water Supply Zone to support development within the Greater Macarthur region. This includes the construction of new mains, as well as the amplification of existing mains, pumps, and storage. As such, the site could potentially receive potable water supply from the Appin Reservoir, which is located 7.0km south of the Subject Site. A trunk main will need to be extended from this reservoir to the development site, along Appin Road as shown in Figure 7.

Based on the status of surrounding developments and length of lead-in mains, we expect that the Rosemeadow Elevated Reservoir option is the most suitable.

Figure 6 Proposed Servicing Strategy Option 1 – Rosemeadow Elevated

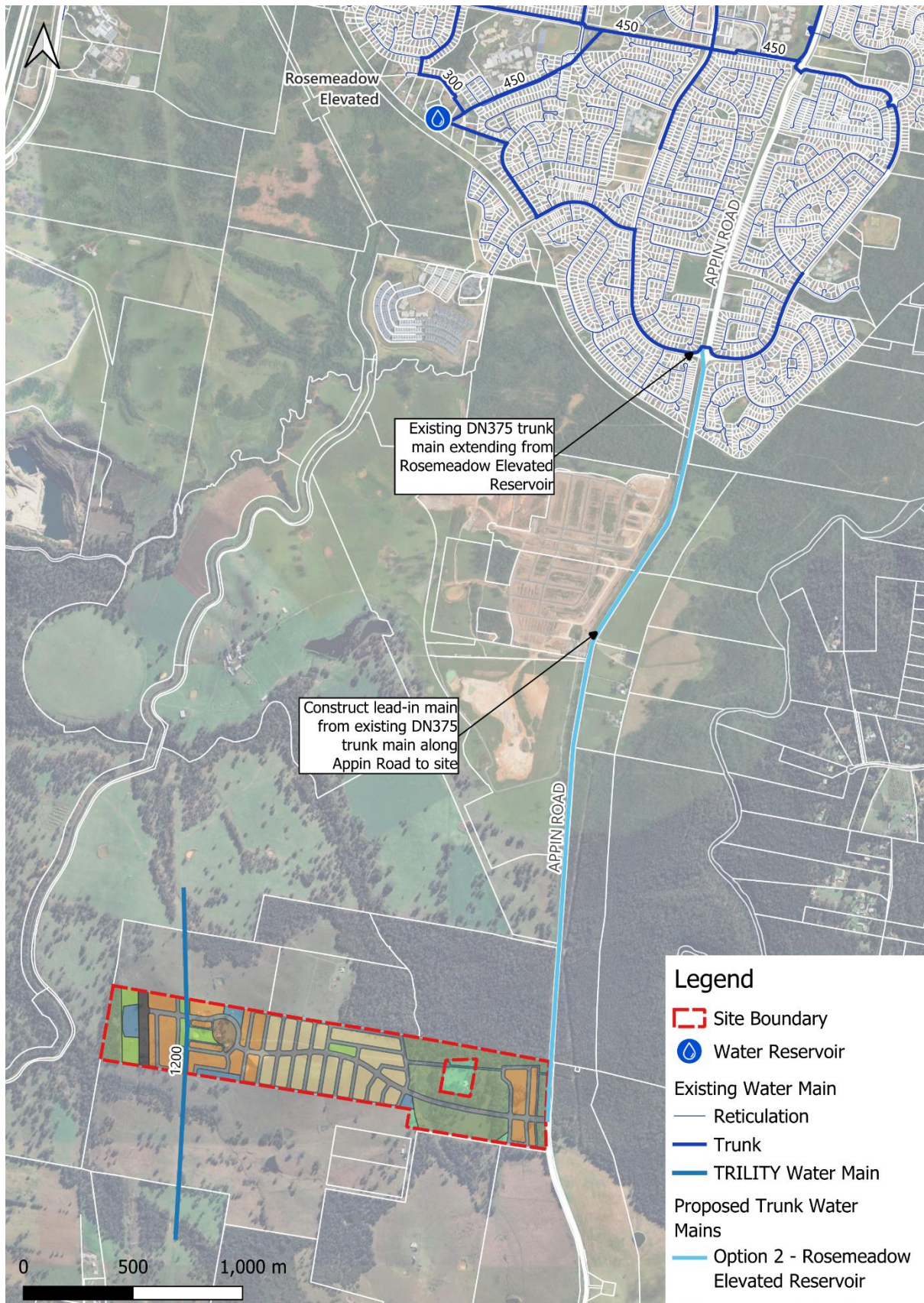
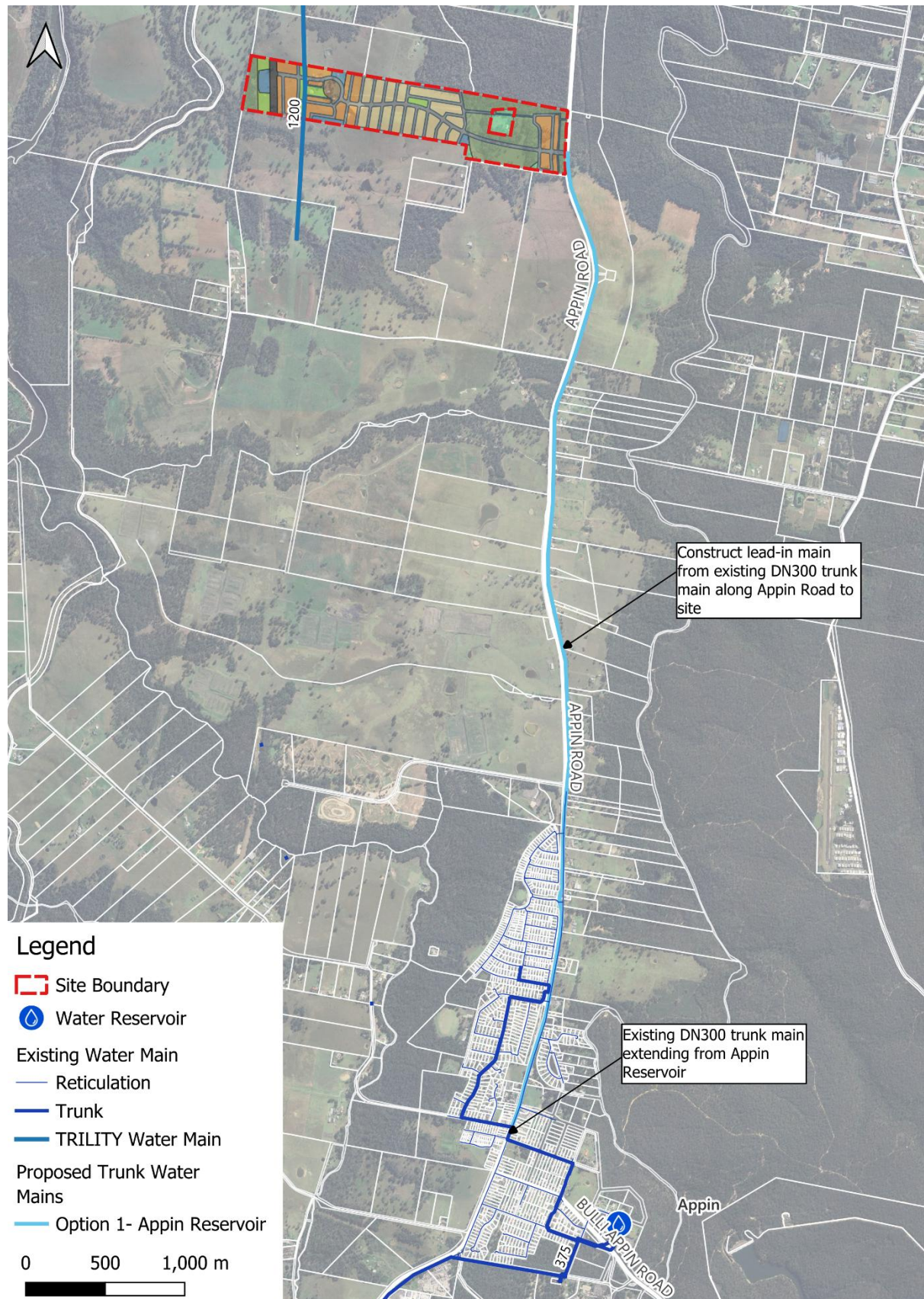


Figure 7 Proposed Servicing Strategy Option 2 – Appin Reservoir



For both servicing options, new reticulation mains will need to be constructed from the proposed trunk main along all proposed roads within the site.

The proposed servicing strategies discussed above will be discussed with Sydney Water and further refined as required during a subsequent stage of the project.

6.1.5 Feasibility Application

A feasibility application has been lodged with Sydney Water to determine the servicing requirements for the site. The associated case number is CN 227179. A supplementary report will be provided upon receipt of the Feasibility Advice Letter, if necessary.

6.2 Sewer

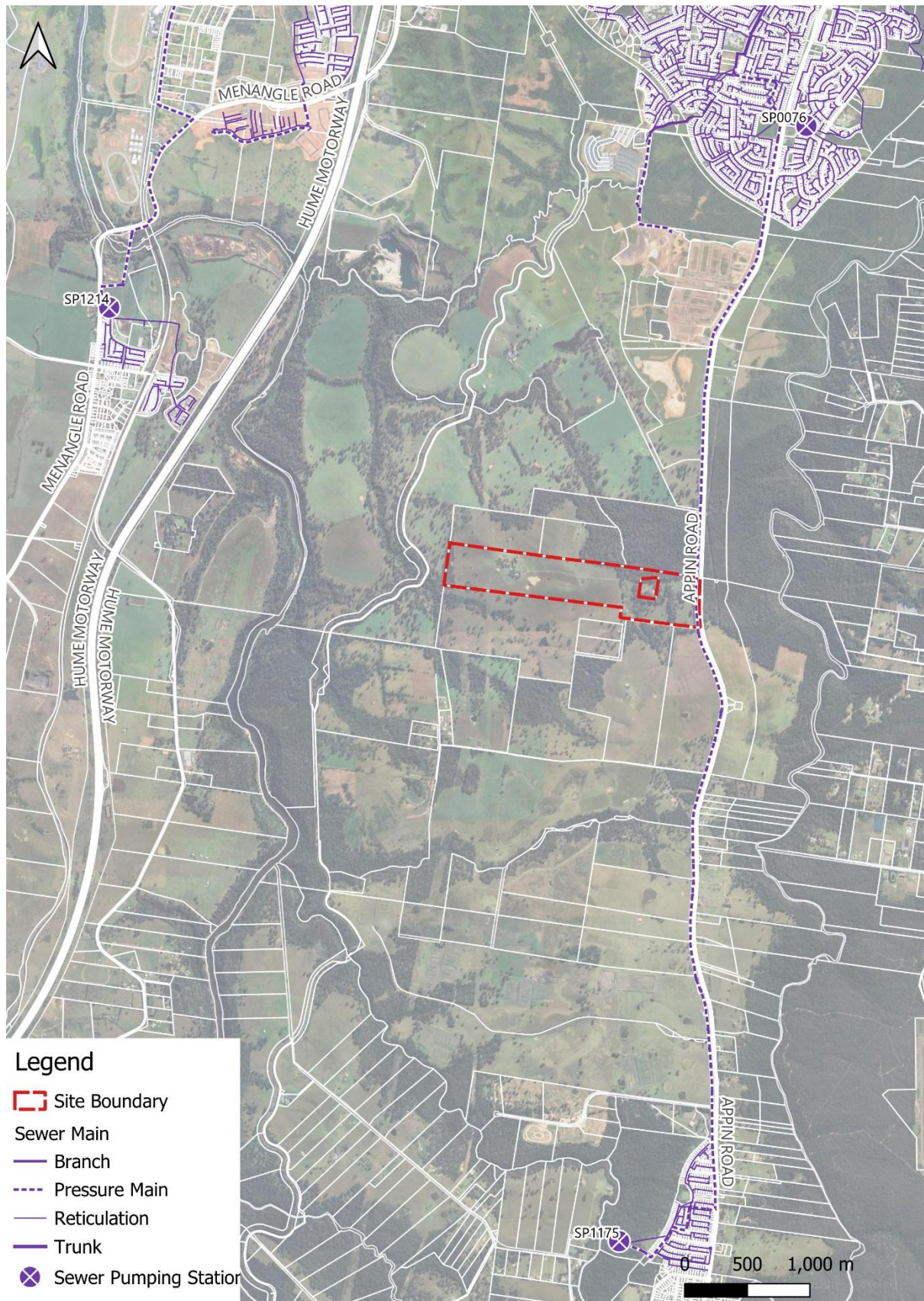
6.2.1 Existing Infrastructure

The site is currently not serviced by the Sydney Water sewer network. BYDA records indicate that the only existing sewer asset on site is a DN225 PE pressure main that runs adjacent Appin Road on the eastern side of the site. This main connects from sewer pump station SP1175, which is located 5.3km south of the site in the Appin Township, to the Glenfield Water Recycling Plant (WRP) via Rosemeadow. However, once again the Fig Tree Hill development to the north of the Subject Site does have registered lots and we expect that the sewer services will shortly be uploaded to Sydney Water's records and be available shortly for review. We understand that this consists of standard gravity reticulation network with a new Sewer Pump Station (SPS) and rising main which connects the site to the Glenfield Water Recycling Plant (WRP). Figure 8 below shows the approximate location of the rising main leaving the site.

The Glenfield WRP is located approximately 26.3km northeast of the development site and services existing developments within Campbelltown, as well as the Appin township. In addition to this there is reticulation, trunk mains and a pumping station being delivered to the north of the site for the Fig Tree Hill development that also connect to Glenfield via Rosemeadow.

Existing sewer infrastructure within the vicinity of the site is shown in the figure below.

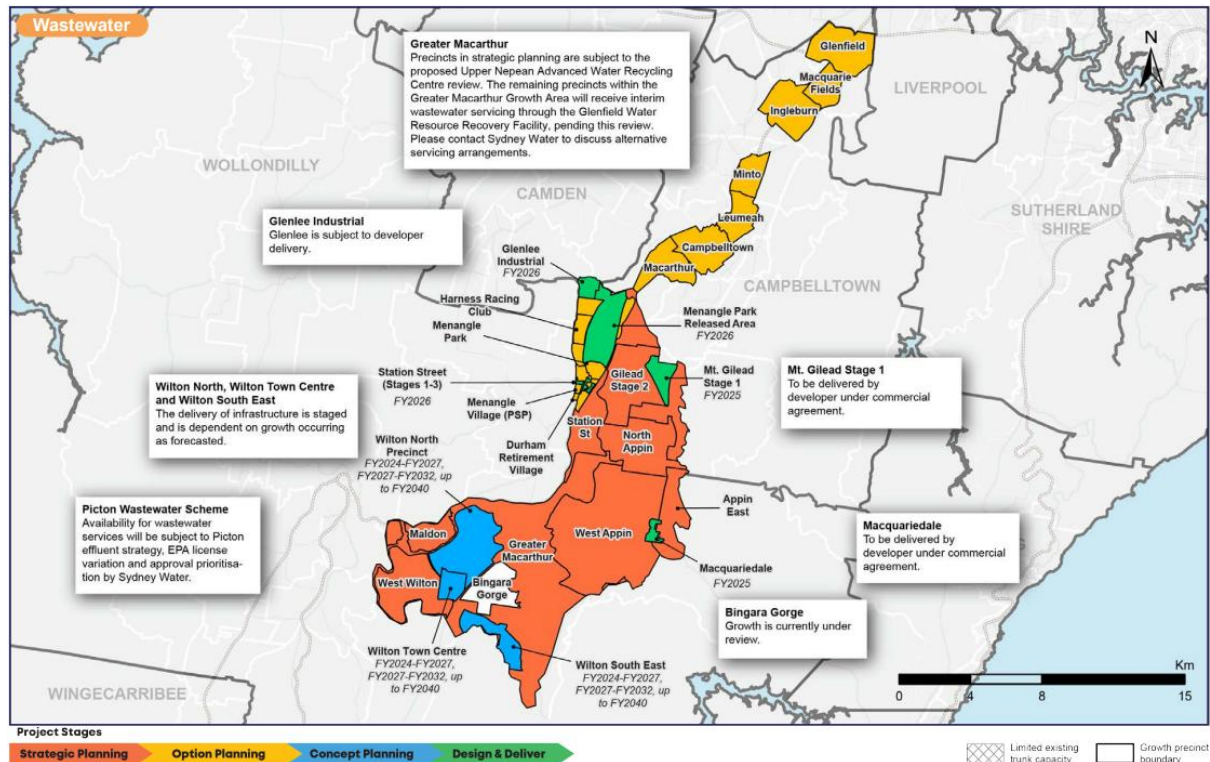
Figure 8 Existing Sewer Infrastructure



6.2.1 Sydney Water Growth Servicing Plan

Sydney Water's GSP indicates that trunk sewer infrastructure for the Greater Macarthur region is currently in the strategic planning stage. No date is provided for the delivery of the ultimate trunk infrastructure required to support the planned growth in these precincts.

Figure 9 Sydney Water GSP - Sewer



Source: Sydney Water Growth Servicing Plan 2024-2029 (accurate 26/08/25)

It should be noted that Sydney Water's strategic plan for the Greater Macarthur region includes the construction of a new advanced water recycling centre (similar to the Upper South Creek facility currently under construction in the Aerotropolis) and is referred to as the Upper Nepean Advanced Water Recycling Centre (AWRC). The delivery date for the Upper Nepean AWRC is currently estimated to be 2040. Whilst the location of the Upper Nepean AWRC has not been finalised, it is understood that potential sites for the Upper Nepean AWRC being investigated are across the Appin/Greater Macarthur Region.

6.2.2 Demand Calculations

A high-level assessment of the required sewer infrastructure was undertaken using the Sewerage Code of Australia (WSA-02). The load on the sewer network is expressed in Equivalent Population (EP). The EP for each dwelling type was extracted from the SSA. The results of the sewer demand calculations are provided in

Table 4.

Table 4 Sewer Load Calculations

Dwelling Type	Land Use	EP/Unit	Unit	Total EP
Low Density	Single Occupancy Lot	3.5	Lot	886
Environmental Living	Single Lot 1000m ²	25	Gross Hectare	65
Medium Density	Single Occupancy Lot	3.5	Lot	1,932
Total				2,882

Based on the above assessment, a total equivalent population of 2,882 would be expected as a result of the proposed development. A minimum main size of 225mm would be required to support the development.

6.2.3 Servicing Strategy

The long-term strategy for Greater Macarthur Region currently includes the construction of the Upper Nepean AWRC, which has an uncertain delivery date, and potentially as late as 2040. The location of the Upper Nepean AWRC has not been determined, however we understand that several site in the Appin area to the south are being explored. Any interim development will need to be serviced either by the Glenfield WRP, or temporary package plant type systems.

The ultimate sewer servicing strategy for the site is not yet certain, but several feasible options exist. To determine a suitable servicing arrangement, and to ensure coordination with other surrounding development sites, a feasibility application has been lodged with Sydney Water (Case Number CN 227179).

It is expected that this advice will include an option to drain to the existing Glenfield WRP to the north – at least as an interim option, following on from the existing Fig Tree Hill development to the north which is shown in Figure 10 below.

Based on topography, we expected that the site will require two new sewer pumping stations to convey flows to the receiving infrastructure to the north. Indicative locations for these pump stations are shown conceptually in Figure 10 below. based on the ecologically sensitive land to the north, we expect that any rising main to the north will be required to be constructed along the Appin Road corridor.

Figure 10 - Site Trunk Sewer Services

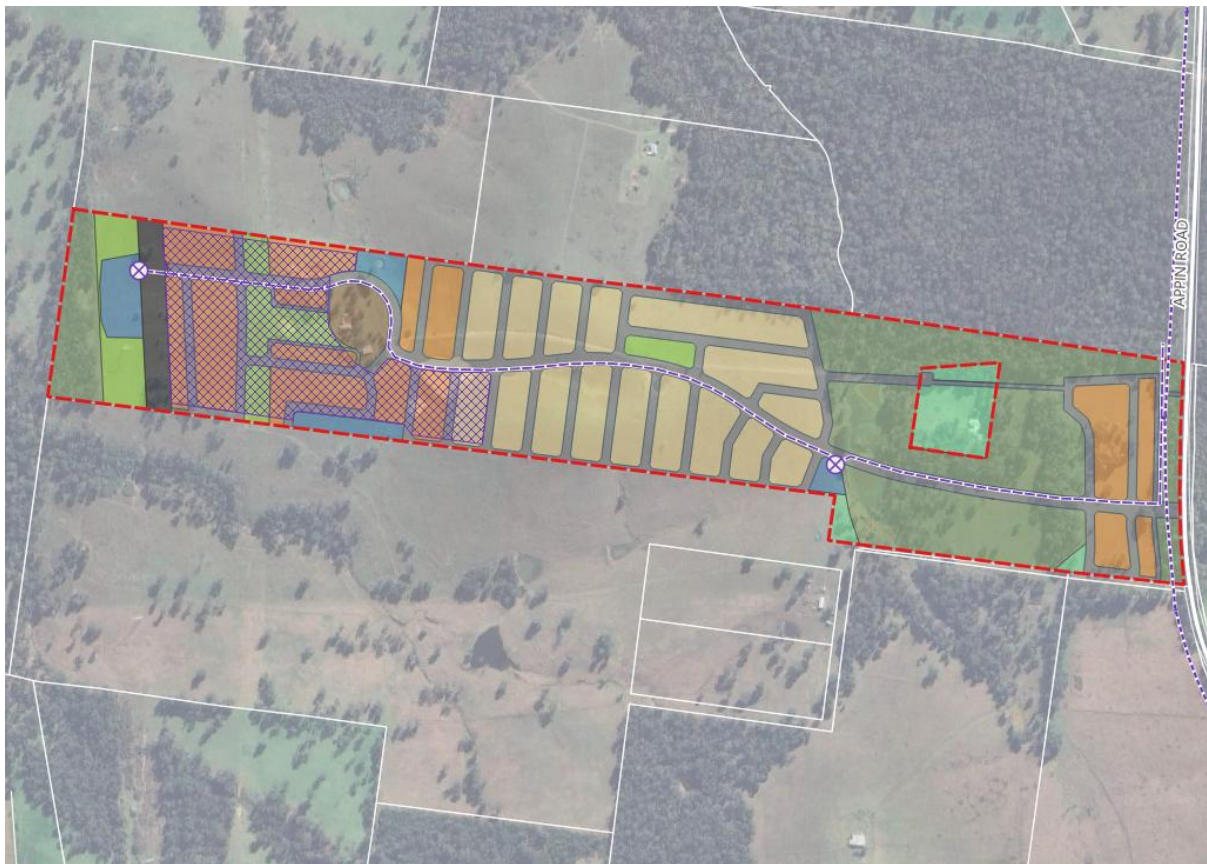


If the initial development is unable to connect to adequate surrounding infrastructure, it is possible that a short-term on-site package plant, which would dispose of treated wastewater on site via irrigation systems, could be used.

Given that it is expected that each new dwelling would require approximately 300m² – 600m² of irrigation area (subject to the site slope, soil conditions, and other detailed analyses), there would be a limit to the number of dwellings able to be delivered until the amount of available land for irrigation is exhausted.

The delivery of the first 250 homes would require somewhere in the order of 12 Ha for irrigation. For context, this land take is indicatively shown in the hatched area on Figure 11 below.

Figure 11 - Indicative Irrigation Area for 250 Dwellings



6.3 Electricity

6.3.1 Existing Infrastructure

The site is located within the Endeavour Energy (EE) electrical supply zone. The closest zone substations (ZS) to the site are the Ambarvale ZS, which is located approximately 4.9km north of the site, and the Menangle Park Mobile ZS, located approximately 6km northwest of the site.

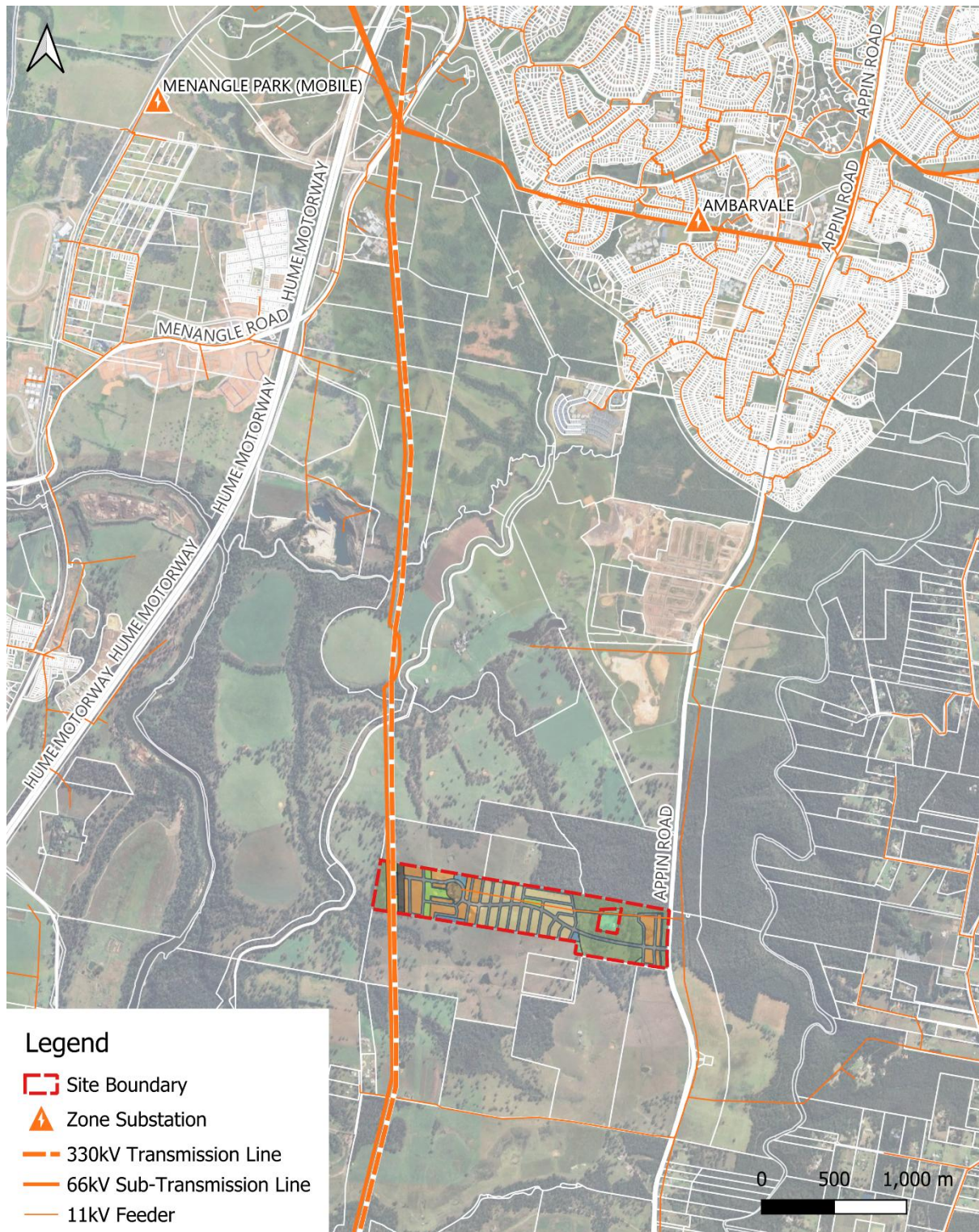
The Ambarvale ZS operates on the 66/11kV network and includes two 35MVA transformers. The zone substation is forecast to exceed the available firm capacity by 2028.

Endeavour Energy will upgrade an existing mobile zone substation at Menangle Park to a permanent zone substation with two transformers and space for a third transformer to be delivered in future. Once this zone substation is operational, it is expected that additional capacity will become available in surrounding zone substations, including the Ambarvale ZS. The Menangle Park ZS is further discussed in Section 0 below.

A 330kV transmission line and 66kV sub-transmission line bisects the western part of the site. These transmission and sub-transmission lines are overhead and are located within a 60m wide easement.

Existing uses on the site are supplied via an overhead 11kV high voltage feeder which originates from the Ambarvale ZS and traverses Appin Road on the eastern site boundary. The existing electrical infrastructure within the vicinity of the site is shown in the figure below.

Figure 12 Electrical Infrastructure



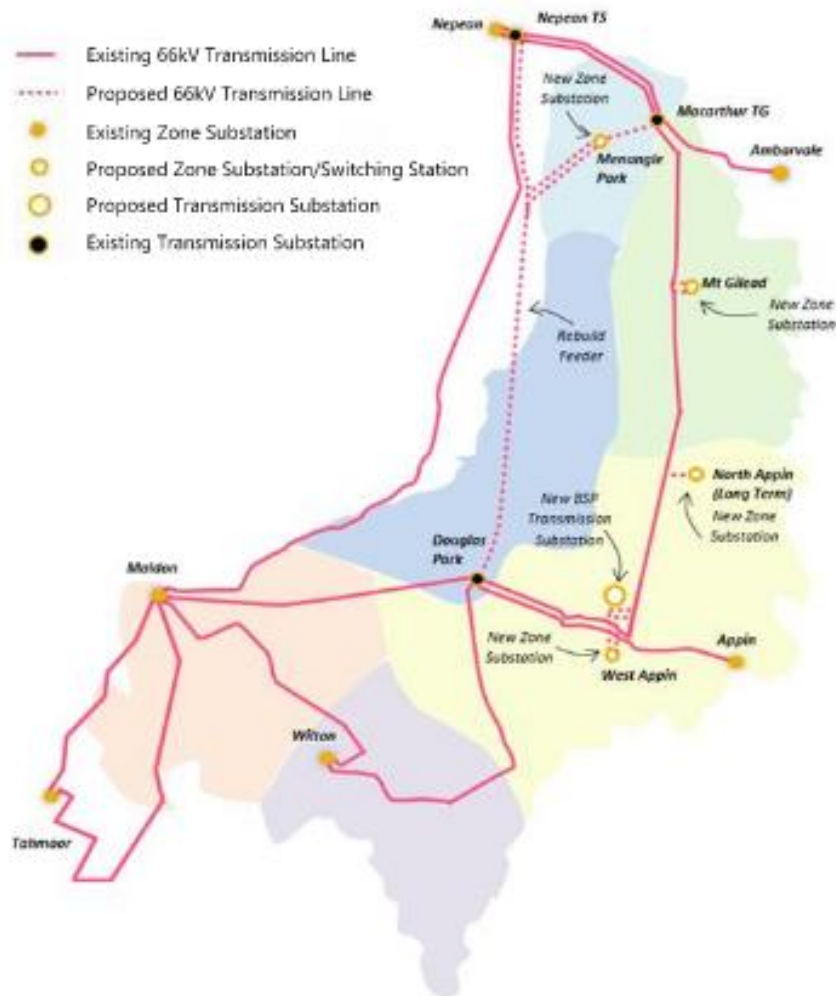
6.3.2 Regulatory Proposal & Greater Macarthur Priority Growth Area Plan

Endeavour Energy's latest Regulatory Proposal outlines the planned investment to maintain and support growth in the electricity network from 2024-2029. Within Greater Macarthur, EE will invest \$42 million on growth projects to ensure connection capacity is available to meet planned growth in the area.

This includes the establishment of new zone substations at West Appin and Mount Gilead, and the conversion of Menangle Park from a mobile to a permanent zone substation. The existing mobile substation includes a single transformer and does not have the capacity to meet the anticipated demand for electricity beyond 2027. The upgraded zone substation will support growth in the Appin, North Appin and Gilead precincts. EE planned to start work in mid-2025, with the upgraded zone substation operational by the end of 2027.

EE will also fund the acquisition of sites for new zone substations at South Gilead and North Appin, with this infrastructure to be delivered later, beyond 2029. Indicative locations for the proposed zone substation are shown on Figure 13 below.

Figure 13 Endeavour Energy Greater Macarthur Area Plan



Source: Greater Macarthur Priority Growth Area Plan – Endeavour Energy (2022)

6.3.3 Preliminary Enquiry Application

A Preliminary Enquiry was lodged with Endeavour Energy to determine the servicing requirements for the site. The associated reference number is ENL7754. A supplementary report will be provided upon receipt of Endeavour Energy's response, if necessary.

6.3.4 Demand Calculations

A high-level assessment was undertaken to determine the electrical servicing requirements for the site. The electrical demand generated by the proposed development was calculated using electrical demand rates provided by Endeavour Energy and supplemented with rates extracted from *AS/NZS 3000 Electrical Installation Wiring Rules*.

A diversification factor of 0.8 was applied to the total load to provide an estimate of the peak load generated by the proposed development. The results of the assessment are tabulated in Table 5 below.

Table 5 Electrical Demand

Dwelling Type	Land Use	VA/Unit ¹	Unit	Diversified Load (MVA)
Low Density	Low Density House >350m ²	6.5	kVa/dwelling	1.64
Environmental Living	Low Density House >350m ²	6.5	kVa/dwelling	0.04
Medium Density	Low Density House < 350m ²	5	kVa/dwelling	2.76
Total Diversified Load (MVA)				4.44

¹ The listed rates are diversified rates

Based on the fact that a single 11kV feeder can supply 4.5MVA - 5MVA, the site would likely require one 11kV feeder to supply the proposed development.

6.3.5 Proposed Servicing Strategy

As discussed above, Endeavour Energy are currently delivering a permanent zone substation at Menangle Park. This zone substation is expected to be operational by the end of 2027. It is likely that the delivery of this infrastructure may increase the available capacity at nearby zone substations including Ambarvale ZS.

Future development of the site would therefore likely be supplied from the Ambarvale ZS, if sufficient capacity is available, or alternatively the Menangle Park ZS. The servicing requirements for the site will be confirmed with Endeavour Energy during a subsequent stage of the project, noting that a feeder from Ambarvale would be approximately 5km.

6.4 Telecommunications

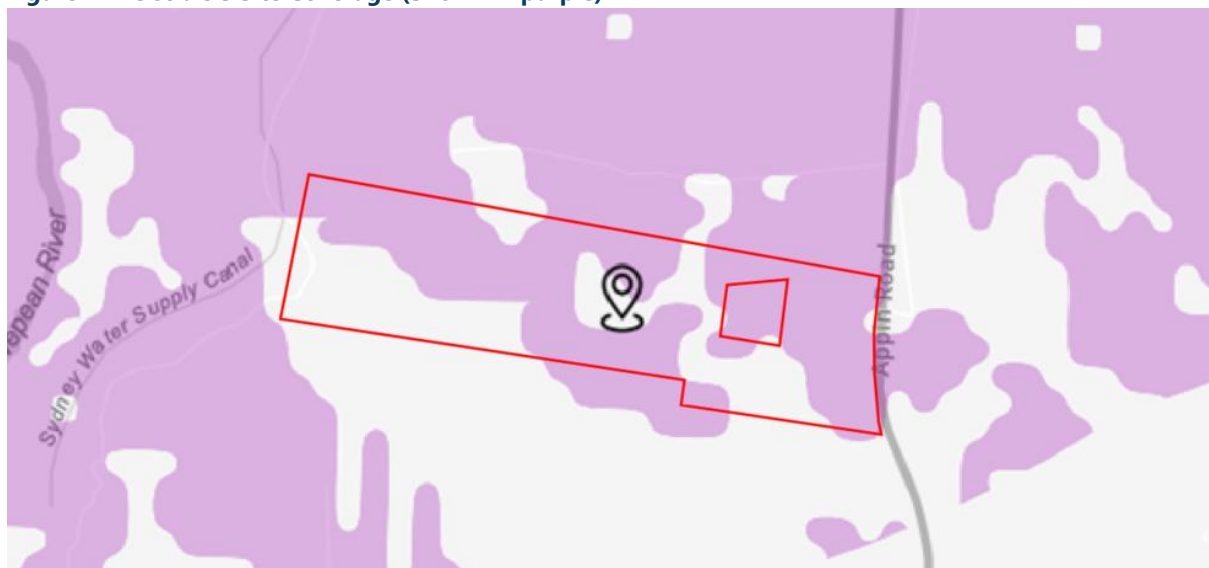
6.4.1 Existing Infrastructure

Telstra 5G Network

Telstra have blanket 4G coverage across the site. The progressive roll-out of Telstra's 5G network has commenced across New South Wales. The site is partially serviced by Telstra's 5G network, as shown in

Figure 14 (site extents shown below are approximate only and are to be confirmed in future design stages). Future infrastructure rollout will be staged to match the pace of development. It is expected that 5G network coverage will extend across the entire site over time.

Figure 14 Telstra 5G Site Coverage (Shown in purple)



Source: Telstra

NBN Network

A BYDA services search indicates that there are no underground NBN Co. telecommunications assets on or near the site.

The site is currently serviced by NBN fixed wireless technology. Fixed wireless technology utilises transmission towers, which can be located up to 14km away from the premises, to transmit data to a rooftop antenna. This technology is generally deployed in rural areas with large distances between users.

Existing dwellings within the Appin township are serviced via fixed line technology, where a physical line connects to each property to provide a connection. It is anticipated that this infrastructure will be extended to the site to support future development.

6.4.2 Proposed Servicing Strategy

To provide fibre servicing to the development site, a connection will be required to the existing Telstra fibre network servicing the Fig Tree Hill development, located approximately 1km north of the development site.

New infrastructure will be extended along Appin Road to the site boundary and reticulated throughout the development site in the standard road allocation.

7 Civil Engineering Assessment

A key input for the development's feasibility are the civil engineering works associated with developing a viable landform and earthworks strategy. The following section details the engineering assessment undertaken to refine the urban design through the application of engineering design principles.

7.1 Landform & Bulk Earthworks

Based on the concept masterplan, an indicative design surface model was developed for the proposed site. This model was utilised to inform the earthworks quantities incorporated into the site feasibility, as well as the proposed surface grading for stormwater assessment components of the engineering analysis.

The landform/earthworks grading was carried out in Civil3D, adhering to the following design aims and considerations:

- Earthworks have been omitted from the Meadowvale Heritage area and CPCP land, where possible, to ensure that these areas remain as per existing
- Earthworks have also been omitted from the proposed transitway, as its details are unknown at this stage (i.e.: transportation type, etc.)
- Providing a design surface that minimises the need for the import of fill to the site
- A key objective of the earthworks design was to preserve the existing catchment boundaries to avoid adverse impacts on downstream stormwater conditions. The landform design was aligned with the natural contours where possible, ensuring that the cut and fill areas were minimised where possible, and the design was sensitive to the existing undulating terrain
- Minimising earthworks along the site boundaries. Where possible, design levels at adjoining boundaries were tailored to match existing topography, creating a neat interface. This was also adopted to reduce retaining wall heights where level matching was not feasible. Notably, batters were preferred over retaining walls to manage level differences along the boundaries, with maximum 1 in 4, or 1 in 6 batters implemented depending on the location and interface requirements. The interface between the existing and design surfaces is to be refined in future design stages with a higher level of detail design
- Considering lot grades to ensure the constructability of future development lots.

It is important to note that the landform grading is subject to refinement during subsequent design phases of the project.

7.2 Cut & Fill Quantities

Bulk earthworks quantities were prepared by comparing the proposed concept design surface with a survey of the existing surface (prepared by StrataSurv Surveyors, received 03/06/25).

The outcome of the above-mentioned landform design resulted in bulk earthworks that is generally balanced. A greater detailed analysis during subsequent development phases will

provide more certainty on the ultimate bulk earthworks solution, limiting the export of fill off site where possible and making additional allowances for road boxing, trench spoil, etc. Refer to Figure 15 and Table 6 below for a preliminary cut to fill representation over the site.

Figure 15 Proposed Cut & Fill

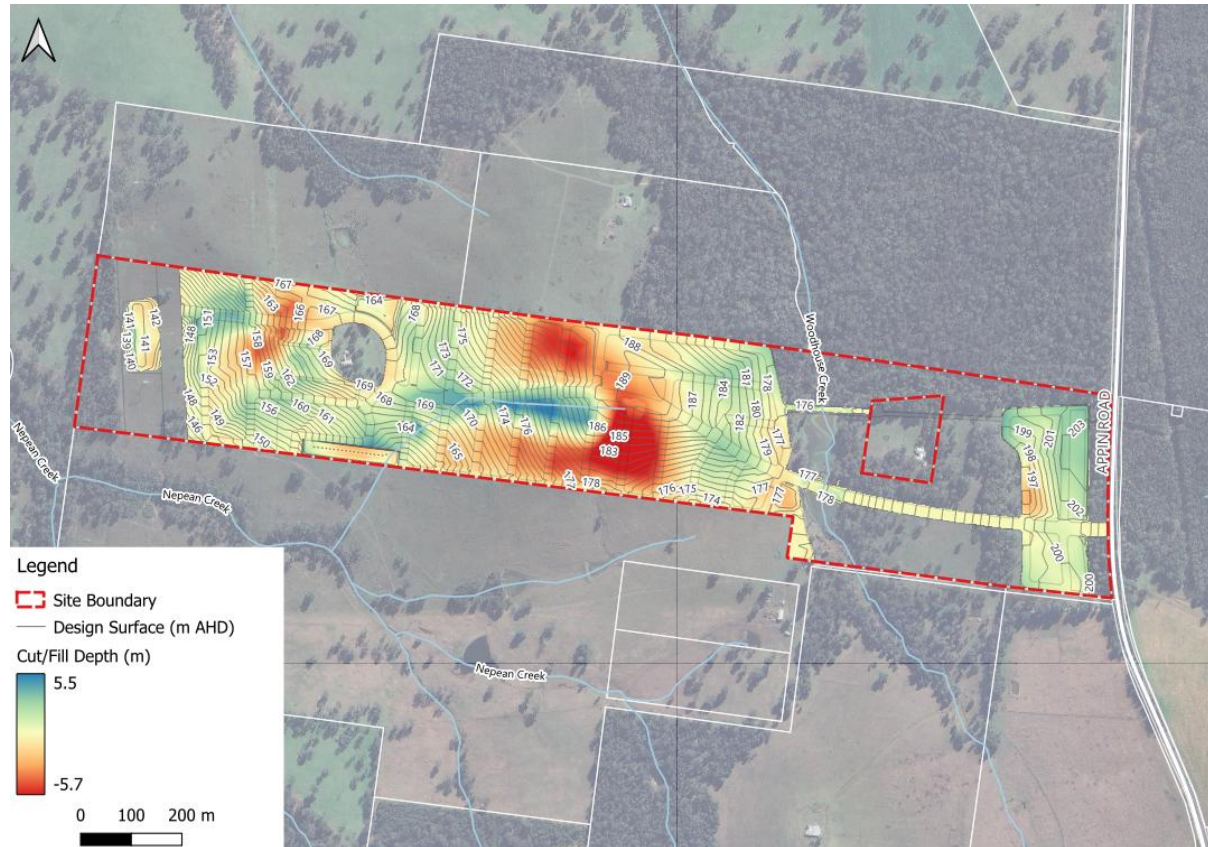


Table 6 - Cut & Fill Quantities

	Cut	Fill	Balance
Volume (m³)	409,225	385,849	23,376

It should be noted that these estimates for bulk earthworks volumes are indicative in nature and there are currently limited allowances for detailed road pavement depths, stormwater/services trenching, and no bulking factors have been applied. It does however show that a balanced earthworks outcome is achievable for the site.

8 Stormwater Management

To understand the land use requirements for water management infrastructure for the proposed development on the receiving waterways, a detailed stormwater analysis of the site has been undertaken to support the Planning Proposal. This analysis has been undertaken by IDC in the form of a water cycle management assessment which examines Council's water quantity and quality requirements.

The aim of this assessment is to:

- Understand the existing stormwater flow conditions for the site
- Develop a post-development stormwater strategy that has a 'no worsening' effect on existing stormwater flows (i.e. a pre-to-post comparison) and creek lines
- Prepare a concept stormwater network consisting of indicative detention basin volumes/footprints and appropriate discharge points
- Identify Council's water quality requirements and determine locations within the proposed development area to implement WSUD principles to treat stormwater, prior to discharge to downstream creeks.

The following analyses have taken into consideration the economics, engineering, and environmental aspects of the works through the implementation of appropriate stormwater controls in accordance with Campbelltown Council's requirements.

8.1 Design Controls & Guidelines

The stormwater network for the site has been designed to comply with the following guidelines:

- Campbelltown Council *Local Environment Plan*, 2015
- Campbelltown (Sustainable City) *Development Control Plan, Volume 1 Development Controls for All Types of Development*, 2015
- Campbelltown (Sustainable City) *Development Control Plan, Volume 2 Engineering Design for Development*, 2015
- *Australian Rainfall and Runoff – A guide to flood estimation*, Version 4.2 (2019)
- *Managing Urban Stormwater: Soils and Construction* 2004.

8.2 Water Quantity Management

8.2.1 Major/Minor System Drainage

The major/minor approach to stormwater drainage is the recognised drainage concept for urban catchments within the Campbelltown Council LGA.

The minor drainage system comprises the below-ground pit and pipe network within the road network and is designed to control nuisance flooding and enable effective stormwater management for the site. In line with Campbelltown Council's *Engineering Design for Development* guide, the minor system is to be designed for the 5-year ARI for rural residential land uses.

The major drainage system incorporates overland flow routes through proposed roads, hardstand, and landscaped areas, and is assessed against the 100-year ARI design storm event. This system is also designed to accommodate minor system failures.

8.2.2 Detention Strategy

Based on post-development hydrologic modelling, the proposed stormwater strategy includes the provision of an on-site detention (OSD) system to attenuate post-developed flows.

The intent of the OSD system is to ensure that peak discharges for the 1% AEP event do not exceed the corresponding pre-developed flows, in accordance with Council's no-worsening objective. Detention storage has been preliminarily sized using DRAINS outputs. Allowances for flow control devices (i.e.: orifices, etc.), maintenance access, safety fencing, and sediment forebays will be incorporated during detailed design.

A key feature of the design is the implementation of a centralised online basin over the 1st order stream, Woodhouse Creek. The DRAINS modelling of the detention basin was confirmed via TUFLOW modelling that shows that the 1% AEP flows do not breach either of the two east-west access roads and that the southern Collector Road is flood free in a PMF event, facilitating flood-free egress from the site in all events.

8.3 Water Quality Management

To address Campbelltown Council's water quality targets, MUSIC modelling was undertaken for the proposed development using the proposed masterplan land uses. The modelling confirms that a well-designed WSUD treatment train can achieve pollutant reduction targets of 80% total suspended solids (TSS), 45% total phosphorous (TP), 45% total nitrogen (TN), and 90% gross pollutants (GP).

The typical proposed treatment train includes:

1. Rainwater tanks that collect runoff from new residential dwellings and allows for rainwater reuse for toilet flushing and lot irrigation;
2. Gross pollutant traps (GPTs), which intercept coarse sediments and litter and provide pre-treatment for the bioretention basins;
3. Bioretention basins at the end of drainage catchments to provide fine sediment filtration and nutrient removal prior to discharge of flows from site.

These elements have been conceptually located to align with internal flow paths and make use of perimeter and verge areas where feasible. Sizing and configuration will be refined as part of future design stages.

The strategy balances performance, constructability, and ongoing maintenance considerations, consistent with Campbelltown Council's *Engineering Design for Development* guide.

8.4 Masterplan Stormwater Strategy

On-site detention for the development has been proposed in the form of multiple detention basins. The proposed northern, southern, and western basins include a bioretention component

and are shown in the figure below as a 'combined OSD/WSUD basin'. However, the OSD/WSUD basins on the eastern side of the site are separate basins, with the OSD basin for this area proposed as an online basin in Woodhouse Creek. The online basin has been coordinated with flood modelling completed for the 1% AEP flood event by GRC Hydro. Refer to the flood report for further details.

Due to level constraints, a portion of the southern catchment (3.8ha) will bypass the detention basins proposed for the site. To prevent increased flows from discharging from the development site, a temporary detention basin has been proposed as shown below. This basin will be decommissioned when the area south of the masterplan has been developed and their detention basin is operational.

Figure 16 Indicative Proposed Basin Locations



9 Stormwater Modelling

Stormwater modelling was undertaken to quantify both the hydrologic (quantity) and pollutant (quality) impacts of the proposed land use change and to test the performance of the indicative stormwater strategy against Council's design standards and environmental objectives.

9.1 Stormwater Quantity Modelling

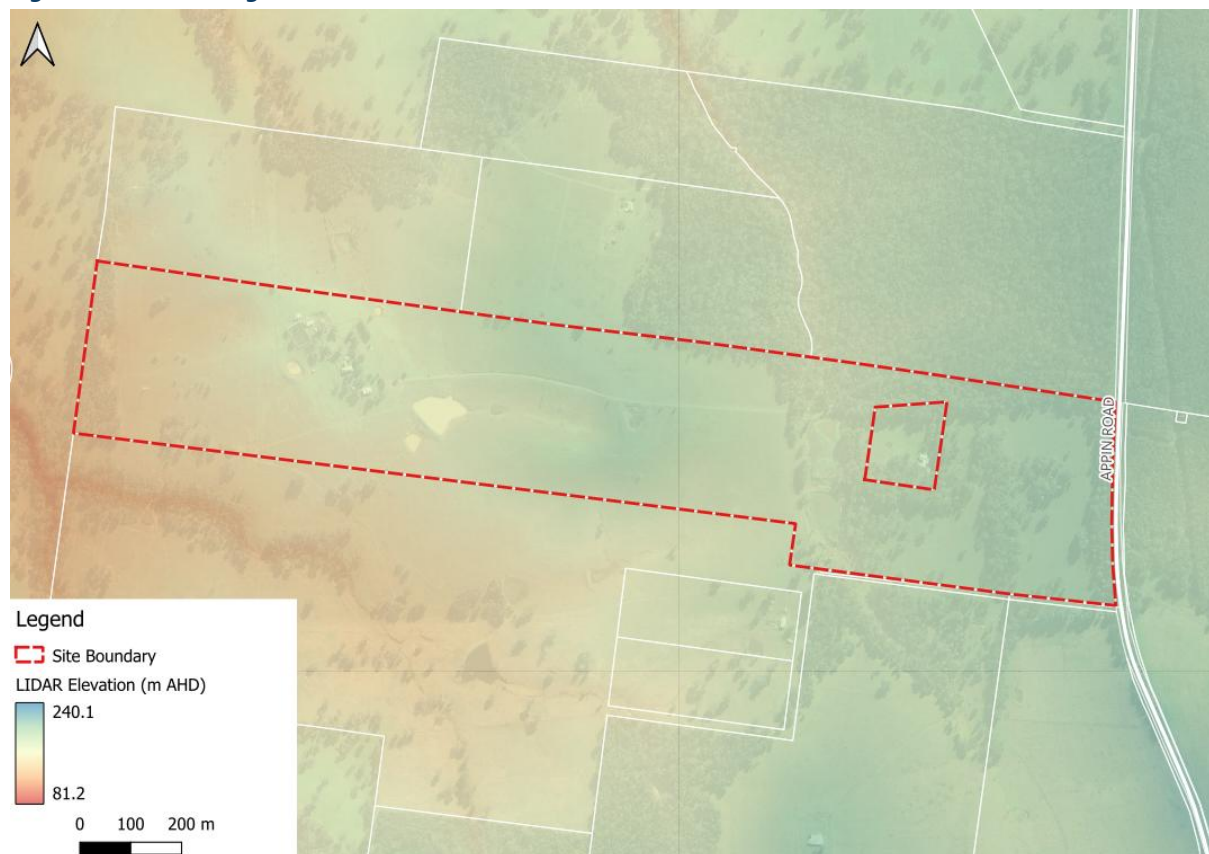
9.1.1 Pre-Developed Stormwater Assessment

LIDAR

A digital elevation model (DEM) was generated using LiDAR (Light Detection and Ranging) aerial survey obtained from the NSW Government Spatial Services for the site and surrounding catchment area.

The figure below shows the LiDAR survey DEM as a representation of the base elevations used to inform the DRAINS model. This image was generated using QGIS Software.

Figure 17 Site Existing Surface Terrain



Rainfall Data

The Intensity-Frequency-Duration (IFD) data adopted for the DRAINS model has been calculated based on the rainfall intensity equations and coefficients obtained from the Campbelltown 25-213 Omya Gilead Civil Engineering, Infrastructure & Water Cycle Management Review

Council *Engineering Design for Development* Guide for the 'Campbelltown Zone'. The minor storm selected for analysis is the 5-year ARI storm event and the 100-year ARI storm event has been selected for major storm analysis. The IFD data for both the minor and major storms are shown in the table below:

Table 7 Campbelltown IFD Data

Storm Duration (mins)	Rainfall Intensity (mm/hour)	
	Average Recurrence Interval	
	5 Years	100 Years
5	134.4	222.8
10	102.9	170.8
15	86.3	143.1
20	75.4	124.9
25	67.4	111.8
30	61.3	101.7
45	49.0	81.4
60	41.4	68.9
90	32.2	53.9
120	26.8	45.0

Hydrological Model

An ILSAX DRAINS model, with the ARR87 design storm procedure, was developed to assess the hydraulic behaviour of the site's catchments. The parameters for the DRAINS model have been adopted from the Campbelltown Council *Engineering Design for Development* guide and are shown in Table 8 below:

Table 8 DRAINS Model Parameters

Parameter	Value
Paved (Impervious) Area Depression Storage (mm)	1
Supplementary Area Depression Storage (mm)	1
Grassed (Pervious) Area Depression Storage (mm)	5
Soil Type	Normal, 3

Catchment Areas

In the existing scenario, stormwater runoff from the site drains toward the Nepean Creek, Woodhouse Creek, and Appin Road.

The site sub-catchments have been delineated based on the existing surface (obtained from LIDAR survey) and discharge points. Upstream catchments directing water towards and through the site have also been included as part of the pre-development model to calculate the full volume and extent of flow through the site.

The pre-development catchments for the site are detailed below:

Figure 18 Pre-development DRAINS Catchments

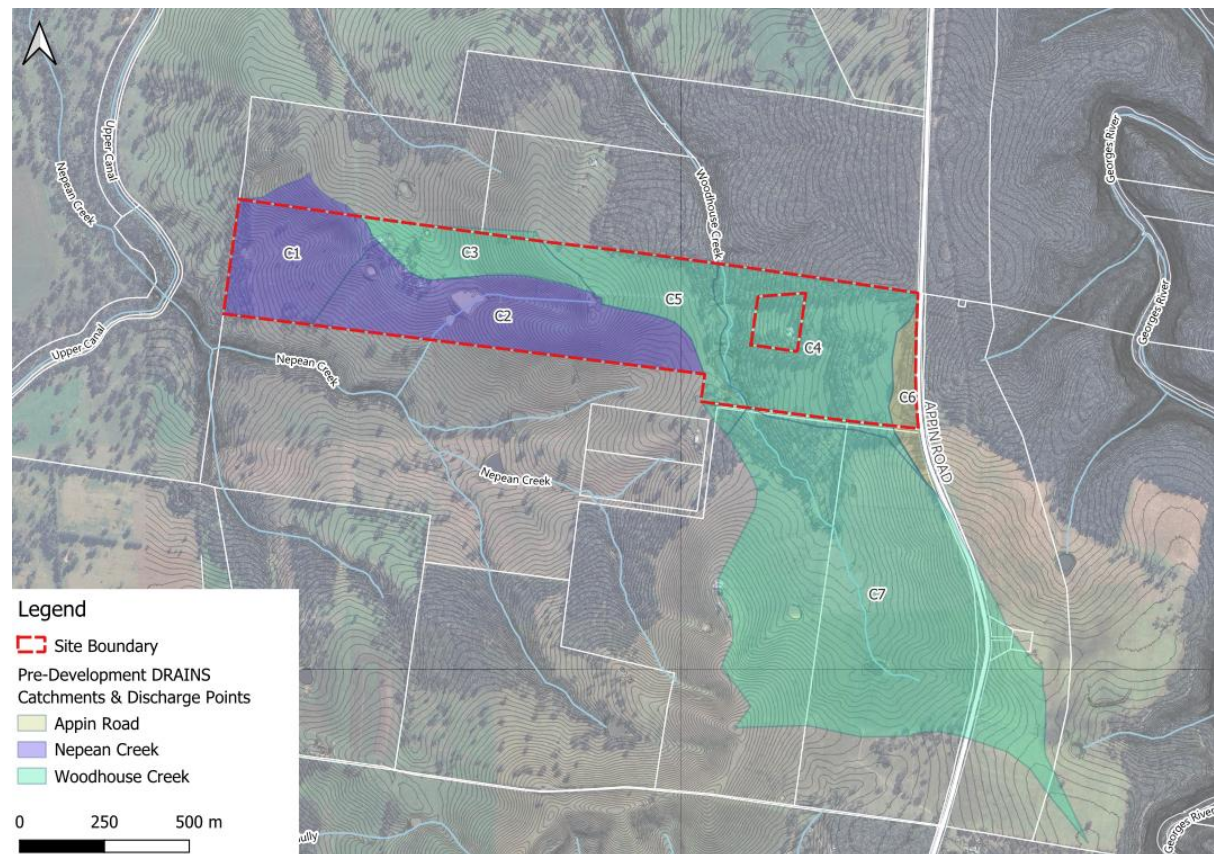


Table 9 Pre-Development Catchment Details

Catchment	Discharge Point	Area (ha)
C1	Nepean Creek	13.20
C2	Nepean Creek	20.74
C3	Woodhouse Creek	7.55
C4	Woodhouse Creek	22.24
C5	Woodhouse Creek	10.33
C6	Appin Road	2.96
C7	Woodhouse Creek	67.36
Total		144.38

Impervious Fraction

The impervious fractions for the pre-development sub-catchments have been obtained from Campbelltown Council's *Engineering Design for Development* guide. The pre-development catchment details adopted for the DRAINS modelling are shown below:

Table 10 Pre-Development Catchment DRAINS Parameters

Catchment Name	Total Area (Ha)	Impervious Fraction (% of Catchment)	Additional Time (mins)	Flow Path Length (m)	Flow Path Slope (%)	Impervious Mannings Coefficient (n*)	Pervious Mannings Coefficient (n*)
C1	13.20	5	0	460	6.21	0.015	0.05
C2	20.74	5	0	527	6.12	0.015	0.05
C3	7.55	5	0	584	5.02	0.015	0.05
C4	22.24	5	0	522	5.24	0.015	0.05
C5	10.33	5	0	378	4.28	0.015	0.05
C6	2.96	0	0	327	4.00	0.015	0.05
C7	67.36	5	0	1,725	2.33	0.015	0.05

Pre-Developed Scenario Results

The below table shows the existing case peak discharge rates for the minor and major storms for the pre-development site:

Table 11 Pre-Development Peak Flow Rates

Catchment	Discharge Point	Pre-Development Peak Flow (m ³ /s)	
		5 Year ARI	100 Year ARI

C1	Nepean Creek	1.59	3.97
C2	Nepean Creek	2.35	5.77
C3	Woodhouse Creek	0.781	1.95
C4			
C5	Woodhouse Creek	6.71	16.10
C7			
C6	Appin Road	0.375	0.945

9.1.2 Post-Developed Stormwater Assessment

A post-development DRAINS model was developed based on the adjustments to the following parameters to represent post development conditions.

Catchment Areas

The post-development catchment areas have been determined based on the proposed masterplan, design surface, and existing discharge points. The post-development catchment analysis is shown below:

Figure 19 Post-Development DRAINS Catchments

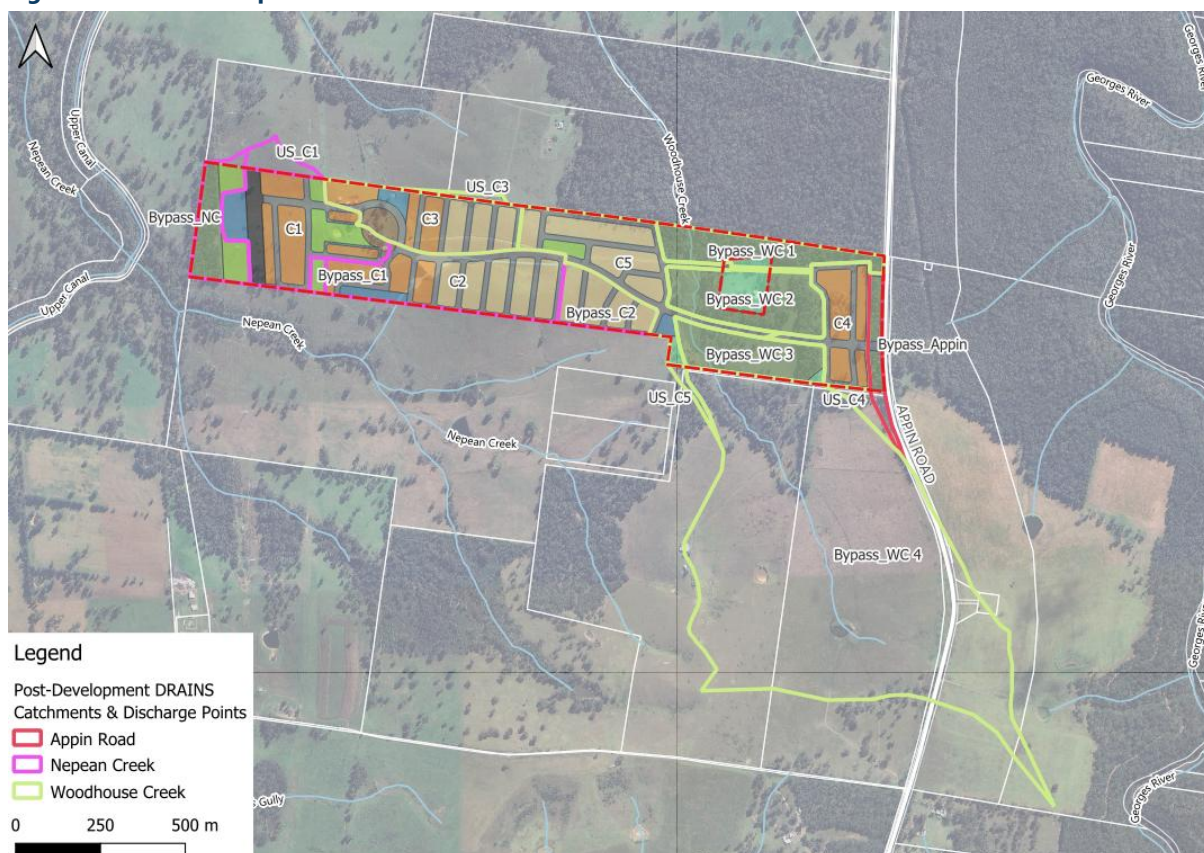


Table 12 Post-Development Catchment Details

Catchment	Discharge Point	Area (ha)
C1	Nepean Creek	10.71
C2	Nepean Creek	11.24
C3	Woodhouse Creek	8.17
C4	Woodhouse Creek	5.48
C5	Woodhouse Creek	9.55
US_C1	Nepean Creek	1.26
US_C3	Woodhouse Creek	0.43
US_C4	Woodhouse Creek	0.94
US_C5	Woodhouse Creek	0.45
Bypass_Appin	Appin Road	1.85
Bypass_NC	Nepean Creek	4.22
Bypass_C1	Nepean Creek	0.47
Bypass_C2	Nepean Creek	3.80
Bypass_WC 1	Woodhouse Creek	5.04
Bypass_WC 2	Woodhouse Creek	7.39
Bypass_WC 3	Woodhouse Creek	5.09
Bypass_WC 4	Woodhouse Creek	68.28
Total		144.37

Impervious Fraction

The impervious fractions for the post-development sub-catchments have been based on the proposed masterplan and Campbelltown Council's *Engineering Design for Development* guide, where catchments remain as per existing. The post-development catchment details adopted for the DRAINS modelling are shown below:

Table 13 Post-Development DRAINS Catchment Details

Catchment Name	Total Area (Ha)	Impervious Fraction (% of Catchment)	Additional Time (mins)	Flow Path Length (m)	Flow Path Slope (%)	Impervious Mannings Coefficient (n*)	Pervious Mannings Coefficient (n*)
C1	10.71	65	0	289	7	0.015	0.035
C2	11.24	75	0	550	6	0.015	0.035
C3	8.17	70	0	488	3	0.015	0.035

C4	5.48	85	0	333	1	0.015	0.035
C5	9.55	80	0	295	5	0.015	0.035
US_C1	1.26	5	0	133	12	0.015	0.05
US_C3	0.43	5	0	334	8	0.015	0.05
US_C4	0.94	5	0	307	4	0.015	0.05
US_C5	0.45	5	0	247	2	0.015	0.05
Bypass_Appin	1.85	10	0	316	4	0.015	0.05
Bypass_NC	4.22	5	0	221	5	0.015	0.05
Bypass_C1	0.47	10	0	111	11	0.015	0.035
Bypass_C2	3.80	75	0	271	8	0.015	0.035
Bypass_WC 1	5.04	5	0	452	6	0.015	0.05
Bypass_WC 2	7.39	5	0	403	6	0.015	0.05
Bypass_WC 3	5.09	5	0	354	6	0.015	0.05
Bypass_WC 4	68.28	5	0	1725	2	0.015	0.05

Development Detention Storage

Iterations were performed in DRAINS to determine the minimum size of the stormwater detention basins necessary to satisfy Council's pre-to-post requirements. The minimum volumes proposed for each detention basin are shown below:

Table 14 Minimum Basin Detention Volumes

Basin Name	Minimum Detention Volume (m ³)
Basin_C1	3,600
Basin_C2	2,000
Basin_Temp_Bypass_C2 ¹	600
Basin_C3	2,500
Basin_C4 – C5 ²	9,900
Total	18,600

¹ Basin_Temp_Bypass_C2 is a temporary basin that will be decommissioned when the area south of the masterplan is developed

² Basin_C4 – C5 is an online basin

It should be noted that the above volumes do not account for existing/post-developed flooding conditions or tailwater conditions imposed by downstream water courses. As such, it is

recommended that these detention volumes are confirmed in future design stages with detailed site survey and flood assessments.

Post-Developed Scenario Results

The results of the DRAINS assessment indicate that the proposed detention storage satisfies Council's requirement of post-development flows not exceeding pre-development flows for each sub-catchment on site.

Table 15 Post-Development Peak Flow Rates

Catchment	Discharge Point	Peak Flow Rates (m ³ /s)			
		5 Year ARI		100 Year ARI	
		Pre-Development	Post-Development	Pre-Development	Post-Development
C1	Nepean Creek	1.59	1.59	3.97	3.69
Bypass_NC					
US_C1					
C2	Nepean Creek	2.35	2.29	5.77	3.94
Bypass_C1					
Bypass_C2					
C3	Woodhouse Creek	0.781	0.675	1.95	1.89
US_C3					
C4	Woodhouse Creek	6.71	5.45	16.1	16.1
US_C4					
C5					
US_C5					
Bypass_WC 1					
Bypass_WC 2					
Bypass_WC 3					
Bypass_WC4					
Bypass_Appin	Appin Road	0.375	0.241	0.945	0.593

9.2 Stormwater Quality Modelling (MUSIC)

A Model for Urban Stormwater Conceptualisation (MUSIC) model has been developed in accordance with technical guidance to demonstrate achievement of Council's stormwater management targets. The parameters and assumptions adopted for the MUSIC model are detailed in the following sections.

9.2.1 Proposed MUSIC Catchments

To form a base for the modelling, the proposed site was divided into catchments based on the proposed road network, design surface, and existing topography (obtained from LIDAR survey data). These catchments are detailed below:

Figure 20 MUSIC Catchments



Table 16 MUSIC Catchment Areas

Catchment	Area (ha)
C1	10.25
C2	11.24
C3	8.64
C4	5.64
C5	9.55
Bypass_C1	0.47
Bypass_C2	3.80
Bypass_West	3.99
Bypass_East 1	1.39
Bypass_East 2	4.94

Bypass_East 3	5.68
Bypass_East 4	4.71
Total	70.29

9.2.2 Land Use Composition

To accurately represent the proposed scenario, the MUSIC catchments were separated based on the proposed land use composition. This breakdown is shown in the table **Error! Reference source not found.** below.

Table 17 MUSIC Catchment Land Use Breakdown

Land Use Summary (ha)										
Catchment	CPCP	Drainage	Meadowvale Heritage	Transitway	POS	Medium Density Residential	Low Density Residential	Environmental Living	Local Roads	Total
C1	0	1.05	0.27	1.57	1.53	4.20	0	0	1.64	10.25
C2	0	0.63	0.05	0	0	2.48	4.36	0	3.73	11.24
C3	0	0.49	0.79	0	0	3.53	1.54	0	2.28	8.64
C4	0	0.15	0	0	0	2.72	0	0	2.76	5.64
C5	0	0.31	0	0	0.50	3.67	0.66	0.34	4.08	9.55
Bypass_C1	0	0	0	0	0.47	0	0	0	0	0.47
Bypass_C2	0	0	0	0	0	0	2.95	0	0.85	3.80
Bypass_West	2.38	0	0	0	1.61	0	0	0	0	3.99
Bypass_East 1	1.25	0	0	0	0	0	0	0	0.15	1.39
Bypass_East 2	4.78	0	0	0	0	0	0	0.15	0	4.94
Bypass_East 3	5.68	0	0	0	0	0	0	0	0	5.68
Bypass_East 4	4.71	0	0	0	0	0	0	0	0	4.71
Total	18.80	2.62	1.11	1.57	4.11	16.59	9.51	0.49	15.50	70.29

It should be noted that land classified as 'CPCP' land has not been included in the MUSIC model as it remains as per existing.

To account for the effects of different surface types on the runoff volume and pollutants generated, differences in pervious and impervious areas have been considered for the non-lot land use types and are shown in Table 18 below. Unless noted otherwise, the below impervious and pervious percentages have been adopted from Campbelltown Council *Engineering Design for Development* guide.

Table 18 Non-Lot Impervious & Pervious Breakdown

Land Use	Impervious (%)	Pervious (%)
Drainage ¹	10	90
Heritage ²	5	95
Transitway ¹	90	10
POS	10	90
Local Roads ¹	90	10

¹ The impervious/pervious breakdown for these land uses have been assumed, as they are not included within Council's guidelines

² Since the Meadowvale Heritage area is comprised of primarily pervious surfaces, it has been classified as a 'Rural' land use as per the Campbelltown Council *Engineering Design for Development* guide.

To better represent the proposed scenario, lot areas were broken down into landscaping, pavement, and roof areas. The amount of impervious area across the different lot types has been based on the average lot sizes provided by Inspire Planning as well as impervious area percentages within Campbelltown Council's *Engineering Design for Development* guide. As such, the impervious percentages adopted for the medium density, low density, and environmental living residential areas are 80%, 70%, and 30% respectively. The split between the different impervious surface types (i.e.: the pavement and roof surfaces) was then measured based on similarly sized residential lots in the vicinity of the site. The surface breakdown for the medium density, low density, and environmental living residential lots are shown below:

Table 19 Lot Breakdown

Lot Breakdown (%)			
Lot Type	Landscape	Pavement	Roof
Medium Density	20	30	50
Low Density	30	30	40
Environmental Living	70	15	15

The breakdown of impervious and pervious area for the different lot surface types have been assumed as per below:

Table 20 Lot Impervious & Pervious Breakdown

Lot Land Use	Impervious (%)	Pervious (%)
Landscape	10	90
Pavement	90	10
Roof	100	0

9.2.3 MUSIC Model Setup

Base Model

Since Campbelltown Council does not have a MUSIC-link/template, the Liverpool City Council MUSIC-link has been adopted, as per Indesco's *Water Cycle Management Plan* (Revision D) for the development site. This MUSIC-link forms the basis of the stormwater quality modelling.

Pollutant Concentration Parameters

The pollutant concentration parameters used within the MUSIC model are based on the defaults within the Liverpool City Council MUSIC-link for different land use types. The classification for the MUSIC source nodes are summarised below:

Table 21 MUSIC Source Node Classification

MUSIC Source Node	Source Node Type	Classification
Drainage	Urban	Mixed
Heritage	Urban	Mixed
Transitway	Urban	Sealed Road
POS	Urban	Mixed
Local Roads	Urban	Sealed Road
Medium Density/Low Density/Environmental Living - Roof	Urban	Roof
Medium Density/Low Density/Environmental Living – Pavement	Urban	Sealed Road
Medium Density/Low Density/Environmental Living - Landscape	Urban	Mixed

Rainfall-Runoff Parameters

The MUSIC rainfall-runoff parameters adopted for all source nodes have been based on the defaults within the Liverpool City Council MUSIC-link and are shown below:

Table 22 MUSIC Source Node Rainfall-Runoff Parameters

Parameter	Adopted Value
Rainfall Threshold (mm/day)	0.3 – Roof areas; 1.5 – All other areas
Soil Storage Capacity (mm)	187
Initial Storage (% of Capacity)	30
Field Capacity (mm)	127
Infiltration Capacity Coefficient a	135
Infiltration Capacity Exponent b	4
Initial Depth (mm)	10

Daily Recharge Rate (%)	10
Daily Baseflow Rate (%)	10
Daily Deep Seepage Rate (%)	0

Proposed Treatment Train

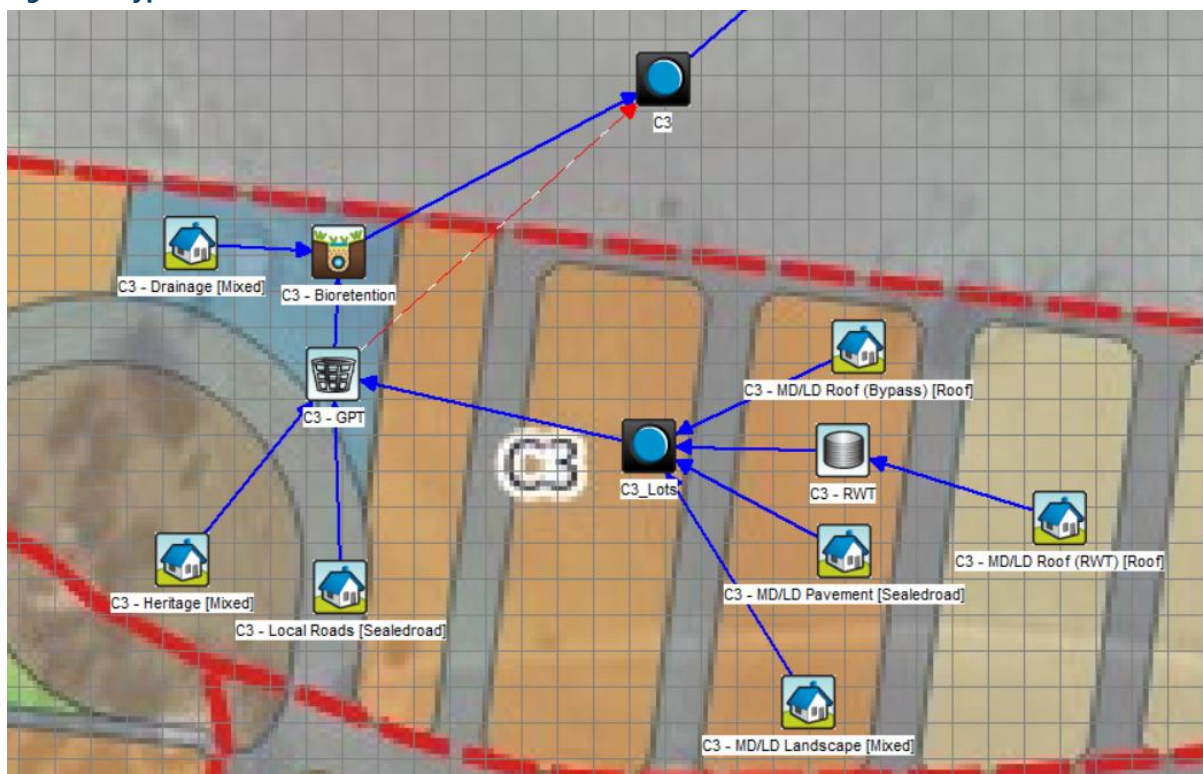
A typical treatment train has been proposed for the site as follows:

- Rainwater tanks will collect runoff from the proposed residential roof areas for reuse for toilet flushing and irrigation of lot landscape areas;
- Flows from site will drain through the GPTs, with high-flow bypass flows directed to outlet nodes;
- Flows from the GPT are then directed to the bioretention basins; and
- Flows from site will discharge to nearby creeks/roads (as per existing discharge points).

For Catchment 4, flows from site will be directed to WSUD zones along the proposed local roads first and then drained through a GPT, before being discharged from site. Additionally, due to level constraints and proximity, flows from the Catchment 5 Environmental Living area will be directly conveyed to the bioretention basin.

The typical MUSIC set up, at catchment C3, is shown below:

Figure 21 Typical Treatment Train



Treatment Train Parameters

The assumptions and calculations utilised for the treatment train nodes are detailed in the following sections.

Rainwater Tanks

Runoff from new dwellings will be collected by rainwater tanks. Rainwater tank volumes have been calculated based on the assumption that a 3kL rainwater tank is required per lot. The calculated rainwater tank volumes per catchment are shown below:

Table 23 Rainwater Tank Volumes

Catchment	Rainwater Tank Volume (kL)
C1	417
C2	600
C3	477
C4	270
C5 (Low/Medium Density)	417
C5 (Environmental Living)	3
Bypass_C2	240
Bypass_East 2	3
Total	2,427

It has been assumed that rainwater collected by these tanks will be reused for toilet flushing and irrigation of lot landscape areas. The demand for toilet flushing has been calculated by assuming a demand of 0.1kL/dwelling/day. The number of proposed low density, medium density, and environmental living dwellings across each catchment have been calculated based on average lot sizes/dwelling yields provided by Inspire Planning. As such, the number of dwellings and the rainwater reuse for toilet flushing have been calculated per catchment and shown below:

Table 24 Toilet Flushing Re-use

Catchment	Total No. of Dwellings	Toilet Flushing Re-use (kL/day)
C1	139	13.9
C2	200	20.0
C3	159	15.9
C4	90	9.0
C5 (Low/Medium Density)	139	13.9
C5 (Environmental Living)	1	0.1
Bypass_C2	80	8.0
Bypass_East 2	1	0.1

The water demand for lot irrigation has been calculated based on the lot landscape area per catchment and by assuming an irrigation rate of 0.4kL/m²/year. As such, the re-use for irrigation is shown below:

Table 25 Lot Irrigation Re-use

Catchment	Irrigation Re-use (kL/year)
C1	3,358
C2	7,213
C3	4,678
C4	2,175
C5 (Low/Medium Density)	3,724
C5 (Environmental Living)	958
Bypass_C2	3,535
Bypass_East 2	427

It is assumed that only 50% of the roof areas will drain to the proposed tanks. The remainder of the roof runoff will bypass rainwater tank collection.

Gross Pollutant Traps (GPTs)

Flows are then directed to GPTs, which provide treatment for total suspended solids and gross pollutants. No removal rates for total phosphorous have been included as a conservative assumption.

The GPTs have been sized for the 3-month (4EY) storm event using DRAINS. As such, the high flow bypass for the GPTs are as follows:

Table 26 GPT High Flow Bypass

Catchment	GPT High Flow Bypass (m ³ /s)
C1	0.59
C2	0.66
C3	0.482
C4	0.3975
C5	0.72

Pollutant removal rates adopted for GPTs have been assumed as per below:

Table 27 GPT Assumed Pollutant Removal Rates

Pollutant	Input	Output	Reduction
Total Suspended Solids (TSS)	1000	300	70%

Total Phosphorous (TP)	5	5	0%
Total Nitrogen (TN)	50	50	0%
Gross Pollutants (GP)	15	1.5	90%

Bioretention Basins

Flows are then directed to bioretention basins for treatment. Unless noted otherwise, the parameters have been adopted from the Liverpool MUSIC-link and are shown below:

Table 28 Bioretention Basin Parameters

Parameter	Adopted Value
Low Flow Bypass (m ³ /s)	0
High Flow Bypass (m ³ /s)	100
Extended Detention Depth (m)	0.30
Surface Area (m ²)	<i>Varies</i>
Filter Area (m ²)	<i>Varies</i>
Unlined Filter Media Perimeter (m) ¹	0.01
Saturated Hydraulic Conductivity (mm/hour)	100
Filter Depth (m)	0.40
TN Content of Filter Media (mg/kg)	800
Orthophosphate Content of Filter Media (mg/kg)	55
Exfiltration Rate (mm/hour)	0
Is Base Lined?	No
Vegetation Properties	Vegetated with Effective Nutrient Removal Plants
Overflow Weir Width	2.00
Underdrain Present?	Yes
Submerged Zone with Carbon Present?	No

¹ An unlined filter media perimeter of 0.01m has been assumed to represent that the filter media is fully lined, which prevents groundwater penetration from the basin

The minimum areas to be allocated for the bioretention basins for each catchment are shown below:

Table 29 Minimum Bioretention Basin Areas

Catchment	Minimum Bioretention Basin Area (m ²)
C1	1,590
C2	1,380

C3	750
C5	380
Total	4,100

Street WSUD Zones

For Catchment C4, flows from site are first conveyed through WSUD zones proposed along local roads. In MUSIC, they have been modelled using the 'bioretention' node with the same high flow bypass that is applied to the C4 GPT ($0.40\text{m}^3/\text{s}$), to ensure that only the 3-month flow is conveyed through the treatment train. All other parameters have been kept the same as per the bioretention parameters outlined in the above section. MUSIC modelling results have demonstrated that a minimum of 480m^2 is required. This can be provided as approximately 0.7m wide WSUD zones along local roads within the C4 catchment, as indicatively shown below:

Figure 22 Indicative WSUD Zone Locations



The arrangement and location of these WSUD zones are to be incorporated as part of the masterplan and refined in future design stages.

9.2.4 Water Quality Modelling Results

The results of the MUSIC model are shown below and demonstrate compliance with Council's stormwater quality targets, with source and residual loads showing the post-development pollutant loads with and without the treatment train respectively:

Table 30 Pollutant Reductions & Targets

Pollutant	Source Load (kg/yr)	Residual Load (kg/yr)	Target (%)	Reduction Achieved (%)
TSS	66,300	11,700	80	82.4
TP	122	54.5	45	55.3
TN	680	351	45	48.4
GP	7,730	650	90	91.6

It should be noted that there will be bypass from local roads and low density residential areas from Catchment Bypass _C2. This catchment does not drain to a bioretention basin due to level constraints and to assume the worst case development scenario. The runoff from this catchment can potentially be treated locally (e.g. with WSUD zones along proposed local roads). However, this to be assessed and refined in future designs stages.

10 Conclusion

The above analysis shows that the development in its proposed form and yield can be supported by critical enabling infrastructure. This will require utility services lead-ins to the site in consultation with the relevant authorities.

A balanced earthworks outcome is achievable with maximum depths of both cut and fill of approximately 5m to provide suitable gradients for roads and development lots.

The proposed basin strategy will detain flows on site so that the pre-development flow rates are largely maintained and the pollution removal rates from the water sensitive urban design infrastructure also achieves compliance with Council's targets.

Further, more detailed design will be required to support future Development Applications which will build upon the investigations supporting this Planning Proposal.