



# Werrington Stage 2C

Civil Engineering and Infrastructure Report

Prepared for Lendlease  
23 November 2021

## Document Information

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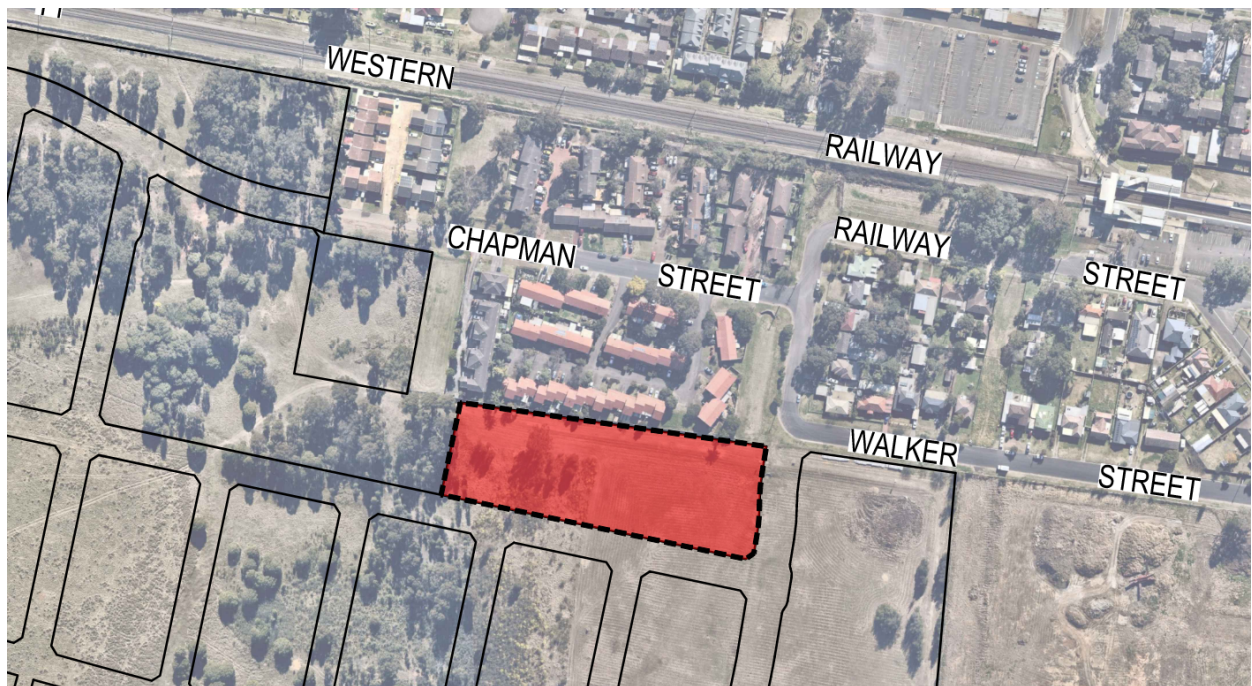
Appendix A      Stormwater Management Report – Kings Central Stage 1D and Stage 2C





## 1 Introduction

Enspire Solutions (Enspire) has been engaged by Lendlease to prepare civil engineering and infrastructure design and documentation to support a development application (DA) for a subdivision creating 29 integrated housing development lots. The subject site is located within the overall Werrington development located at 16 Chapman Street, Werrington., referred to as Stage 2B in Stage 1A-B & Stage 2A Civil Works for Subdivision Certificate – Cardno 03/06/2021. A site locality plan for the subject site is provided in Figure 1.



**Figure 1 Site Location**

Reference: Enspire



### 3 Related Reports and Documents

This report is to be read in conjunction with the following reports and documents:

**Table 1 – Werrington Stage 2C Subdivision Civil Engineering Works Drawing Reference**

Drawing Number	Drawing Title
190060-2C-DA-C01.01	COVER SHEET AND DRAWING SCHEDULE
190060-2C-DA-C01.21	GENERAL NOTES AND LEGENDS - SHEET 01
190060-2C-DA-C01.22	GENERAL NOTES AND LEGENDS - SHEET 02
190060-2C-DA-C01.41	GENERAL ARRANGEMENT PLAN
190060-2C-DA-C03.01	BULK EARTHWORKS EROSION AND SEDIMENTATION CONTROL PLAN
190060-2C-DA-C03.21	EROSION AND SEDIMENTATION CONTROL DETAILS
190060-2C-DA-C05.01	SITWORKS AND STORMWATER MANAGEMENT PLAN
190060-2C-DA-C07.01	ROAD LONGSECTIONS AND TYPICAL SECTIONS
190060-2C-DA-C11.01	PAVEMENT, SIGNAGE AND LINEMARKING PLAN
190060-2C-DA-C20.01	STORMWATER CATCHMENT PLAN
190060-2C-DA-C22.01	TURNING PATH AND BIN LOCATION PLAN
190060-2C-DA-C23.01	SAFETY IN DESIGN

- Enspire drawings for Civil Engineering Works, Werrington Stage 2C Subdivision;
- Stormwater Management Report – Kings Central Stage 1D and Stage 2C, Cardno, 23 November 2021, Refer Appendix A;
- Penrith Development Control Plan 2014, prepared by Penrith City Council 2014;
- Penrith Guidelines for Engineering Works for Subdivisions and Developments, prepared by Penrith City Council, Nov 2013; and
- Cardno drawings and Civil Engineering Report for Kings Central Stage 1A-B & 2A Subdivision Works, Refer DA19/0704.

### 4 Erosion and Sediment Control

The objectives of the erosion and sediment control for the development site are to ensure:

- Adequate erosion and sediment control measures are applied prior to the commencement of construction and are maintained throughout construction; and
- Construction site runoff is appropriately treated in accordance with Penrith City Council requirements.

As part of the works, the erosion and sedimentation controls will be constructed in accordance with Council requirements and the NSW Department of Housing Manual, “Managing Urban Stormwater Soil & Construction” 2004 (Blue Book) prior to earthworks commencing on site and will be modified by the contractor as construction progresses.

#### 4.1 Sediment and Erosion Control Measures

Prior to earthworks commencing on site, sediment and erosion control measures shall be implemented generally in accordance with the Development Application drawings and the “Blue Book”. The measures shown on the drawings are intended to provide minimum treatment only as the contractor will be required to modify and stage the erosion and sedimentation control



measures to suit the construction program, sequencing and techniques. These measures will include:

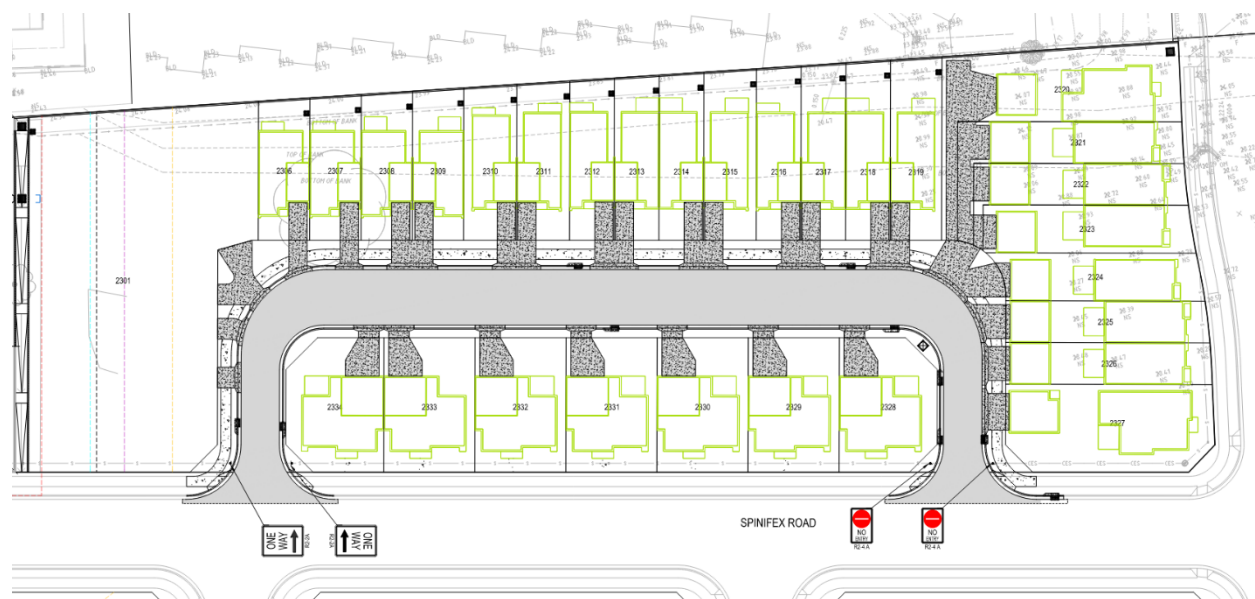
- A temporary site security/safety fence is to be constructed around the site;
- Sediment fencing provided downstream of disturbed areas;
- Dust control measures including covering stockpiles, installing fence hessian and watering exposed areas;
- Placement of hay bales or mesh and gravel inlet filters around and along proposed catch drains and around stormwater inlets pits; and
- Stabilised site access at the construction vehicle entry/exits.

Any stockpiled material, including topsoil, shall be located as far away as possible from any associated temporary overland flow paths. Sediment fences shall be installed to the downstream side of stockpiles and any embankment formation. All stockpiles and embankment formations shall be stabilised by hydroseeding or hydro mulching on formation.

## 5 Siteworks and Grading

### 5.1 General

The proposed development works will involve the construction of a one-way local road, access driveways and a footpath. Figure 2 demonstrates the proposed siteworks.



**Figure 2 Proposed Siteworks**

Reference: Enspire





## 5.2 Bulk Earthworks

The bulk earthworks for the subject site is to be undertaken as part of the Stage 1A-B & 2A works as documented by Cardno in DA19/0704.

## 5.3 Site Grading

The Cardno bulk earthworks design has been used as the foundation for the grading design for the subject site. The site grading is largely governed by the following constraints:

- Spinifex Road design levels on the southern boundary of the subject site;
- Existing open space levels on the western boundary;
- Existing and proposed Cardno road levels on the eastern boundary;
- Existing townhouse levels on the northern boundary; and
- Proposed road drainage pit and pipe network to connect into proposed Spinifex Road drainage network.

The bulk earthworks levels generally fall at 3% in a North-East direction, away from proposed Spinifex Road. The design grading of the lots is generally 1.5% for the lots fronting proposed Spinifex Road and 3.0%-5.5% for the lots fronting the proposed internal road. The site grading has been co-ordinated with the home builders design for the proposed dwellings on the individual lots. The subject site is not affected by regional flooding hence the road levels are not constrained by this factor.

## 5.4 Retaining Walls

Retaining structures are proposed within the subject site and generally are as follows:

- On the western boundary of the subject site there is approximately 51.5m of parallel blockwork retaining walls proposed with a maximum height of 2.2m. The parallel walls have a 2.0m separation to create an access ramp from Spinifex Road to Central Park.
- Along the northern boundary of the site there is approximately 171m of post and panel retaining walls proposed with a maximum height of 1.4m.

Reference shall be made to Enspire's engineering drawings for further details. Final details of structure type, material and colour shall be confirmed during the detailed design phase of the development.

## 5.5 Road Type

The proposed road section outlined in Table 2 applies to the development

**Table 2 – Typical Road Section**

Road	Category	Typical Road Carriageway	Comment
Road 02	Minor Local Road	6m – 8m (varies)	Road 02 is one-way direction only, allowing for a reduced carriageway width upon approach to Spinifex Road intersections. Footpath proposed on northern side of road only. Southern lots front Spinifex Road.



## 5.6 Vertical and Horizontal Geometry

Road geometry is generally designed in accordance with Australian Standards AS2890.1 (2004), AS2890.2 (2018) and Penrith Development Control Plan 2014 – Volume 2 – Part C – South Werrington Urban Village (Penrith City Council, 2014).

Details of the proposed works are demonstrated in Enspire's engineering drawing package.

## 5.7 Design Vehicles

The design vehicle for the development is a 12.5m Heavy Rigid Vehicle (HRV). A swept path analysis has been completed using AutoTURN software and in accordance with AUSTROADS guidelines.

Details of the proposed turning path assessment are demonstrated in Enspire's engineering drawing package.

## 5.8 Pavement Design

The proposed pavement design is consistent with pavement specified for local roads within the Stage 1A-B & 2A subdivision works.

Pavements are subject to detailed assessment during detailed design and construction phase.

## 5.9 Signage and Linemarking

Signage and linemarking is proposed to provide appropriate warning to vehicles, improve driver awareness at intersections, and guide the flow of one-way traffic along Road 02.

Refer to Enspire's Pavement, Signage and Linemarking Plan for details.

# 6 Stormwater Management Strategy

## 6.1 Controls

The stormwater strategy for the development has been developed in accordance with the following documents:

- Stormwater Management Report – Kings Central Stage 1D and 2C – Cardno 23 November 2021;
- Civil Engineering and Infrastructure Report, 2B3B Chapman Street, Werrington – Cardno (2019);
- Design Guidelines for engineering Works for Subdivision and Developments - Penrith City Council (2013);
- Stormwater Drainage Specification for Building Development - Penrith City Council (2016);
- Australian Rainfall and Run-off (AR&R); and
- Water Sensitive Urban Design (WSUD) Technical Guidelines for Western Sydney.

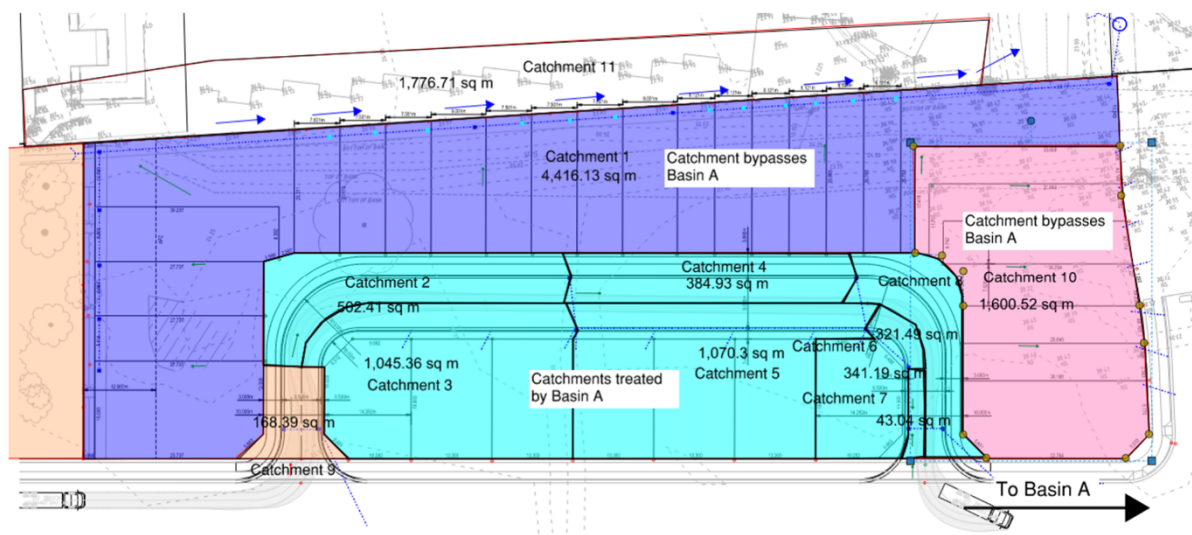
## 6.2 Stormwater Quantity Management Strategy

The stormwater management strategy for the subject site has been designed to ensure site stormwater runoff is managed and co-ordinated with the greater Werrington development.

As outlined in the report *Stormwater Management Report – Kings Central Stage 1D and 2C – Cardno 23 November 2021 (Cardno Stormwater Report)*, the proposed Road 02 and enclosed



southern lots will drain to the trunk drainage network and ultimately to Basin A for water quality treatment and detention. The remaining 2C catchment will bypass detention storage. As outlined in the Cardno Stormwater Report, the stormwater treatment train has been designed to compensate the free drainage catchment in Stage 2C. Figure 3 shows the catchment layout for the subject site.



**Figure 3 Stage 2C Catchment Plan**

Reference: Stormwater Management Report – Kings Central Stage 1D and 2C – Cardno, 23/11/2021.

### 6.3 Pit and Pipe Network

The proposed pit, pipe and overland flow network has been designed in accordance with Councils Engineering Design Guidelines. The following key criteria as noted in Table 3 have been considered and applied in the stormwater drainage design.

**Table 3 - Adopted Design Criteria**

Design Coordination	Design Criteria
General	Major Storm Event – 1% AEP Minor Storm Event – 20% AEP
Blockage Factor	Sag pits 50% On-grade pits 20%
Minor Storm Event	Maximum 150mm freeboard to grate level
Vd Ratio	Velocity x depth in roadway gutter < 0.4ms/s
Overland Flow	Reverse verge cross fall at road sag locations

### 6.4 Network Modelling

The proposed residential development will be drained by an in-ground pit and pipe network designed to cater for the 20% AEP (minor storm event). The network has been designed and modelled using DRAINS software (standard hydraulic model).

The interallotment drainage positioned adjacent to the retaining wall at the rear of the development has been designed to cater for the 1% AEP to prevent water from overtopping.





Reference shall be made to the DRAINS model prepared by Enspire Solutions, '190060-02-Enspire-R01-Werrington2C-DRAINS-211116'.

## 6.5 Stormwater Quality Management Strategy

As outlined in the report *Cardno Stormwater Report*, proposed Road 02 and enclosed southern lots will drain to the trunk drainage network and ultimately to Basin A for water quality treatment and detention. The remaining 2C catchment will drain to the north via a proposed Gross Pollutant Trap (GPT).

### 6.5.1 Stormwater Quality Management Modelling

A water quality analysis has been undertaken to assess the performance of the proposed Water Sensitive Urban Design (WSUD) strategy against the adopted stormwater quality targets. The stormwater quality analysis for this study was undertaken using the industry standard software model MUSIC (Model for Urban Stormwater Improvement Conceptualisation) Version 6.3.

MUSIC modelling was undertaken in accordance with Penrith Council MUSIC Link. Catchment 01 that bypasses Basin A has been separated into two unique land use nodes, roof and residential in a 60:40 ratio. The Central Park catchment has been assumed to have a mixed land use node. Industry parameters for proprietary treatment nodes have been adopted.

The treatment system for the catchments that bypasses Basin A will involve the use of a proprietary GPT product as demonstrated on Enspire's engineering drawing package.

Refer Figure 4 for the proposed MUSIC Model strategy.

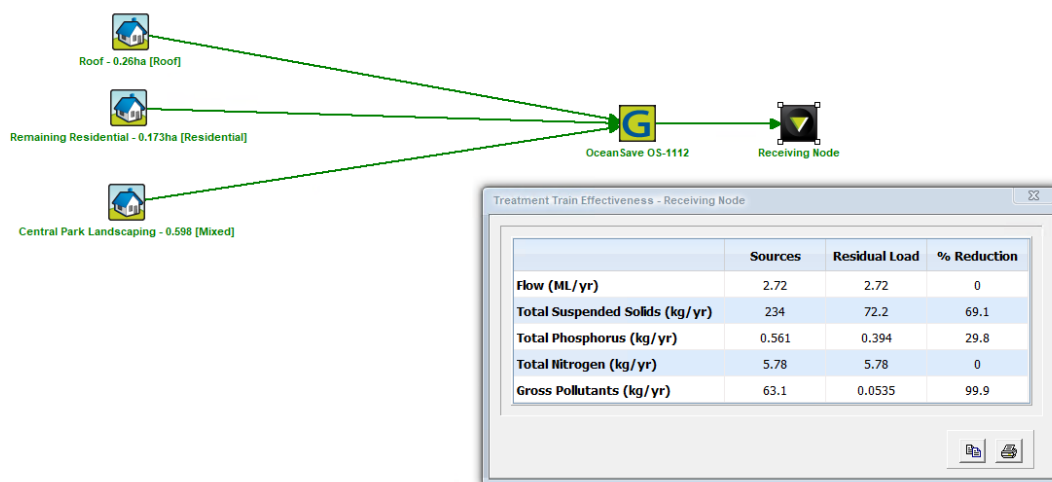


Figure 4 MUSIC Model

### 6.5.2 MUSIC Model Results

The MUSIC model was prepared to estimate the annual gross pollutant loads generated by the proposed development catchment that bypasses Basin A.

Table 4 summarises the average annual pollutant loads and reductions. Resultant pollutant loads for Lot 2C can be referred back to the Stormwater Management Report by Cardno.



**Table 4 – Estimated Average Annual Pollutant Load Reductions**

Criteria	Target % Reduction	Achieved % Reduction	Compliance
Gross Pollutants (GP)	90	99.9	OK

The results above demonstrate that the proposed stormwater quality strategy meets Council's target reductions for pollutant loads.

## 7 Utilities

New utility infrastructure will be provided to service the proposed subdivision. These services will be placed in typical shared trench arrangements in accordance with the NSW Streets Opening Conference Guide to Codes and Practices for Streets Opening (2009) or equivalent alternative approved by the relevant authority.

The services to be provided within the Stage 2C development include:

1. Potable water;
2. Wastewater;
3. Telecommunications; and
4. High and low voltage electrical services.

### 7.1 Potable Water

Stage 2C is intended to be serviced by Sydney Water. The potable water reticulation within Stage 2C will be serviced from the proposed mains in Spinifex Drive which are currently being constructed as part of DA19/0704.

A Section 73 Certificate Application to Sydney Water will be required for assessment. Sydney Water will then issue a Notice of Requirements to outline the servicing requirements for the proposed development.

### 7.2 Wastewater

Stage 2C is intended to be serviced by Sydney Water. Wastewater reticulation within Stage 2C will be serviced from the existing mains located in the Northeastern corner of the development site.

A Section 73 Certificate application to Sydney Water will be required to be submitted for assessment. Sydney Water will then issue a Notice of Requirements to outline the servicing requirements for the proposed development.

### 7.3 Telecommunications

Telecommunications services reticulation within Stage 2C will be serviced from the proposed mains in Spinifex Drive which are currently being constructed as part of DA19/0704.

### 7.4 High and Low Voltage Electrical Services

Stage 2C is intended to be serviced by Endeavour Energy. The electrical cabling reticulation within Stage 2C will be serviced from the proposed mains in Spinifex Drive which are currently being constructed as part of DA19/0704, subject to Endeavour Energy requirements and approvals.



## **8 Conclusion**

Enspire Solutions has been engaged by Lendlease to prepare the Civil Engineering design and documentation in support of the proposed integrated housing development known as Stage 2C.

This Civil Engineering and Stormwater Management Report supports the proposed construction of roads, stormwater and utilities and has been prepared to provide a summary of design assumptions and adopted design procedures, and as a guide to the stormwater management strategy.

The overall stormwater management strategy and civil engineering design has been designed in co-ordination with the greater Werrington subdivision development and in accordance with normal engineering practice, industry standards and Australian Standards and generally meets the requirements of Penrith City Council.



## Appendix A

# Stormwater Management Report – Kings Central Stage 1D and Stage 2C

Cardno



Our Ref: 80219053-21-022 (3):PL  
Contact: Matthew Zollinger

23 November 2021

Lend Lease  
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**Parramatta 2150**

Attention: Mr Mark Reyes

**Cardno (NSW/ACT) Pty Ltd**  
ABN 95 001 145 035

Suite 3.01, Level 3  
3 Horwood Place  
Parramatta NSW 2150  
As above

**Phone +61 2 9496 7700**  
**Fax +61 2 9439 5170**

Dear Mark,

## **STORMWATER MANAGEMENT REPORT – KINGS CENTRAL STAGE 1D AND STAGE 2C**

Cardno (NSW/ACT) has been engaged by Lend Lease to prepare a stormwater management strategy for the proposed development in Stage 1D and Stage 2C of Kings Central Development (16 Chapman Street, Werrington). Due to the site constraints and further design to the site gradings, there are some minor changes to the catchment areas that drain to the proposed stormwater detention and bio-retention basins.

Cardno has amended the stormwater drainage strategy to suit the latest gradings, amended the hydrology model (DRAINS) and water quality model (MUSIC) to assess the capacity of the onsite detention basins and the efficiency of the treatment train.

Cardno has prepared this report to outline the modelling parameters used in the models, the stormwater treatment train for proposed developments and the modelling results to support the development application of the above developments.

### **PROPOSED CATCHMENTS**

#### **Stage 1D**

The proposed development is bounded by Chapman Street to the north, existing residential development to the east, Central Park to the south and the onsite detention/bioretenion Basin B to the west, which is anticipated to have a top water level of RL 25.26m in the 1% AEP storm event. The proposed houses in Stage 1D, adjacent to Basin B are at a minimum RL 25.40m, which is higher than the 1% AEP water level. The top of basin batter and retaining wall surrounding the basin will be constructed to approximately RL 25.80m to provide minimum 500mm freeboard and flood protection to the surrounding lands.

Basin B consists of an emergency overflow pit (N02/A) and a 600mm diameter pipe to drain the basin in if the main control pit is blocked. The risk of overflow onto the proposed road in Stage 1D will be low as the lowest part of the proposed wall is fronting Chapman Street, where water will be discharged in case of emergency.

Stage 1D will not drain into Basin B to avoid a high tailwater level within Stage 1D due to the Basin B top water level. Stormwater runoff will drain to the treatment chamber with 9 filter cartridges before draining to the Chapman Street drainage network. Figure 1 below shows the catchment plan and stormwater drainage network in Stage 1D.



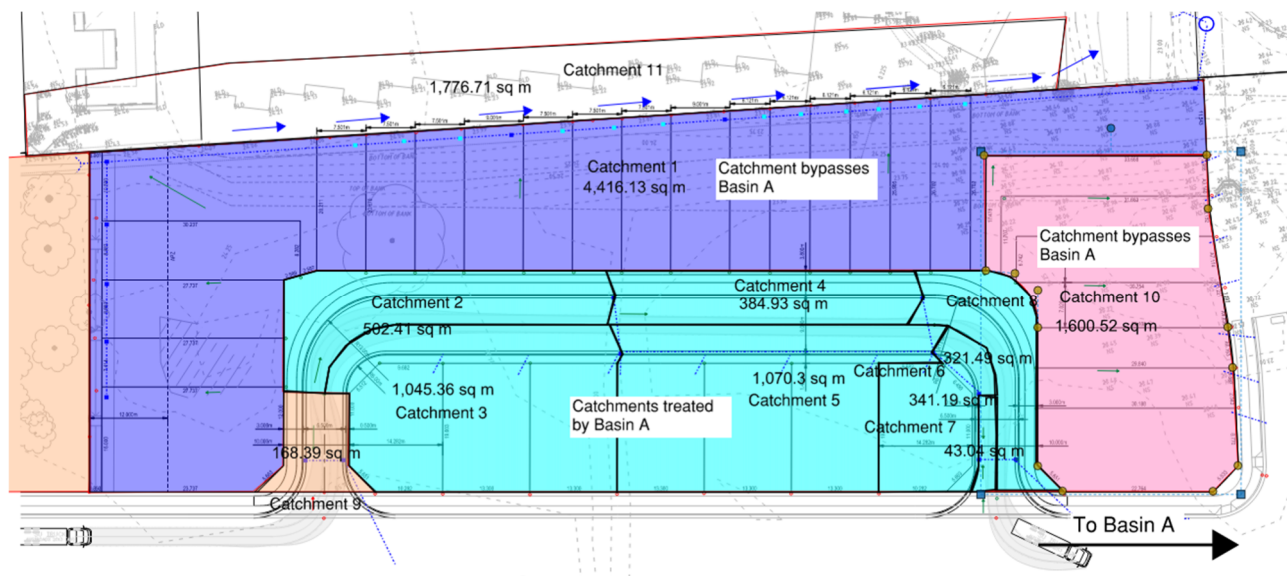


**Figure 1 Stage 1D Catchment Plan**

## Stage 2C

The Stage 2C development site is bounded by the existing residential development to the North, Basin A to the east, Stage 2B to the south and Central Park to the west. The proposed ring road and the enclosed lots will drain to the trunk drainage network to Basin A for treatment and detention,

The rest of the catchment will drain to the north and be treated by a gross pollutant trap (GPT). The stormwater treatment train has been designed to compensate the free draining catchment in Stage 2C. Figure 2 shows the catchment layout for 2C.



**Figure 2 Stage 2C Catchment Plan**

## **WATER QUANTITY ANALYSIS**

The DRAINS model that was prepared for the subdivision certificate for the overall development has been modified in accordance with the proposed catchment layouts as shown in Figure 1 and Figure 2. The parameters used in the model are described in the Civil Engineering and Infrastructure Report prepared for the development application of the Kings Central Development.

The fraction of imperviousness for different land uses in Stage 1D and Stage 2C are shown in **Table 1**

**Table 1 Fraction of imperviousness of different land use**

Catchment	% Impervious	Comment
Medium Density Residential	85	Based on Penrith City Council Engineering Design Guidelines
Normal Residential – including half road	80	Based on Penrith City Council Engineering Design Guidelines
Local Roads	95	Based on Penrith City Council Engineering Design Guidelines

The modelling results have shown Basin A and Basin B have adequate capacities to attenuate peak flows for the 20%, 5% and 1% AEP. However, the 50% AEP post-development flow is higher than the pre-development flow, at 0.72m<sup>3</sup>/s and 0.66m<sup>3</sup>/s respectively. The modelling results are presented in **Table 2**.

**Table 2 DRAINS modelling results**

AEP (%)	Pre-development flow (m <sup>3</sup> /s)	Post- development flow (m <sup>3</sup> /s)
50%	0.66	0.763
20%	1.81	1.026
5%	3.2	2.49
1%	4.8	3.74

The changes in 1% AEP water levels in Basin A and Basin B are shown in Table 2 and demonstrating adequate freeboard from the proposed lot levels.

**Table 2 1% AEP Flood Levels in the Basin A and Basin B**

	Previous design	New Design
Basin A	RL 24.68m	RL 24.73m
Basin B	RL 25.34m	RL 25.26m

The 10% increase in the 50% AEP storm event should not pose a flooding or safety risk to the downstream properties as the flow is less than the design storm event of the existing stormwater drainage network. However, the increase in the 50% AEP flow rates could increase the risk of stream erosion, therefore, stream erosion index (SEI) has been calculated.

### **STREAM EROSION INDEX (SEI) ANALYSIS**

The SEI has been determined in accordance with NSW MUSIC Modelling Guidelines (2015) and WSUD Technical Guidelines Volume 3, Penrith City Council (2015). Generic nodes have been used to transform modelled flows below 50% of 2-year ARI flows to zero. The SEI results are shown in **Table 3**.

**Table 3 Stream Erosion Index results**

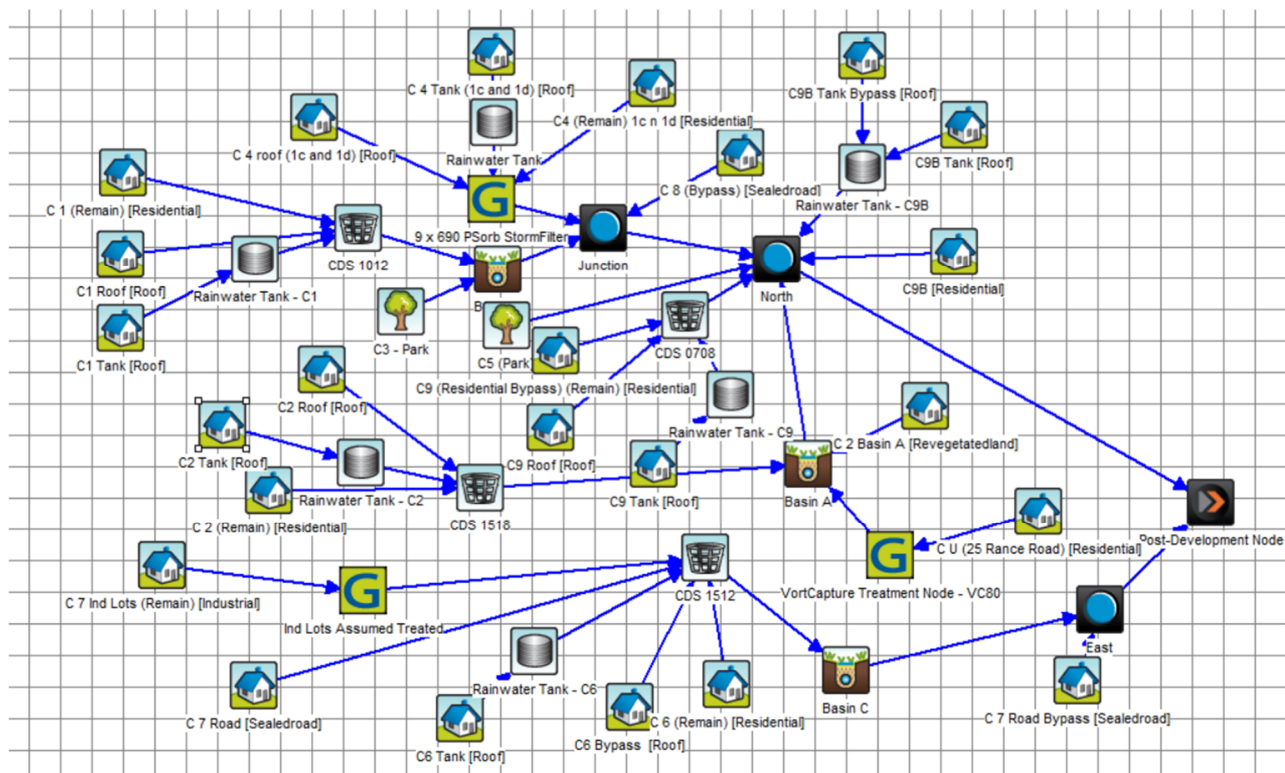
Node	Flow (ML/y)
Pre-development	16.98
Post-development	52.2
SEI from MUSIC assessment	3.07
Upper Limit of SEI	3.5

As shown in Table 3, the SEI ratio for comparing the pre-development condition and post-development condition is 3.1, which is below 3.5, the upper limit of the SEI. Hence, the potential risk for stream erosion is low.

### **WATER QUALITY ANALYSIS**

The stormwater treatment train has been modelled using the MUSIC software package (v6.3.0) incorporating Penrith City Council MUSIC link data for hydrology and node parameters. Figure 3 provides a MUSIC node diagram reflective of the stormwater quality management strategy.

Catchment 1 and Catchment 10 as shown in Figure 2 will bypass the water quality treatment system due to site grading, with the remainder diverted to a treatment train of bioretention basins and gross pollutant trap (GPT) units. For Stage 1D, the site will drain to a treatment chamber with 9 filter cartridges (Ocean Protect Psorb Filters or equivalent approved) to remove pollutants from the stormwater runoff.



**Figure 3 MUSIC Node and Link Diagram**

The treatment efficiencies modelled in MUSIC are given in **Table 4**. It meets the stormwater quality pollutant reduction targets noted in the Council DCP.

**Table 4 Stormwater Quality Treatment Train Effectiveness**

Pollutants	Sources	Residual Load	Percentage reduction (%)	Council DCP reduction target (%)
Total Suspended Solids (kg/yr)	27900	4050	85.5	85
Total Phosphorus (kg/yr)	48	16.4	65.8	60
Total Nitrogen (kg/yr)	350	161	53.9	45
Gross Pollutants (kg/yr)	4640	233	95	90

## **CONCLUSION**

The existing basins have adequate capacity to attenuate peak flows for the 20%, 5% and 1% AEP. Although the 50% AEP post-development flow is approximately 10% higher than the pre-development condition, the Stream Erosion Index analysis has shown the erosion potential is low (3.07) and meets Penrith City Councils requirements.

The majority of Stages 1D & 2A are treated in either Basin A, B or through a proposed filtration tank. However, there is a small area that bypasses any direct water quality treatment, and as such the other treatment features have been increased in size to ensure that the net result of all the catchments combined achieves Council's water quality requirements.

Yours sincerely,

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