



Werrington Stage 1D

Civil Engineering and Infrastructure Report

Prepared for Lendlease
08 February 2022



Document Information

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Document Title	Werrington Stage 1D
Document Subject	Civil Engineering and Infrastructure Report
Prepared For	Lendlease
Project Name	Werrington Stage 1D
Project Number	190060
File Name	REPT001-180001-01-Enspire-R03-220201-1D DA Report .docx

Transmittal

Revision	Date	Prepared by	Checked by	Approved by
A	23/11/2021	R.Andrew	C. Vella	R. Andrew
		Issued for Client Review		
B	10/12/2021	R.Andrew	R. Andrew	R. Andrew
		Issued for Development Application		
C	01/02/2022	R.Andrew	R. Andrew	R. Andrew
		Issued for Development Application		
D	8/02/2022	A Liu	R. Andrew	R. Andrew
		Issued for Development Application		



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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 15 integrated housing development lots. Lots 1301-1304 fronting Chapman Street are to be Torrens title, remaining lots 1305-1315 fronting private Road 01 are to be community title.

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



2 Related Reports and Documents

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

Table 1 – Werrington Stage 1D Subdivision Civil Engineering Works Drawing Reference

Drawing Number	Drawing Title
190060-1D-DA-C01.01	COVER SHEET AND DRAWING SCHEDULE
190060-1D-DA-C01.21	GENERAL NOTES AND LEGENDS - SHEET 01
190060-1D-DA-C01.22	GENERAL NOTES AND LEGENDS - SHEET 02
190060-1D-DA-C01.41	GENERAL ARRANGEMENT PLAN
190060-1D-DA-C03.01	EROSION AND SEDIMENTATION CONTROL PLAN
190060-1D-DA-C03.21	EROSION AND SEDIMENTATION CONTROL DETAILS
190060-1D-DA-C04.01	BULK EARTHWORKS – CUT AND FILL PLAN
190060-1D-DA-C05.01	SITEWORKS AND STORMWATER MANAGEMENT PLAN
190060-1D-DA-C06.01	ROAD TYPICAL CROSS SECTION AND LONGITUDINAL SECTION
190060-1D-DA-C11.01	PAVEMENT, SIGNAGE AND LINE MARKING PLAN
190060-1D-DA-C20.01	STORMWATER CATCHMENT PLAN
190060-1D-DA-C22.01	TURNING PATH AND BIN LOCATION PLAN
190060-1D-DA-C23.01	SAFETY IN DESIGN

- Enspire drawings for Civil Engineering Works, Werrington Stage 1D Subdivision;
- Stormwater Management Report – Kings Central Stage 1D and Stage 2C, Cardno, 8 December 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.

3 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.

3.1 Sediment and Erosion Control Measures

Prior to any 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.

4 Siteworks and Grading

4.1 General

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

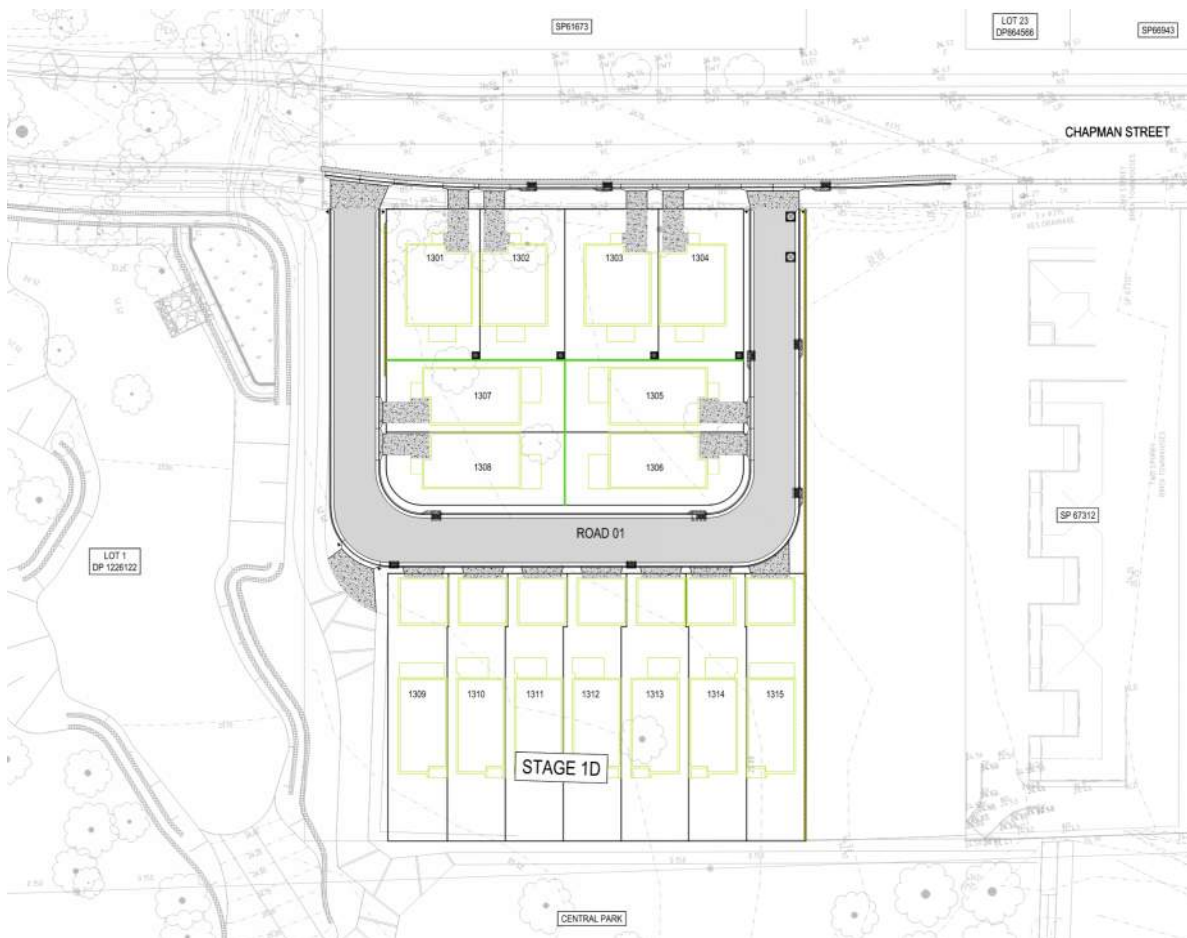


Figure 2 Proposed Siteworks

Reference: Enspire



4.2 Bulk Earthworks

The proposed earthworks operations for the site will consist of excavation works to facilitate construction of the future roadway, building pads and retaining wall.

The works associated with this Development Application include:

- Bulk earthworks and operations to achieve required levels;
- Erosion and sediment controls; and
- Boundary retaining wall.

Earthworks will generally consist of cut and fill operations to establish proposed road formations and site levels. The ultimate design levels have been designed to provide an optimal interface with the existing open space surrounding the site as well as deliver a suitable connection with the existing Chapman Street.

The cut and fill earthworks operations provided are concept only and are subject to change pending final coordination and detailed design. The cut and fill operations for this development are based on the following assumptions:

- No allowance for earthworks bulking factors;
- 200mm topsoil stripping;
- 150mm topsoil placement on lots;
- 200mm topsoil placement on verge;
- 430mm pavement boxing;
- 3.2m³ spoil generated from utility service and stormwater drainage trenching; and
- No allowance for future house slabs.

Reference is made to Enspire's engineering drawing package for the proposed cut and fill earthworks operations.

4.3 Site Grading

The site grading is largely governed by the following constraints:

- Chapman Street levels on the northern boundary of the subject site;
- Existing open space levels on the southern and eastern boundary;
- Proposed Basin B levels on the western boundary; and
- Proposed road drainage pit and pipe network to connect into Chapman Street drainage network.

The site grading levels generally fall at 3% in a North-East direction, towards Chapman Street. 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, however is adjacent to Basin B with a top water level (TWL) of RL25.26¹. The top of basin between Basin B and the subject site will be constructed to approximately RL25.80m, providing 500mm freeboard within the basin. The subject site drainage network does not connect into Basin B and so the TWL does not impose on the subject site grading.

¹ Source - Stormwater Management Report – Kings Central Stage 1D and 2C – Cardno 8 December September 2021 (Cardno Stormwater Report).



4.4 Retaining Walls

A retaining structure is proposed along the eastern boundary of the subject site. The retaining wall is approximately 80m in length with a maximum retained height of 0.5m. 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.

4.5 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 01	Private Road	6.1m – 6.5m (varies)	Road 01 is private to provide access for community title lots 1306-1317. Road 01 is one-way direction only.

4.6 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.

4.7 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.

4.8 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 phase.

4.9 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 01.

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



5 Stormwater Management Strategy

5.1 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 8 December 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.

5.2 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 Cardno Stormwater Report, Stage 1D catchment will not drain into Basin B to avoid a high tailwater level within the subject site due to the Basin B TWL. The subject site will bypass detention storage. As outlined in the Cardno Stormwater Report, the masterplan stormwater treatment train has been designed to compensate for Stage 1D being a free draining catchment.

5.3 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

5.4 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).

Reference shall be made to the DRAINS model prepared by Enspire Solutions, '190060-01-Enspire-R02-Werrington1D-DRAINS-220131'.

5.5 Stormwater Quality Management Strategy

As outlined in the Cardno Stormwater Report, the subject site will drain via an OceanProtect stormwater chamber with 13x690 PSORB SF Cartridges (or similar) to the Chapman Street drainage network. Each kerb inlet pit is to contain an Oceanguard filter pit inset to provide additional treatment of gross pollutants. Stage 1D will not drain into Basin B to avoid a high tailwater level within the subject site due to the Basin B TWL. Figure 3 demonstrates the catchment layout for the subject site.

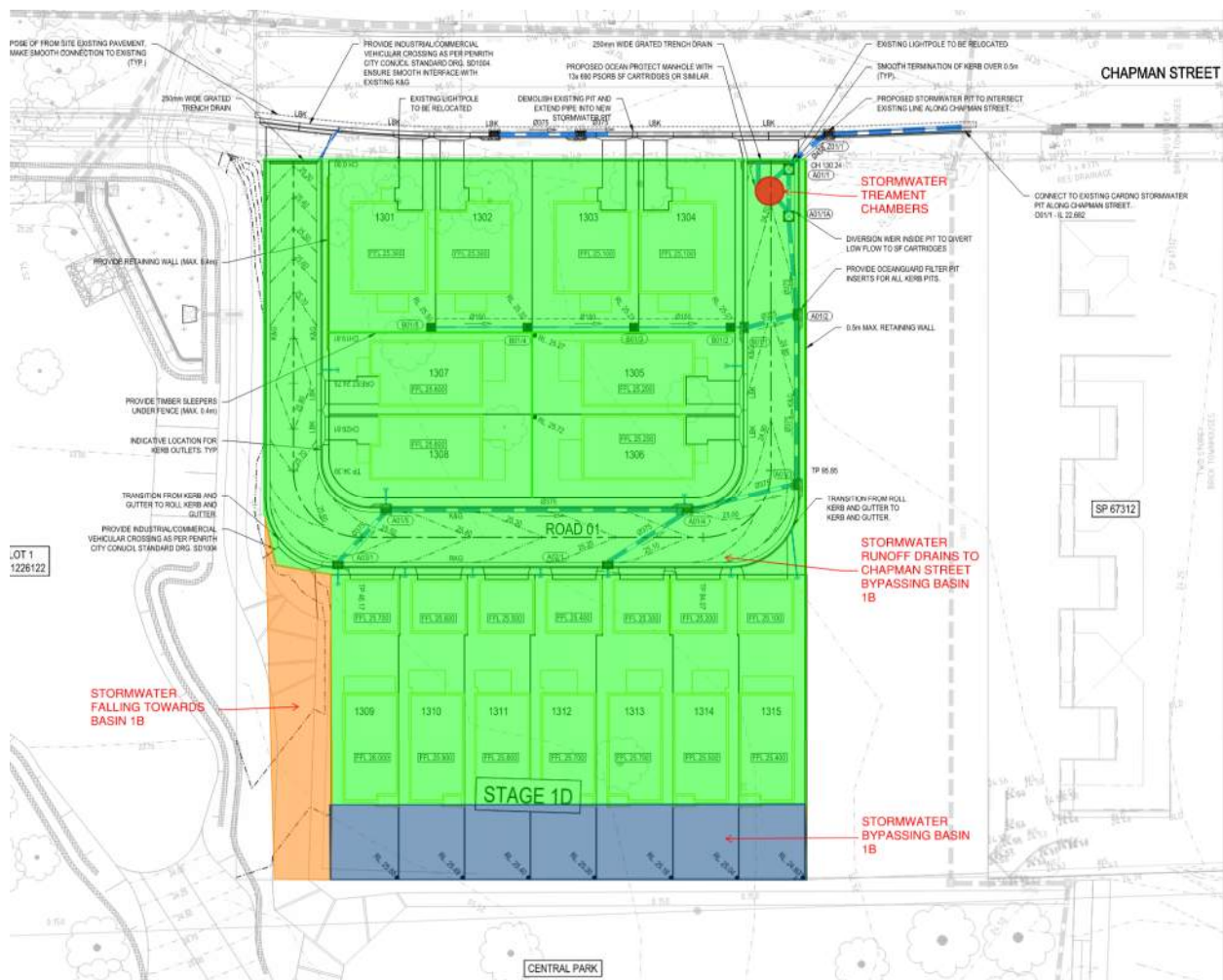


Figure 3 Stage 1D Catchment Plan

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

5.5.1 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. The catchments for the site have been separated into three unique land use nodes, specifically roof, road, residential, with treatment nodes adopting parameters set out in the NSW MUSIC Modelling Guidelines and generally accepted industry parameters for proprietary products.

Refer Figure 4 for the proposed MUSIC Model strategy.

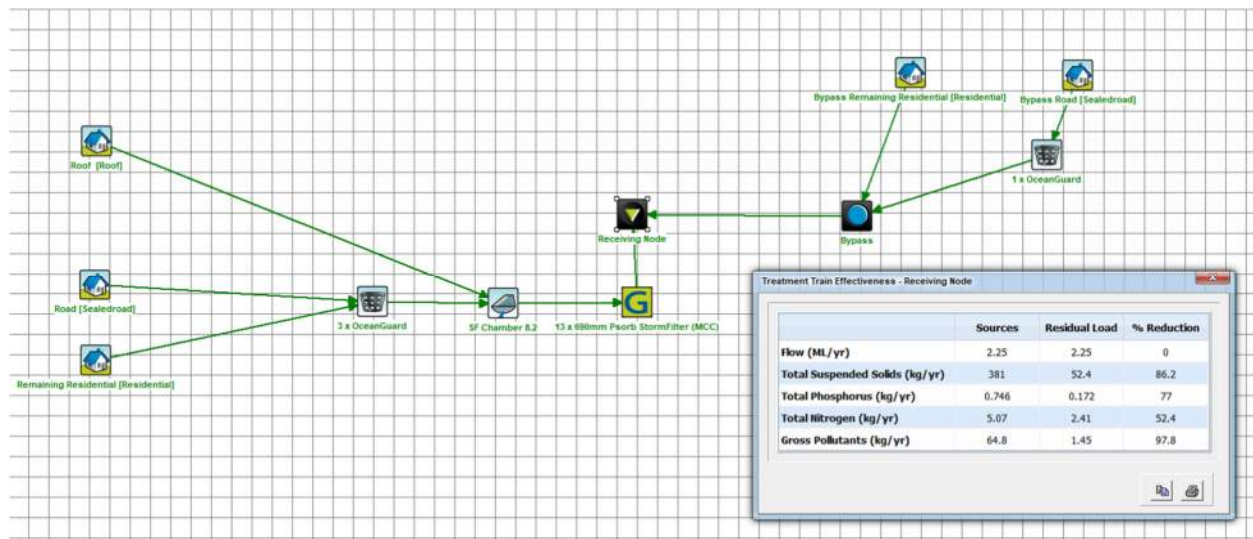


Figure 4 MUSIC Model

5.5.2 MUSIC Model Results

The MUSIC model was run to estimate the annual pollutant loads generated by the proposed development catchment, as well as the resultant pollutant loads discharging from the site after flows pass through the proposed treatment train.

Table 4 summarises the average annual pollutant loads and reductions.

Table 4 – Estimated Average Annual Pollutant Load Reductions

Criteria	Targety Reduction	%	Achieved % Reduction	Compliance
Gross Pollutants (GP)	90		7.8	OK
Total Suspended Solids (TSS)	85		86.2	OK
Total Phosphorous (TP)	65		77.0	OK
Total Nitrogen (TN)	45		52.4	OK
Gross Pollutants (GP)	90		7.8	OK

MUSIC model

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

6 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 1D development include:

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

6.1 Potable Water

Stage 1D is intended to be serviced by Sydney Water, connecting into the main in Chapman Street.

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.

6.2 Wastewater

Stage 1D is intended to be serviced by Sydney Water connecting into the existing main located in Chapman Street.

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.

6.3 Telecommunications

Telecommunications services reticulation within Stage 1D will be serviced from the existing mains in Chapman Street.

6.4 High and Low Voltage Electrical Services

Stage 1D is intended to be serviced by Endeavour Energy, connecting into the proposed mains in Chapman Street 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 1D.

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 (5):PL
Contact: Matthew Zollinger

8 December 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
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Parramatta NSW 2150
As above

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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/bioretention 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.

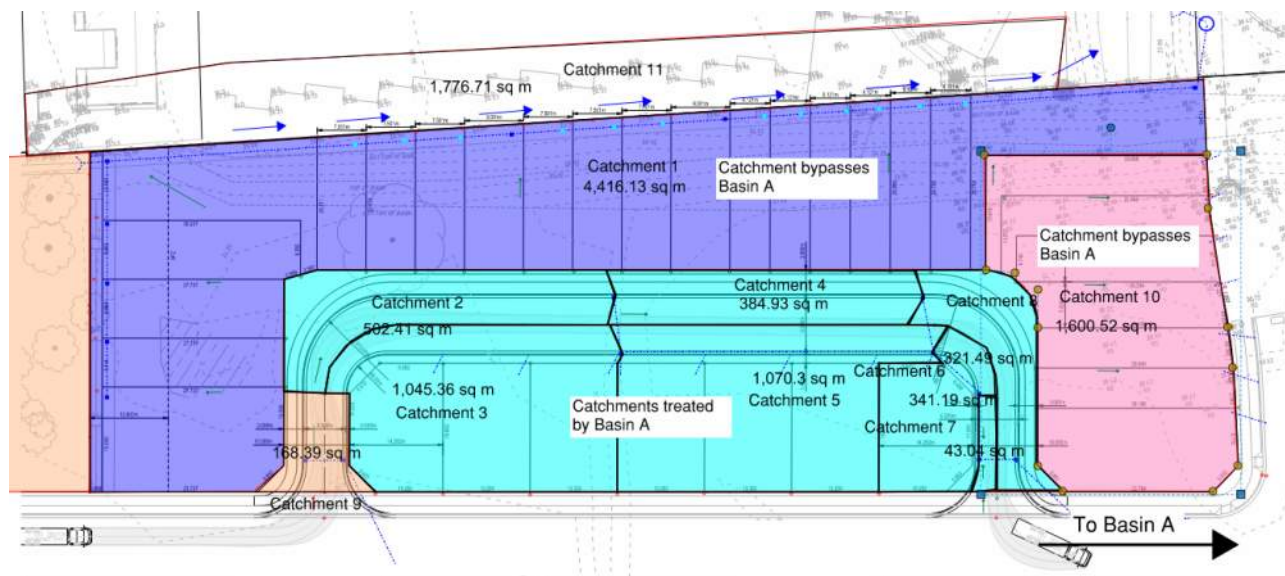


Figure 2 Stage 2C Catchment Plan

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 0.72m³/s and 0.66m³/s respectively. The modelling results are presented in **Table 2**.

Table 2 DRAINS modelling results

AEP (%)	Pre-development flow (m ³ /s)	Post- development flow (m ³ /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

Cardno notes that the design of Basin B is being amended slightly to accommodate downstream network changes to resolve clashes with existing utilities in Chapman Street. Details of any changes to peak water levels will consider Stage 1D and will be detailed in a letter to be agreed with Council.

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.

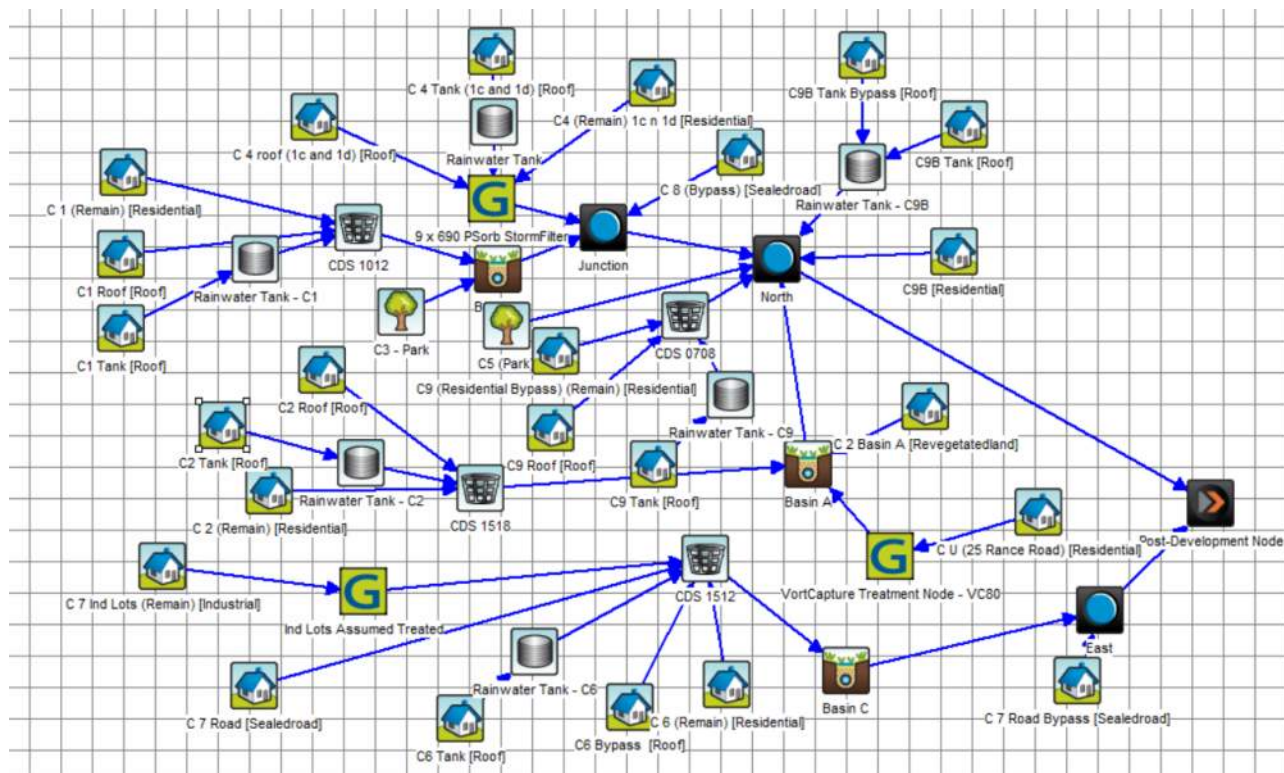


Figure 3 MUSIC Node and Link Diagram

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)	27,900	4,050	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)	4,640	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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