COSTIN ROE CONSULTING

CIVIL & STRUCTURAL ENGINEERS

STORMWATER MANAGEMENT SYSTEM DESIGN
SSD-10272349

DEVELOPMENT SITE

YIRIBANA EAST
LOTS 59 & 60 DP 259135 MAMRE RD, KEMPS CREEK, NSW

Prepared for:

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1 INTRODUCTION & SCOPE

1.1 Introduction

Costin Roe Consulting Pty Ltd has been commissioned by Project Strategy on behalf of The GPT Group to prepare this *Stormwater Management System Design Report (SMSDR)* as part of the post approval requirements of SSD-10272349, being a State Significant Development Application (SSDA) with the NSW Department of Planning and Environment (DPE) for the construction of the infrastructure works for the industrial estate.

This report provides a detailed assessment of the stormwater management system design including Water Sensitive Urban Design (WSUD) elements such as stream health and water quality, and trunk drainage designs.

The submission of the ***SMSDR*** for approval by DPE has been completed in accordance with **Conditions of Consent (CoC) B28** and **B31.**

The *SMSDR* has been prepared in accordance with the reporting requirements of **CoC C1**.

The subject area of this *SMSDR* comprises the stormwater management plan for the estate. These works include estate roads and infrastructure drainage and requirements for individual building lots throughout the development extent.

It is also noted that this SMSDR has been completed with consideration to the Costin Roe Consulting "Ci*vil Engineering Report Incorporating Water Cycle Management Strategy* (Ref: **Co13874.06-04j.rpt**)" included in the Environmental Impact Statement (EIS) for the approved SSD-10272349.

We note that this report and drawings do not include any information pertaining to stormwater management during the construction phase of the project. Reference to design and reporting by the CPESC consultant should be made in relation to the construction stormwater management requirements for the development.

1.2 Scope

This SMSDR provides details of the design principles and construction requirements for stormwater management, as for the DPE submission approval under **CoC B28**.

This plan details the overall estate stormwater management procedures for water quantity and quality, and for future lot developments within the estate as described in **Section 1.1** and **Section 2.2** of this *SMSDR*.

This SMSDR does not include works within Mamre Road which are subject to a separate *Transport for New South Wales* (TfNSW) approval and a separate *Works Authorisation Deed* (WAD) with TfNSW.

The SMSDR will be read in conjunction with the *Stormwater Management System* design package, drawings **Co13874.06-SDD** and the trunk drainage design package **Co13874.06-TD** as included in **Appendix A1 & A2**.

1.3 Conditions of Consent Matrix

This Stormwater Management System Design report and drawings have been completed in accordance with the approved stormwater management strategy and EIS approved in the NSW DPIE in SSD-*10272349*.

We provide the following tables which confirms how and where, within the report or respective drawings and models, each of the requirements of SSD-*10272349* **CoC B28 & B31** have been met.

SSD10272349 Consent Condition Matrix

CoC No.	***Item***	***Response***
Stormwater Management		
B28	Within three months of the date of this consent, or as otherwise agreed with the Planning Secretary, the Applicant must design the stormwater management system to the satisfaction of the Planning Secretary. The stormwater management system design must:	
B28(a)	*be prepared in consultation with the EHG, Sydney Water and Council and include written evidence of the outcomes of the consultation process and how the recommendations have been incorporated into the stormwater management system design;*	The SMSDR and associated design drawings have been prepared in consultation with the relevant authorities including EHG, Sydney Water and Council. The design has been completed in accordance with The Mamre Road Precinct DCP 2021, *Department of Planning and Environment Technical guidance for achieving Wianamatta–South Creek stormwater management targets,* Australian & New Zealand Standard AS/NZS 3500.3:2003 Plumbing and drainage – Stormwater Drainage, Penrith City Council requirements (including *Engineering Construction Specifications for Civil* Works, *Stormwater Drainage Specification for Building Developments* and *Design Guidelines for Engineering Works for Subdivisions and Developments)* and per accepted engineering and best practice.

CoC No.	Item	Response
		In addition to the documents noted above, the design has also been completed in accordance with the Regional Stormwater Authority (Sydney Water) requirements as outlined in their letter dated 7 November 2023.
B28(b)	*be prepared and certified by a suitably qualified chartered professional engineer with experience in modelling, design and supervision of WSUD systems, whose appointment has been endorsed by the Planning Secretary;*	This SMSDR has been prepared for the applicant by Costin Roe Consulting Pty Ltd, civil and structural consulting engineers. Costin Roe Consulting is experienced in the preparation and implementation of *Stormwater Management Plans* for industrial developments of similar scope to this development. Recent similar projects include SSD approved developments such as The Yards Estate Kemps Creek, Moorebank Intermodal Precinct, The Eastern Creek Business Park Stages 4 & 5, The Horsley Drive Business Park Stage 1 at Wetherill Park, Altis First Estate at Erskine Park, Prestons Industrial Estate at Prestons and the DEXUS Quarry at Greystanes. Certification is provided, on behalf of Costin Roe Consulting, by Mark Wilson. Mark is a Chartered Professional Engineer (CPEng) and Member of the Institute of Engineers Australia (MIEAust) and is also register on the National Engineering Register (NER). The credentials and experience to support the appointment of Costin Roe Consulting has been provided to the department, as per the Costin Roe Consulting

CoC No.	Item	Response
		Letter Co13874.06-22.ltr dated 17 October 2023.
B28(c)	*be consistent with the plan shown on Figure 2 in Appendix 1;*	We confirm that the design is consistent with the plan included in Figure 2 of Appendix 1 (being Costin Roe Consulting drawing **Co13874.06-SDD405**). Refer to drawings in **Appendix A1** and **Sections 4** to **7** of this report.
B28(d)	*include all private, Council and trunk drainage infrastructure within the site including connections to adjacent landholdings;*	The design drawings (refer **Appendix A1 & A2**) and report include all relevant council and trunk drainage systems. We note that the section of the north-south road known as the 50/50 road (i.e. that section of road being shared between GPT and Mirvac) is subject to separate approvals by Council and a modification to the Mirvac Aspect Estate SSD. The details of this section of road have been included in this design submission for completeness, however separate approval process will be required prior to construction. This body of work does not impact or progression of earthworks over the broader estate, as currently contemplated by the GPT Group.
B28(e)	*be designed in accordance with the Technical Guidance and demonstrate:* *(i) through MUSIC modelling, how the waterway health objectives and targets set out in the MRP DCP and Technical Guidance will be achieved;* *(ii) how the development will ultimately connect to the Regional Stormwater Scheme and how the*	The design has been completed in accordance with The Mamre Road Precinct DCP 2021, *Department of Planning and Environment Technical guidance for achieving Wianamatta–South Creek stormwater management targets.* Refer to **Section 9** & **Appendix F** of this report should be made in relation to the regional

CoC No.	Item	Response
	interim measures (such as the water reuse components of on-site detention tanks, bioretention systems and rainwater tanks) will be decommissioned once the development is connected to the Regional Stormwater Scheme; *(iii) that all stormwater management devices contain an impermeable liner and all naturalised trunk drainage (or other open drainage) is either lined with an impermeable liner, or ameliorated (i.e., gypsum), and compacted to a suitable depth and topsoiled (AS44119) to limit infiltration to soils;*	stormwater scheme and decommissioning of the interim measures on the property. Refer to drawings **Co13874.06-SDD460** & **SDD461** in **Appendix A**. The drawings demonstrate the inclusion of impermeable HDPE liners to the stormwater management basins, and amelioration of trunk drainage systems as noted.
B28(f)	*include functional design drawings that addresses the requirements of EHG's letter dated 31 August 2023;*	Refer to separate response table included in **Section 1.4** of this report. **Section 1.4** confirms how each of the items included in the EHG letter have been addressed in the design.
B28(g)	*ensure proprietary devices are located on private land and only include sediment and nutrient removal if certified under Stormwater Quality Improvement Device Evaluation Protocol (SQIDEP);*	Drawings **Co13874.06-SDD410**, **SDD431 & SDD433** shows the proposed proprietary water quality devices are located on private land. The proposed devices are noted to be SQIDEP approved and sized appropriately as confirmed in **Section 7.4** of this report.
B28(h)	*ensure gross pollutant traps are appropriately sized and designed in accordance with the Infrastructure Design Guidelines;*	The GPT's have been sized in accordance with *Section 3.5* of the *Stormwater Scheme Infrastructure Design Guideline DRAFT Western Sydney Version No. 2022-1.0* and MUSIC modelling, and provided prior to the legal point of discharge of each development lot as

CoC No.	Item	Response
		confirmed in **Section 7.4** of this report. There are no wetland systems proposed or required for the development.
B28(i)	*demonstrate maintenance access driveways to water storage or bio-retention basins are designed in accordance with Council's specifications;*	Maintenance access is provided to the trunk drainage corridor, and Basins 1, 2A and 2B. The maintenance access to the trunk drainage corridor has been consulted and agreed with Sydney Water. Refer to drawing **Co13874.06-TD420**. Maintenance access is provided to Basin 1, including Bio-retention Basin 1A and 1B as shown on drawing **Co13874.06-SDD431 & SDD433.**
B28(j)	*demonstrate that sufficient land is reserved on-site for stormwater management purposes (such as irrigation areas and undeveloped areas) as shown on Figure 2 in Appendix 1, to ensure the development meets the waterway health objectives and targets in the MRP DCP and Technical Guidance, unless an alternative stormwater management strategy has been approved by the Planning Secretary;*	Refer to drawing **Co13874.06-SDD405** should be made for confirmation of area available for irrigation and WSUD reservations. The areas provisioned for irrigation are consistent with those shown on Figure 2 of Appendix 1 of the consent.
B28(k)	*include landscape drawings that include planting details of the WSUD systems;*	Refer to drawings by Site Image for landscape drawings which include planting details for the WSUD systems.
B28(l)	*include certification (and appropriate designed checklists) of the civil and landscape drawings by the chartered professional engineer appointed under Condition B28(b), that the*	Refer to certification by Costin Roe Consulting (ref: **Co13874.06-25a.cert)** which confirms design compliance of the civil engineering design with the technical guidance documents.

CoC No.	Item	Response
	design drawings comply with the Technical Guidance; and	Refer separate certification by Site Image for the Landscape designs.
B28(m)	*include evidence that the design and mix of WSUD infrastructure has considered ongoing operation and maintenance, including a detailed lifecycle cost assessment (including capital, operation / maintenance and renewal costs over 30 years).*	Refer to **Section 8** and **Appendix E** for maintenance and lifecycle cost assessments.
Trunk Drainage Design		
B31	*Within three months of the date of this consent, or as otherwise agreed with the Planning Secretary, the Applicant must design the trunk drainage infrastructure on the site, to the satisfaction of the Planning Secretary. The trunk drainage infrastructure must:*	
B31(a)	be designed in consultation with the Regional Stormwater Authority;	The design has been completed in consultation with the Regional Stormwater Authority (Sydney Water) as included in **Appendix D**. The design addresses the items included in Sydney Waters letter dated 13 July 2023, and subsequent letter dated 7 November 2023 (which supersedes that of 13 July 2023) as set out in **Section 10** and **Appendix D** of this report. Futher consultation and clarification of technical design requirements with Sydney Water (Mr John Molinto) also informed the design and modelling as set out in **Section 10** and the Trunk Drainage design drawings included in **Appendix A2**.
B31(b)	be integrated into the Stormwater Management System Design required under Condition B28;	The design of the trunk drainage system is integrated into the overall stormwater management

CoC No.	Item	Response
		system design as required of Condition B28.
B31(c)	be consistent with the plan shown on Figure 3 in Appendix 1 and the Infrastructure Design Guidelines 2022 or its latest version, unless otherwise agreed with the Regional Stormwater Authority;	The design is consistent with the plan shown on *Figure 3* in *Appendix 1 of the SSDA* consent, the arrangements agreed with Sydney Water, and is supported by hydraulic modelling, in accordance with the Infrastructure Design Guidelines.
B31(d)	be designed so that the naturalised trunk drainage channel conveys, as a minimum, critical 1% AEP overland flows where the catchment area upstream of the commencement of the trunk drainage exceeds 15 ha or where overland flows are unsafe to pedestrians and vehicles, whichever occurs first;	The trunk drainage corridor begins at the upstream, eastern most point on the property. The contributing catchment is noted to be greater than 15Ha. It is noted that continuation of trunk drainage east of the subject land will be required by the developer of those parcels. The provided design allows for conveyance of the current undeveloped flows and/or attenuated flows from those parcels once developed.
B31(e)	be supported by hydraulic modelling that addresses the Infrastructure Design Guidelines and the requirements outlined in Sydney Water's letter dated 13 July 2023;	The design is supported by hydraulic modelling, in accordance with the Infrastructure Design Guidelines. The design addresses the items included in Sydney Waters letter dated 13 July 2023, and subsequent letter (which supersedes that of 13 July 2023) dated 7 November 2023 as set out in **Section 10** of this report.
B31(f)	ensure external catchments are drained to the trunk drainage channel;	Drawing **Co13874.06-TD402** confirms that the external catchments are drained to the trunk drainage channel. The trunk drainage channel is aligned with the existing

CoC No.	Item	Response
		watercourse at the upstream point of the channel at the eastern most property boundary. It is noted that future developments east of the subject land will require some tail-in adjustments to align with the designed system, when those developments occur.
B31(g)	demonstrate alignment with the upstream neighbouring stormwater drainage channel;	The trunk drainage channel is aligned with the existing watercourse at the at the upstream point of the channel at the eastern most property boundary. It is noted that future developments east of the subject land will require some tail-in adjustments to align with the designed system, when those developments occur.
B31(h)	include appropriate connections from the trunk drainage channel on-site to the trunk drainage infrastructure downstream of the site;	Connection of the trunk drainage system is proposed to that downstream of the property within the Mirvac Aspect Estate. The location of that drainage system has been agreed with Mirvac, and is consistent with that included in the EIS. We note that the existing watercourse discharge point will need to be utilised until such time that the 50/50 portion of the north-south road is approved by Council and constructed. These requirements are addressed within the CPESC designs by others.
B31(i)	include landscape drawings showing planting details; and	Refer to landscape drawings by Site Image for planting details.

CoC No.	Item	Response
B31(j)	include adequate access for maintenance by the Regional Stormwater Authority, in accordance with the Infrastructure Design Guidelines, including provision of an easement as required by Condition B36.	Access has been provided as agreed with Sydney Water and included in the Trunk Drainage design drawings included in **Appendix A2**.
Management Plan Requirements		
Management plans required under this consent must be prepared in accordance with relevant guidelines, and include:		
C1(a)	*Detailed Baseline Data*	Detailed baseline data pertaining to stormwater is included in **Section 2** and **Appendix C** of the SMSDR.
C1(b)	*Details of:* *(i) The relevant statutory requirements (including relevant approval, licence or lease conditions);* *(ii) Any relevant limits or performance measures and criteria; and* *(iii) The specific performance indicators that are proposed to be used to judge the performance of, or guide the implementation of, the development or any management measures.*	Statutory requirements are included in **Section 3.3** of the SMP. Stormwater objectives and discharge control criteria, being the measure of performance and performance indicators, are provided in **Section 4** of the SMSDR.
C1(c)	*A description of the measures to be implemented to comply with the relevant statutory requirements, limits or performance measures and criteria*	Measures required to be implemented are included in the **Section 3** and **4** of the SMSDR.
C1(d)	*A program to monitor and report on the:*	Inspection and monitoring requirements have been included in **Section 8** of the SMSDR.

CoC No.	Item	Response
	(i) Impacts and environmental performance of the development ***(ii)*** *Effectiveness of the management measures set out pursuant to paragraph (c) above.*	Additional reference to **Sections 3.5 to 3.9** should be made for contingency planning, incident classification and notification, environmental auditing and reporting, non-compliance, non-conformance and actions, and review and improvement requirements, respectively.
C1(e)	*A contingency plan to manage any unpredicted impacts and their consequences and to ensure that ongoing impacts reduce to levels below relevant impact assessment criteria as quickly as possible.*	Reference to **Section 3.5** of the SMSDR for contingency planning.
C1(f)	*A program to investigate and implement ways to improve the environmental performance of the development over time.*	Reference to **Section 3.9** should be made for review and improvement requirements.
C1(g)	*A protocol for managing and reporting any:* *(i) Incident and any non-compliance (specifically including any exceedance of the impact assessment criteria);* *(ii) Complaint;* *(iii) Failure to comply with statutory requirements;*	Reference to **Sections 3.6 to 3.8** should be made for, incident classification and notification, environmental auditing and reporting, non-compliance, non-conformance and actions requirements respectively.
C1(h)	*A protocol for periodic review of the plan.*	Reference to **Sections 3.9** should be made review and improvement requirements.

1.4 Responses to EHG Letter dated 31 August 2023

The following table outlines how each of the items included in NSW EHG letter dated 31 August 2023 has been addressed, as required of CoC B28(f).

Item No.	***EHG Item***	***Response***
Outstanding Information		
1	Provide revised and additional functional design drawings for the water management systems in accordance with the Technical guidance for achieving Wianamatta–South Creek stormwater management targets (DPE, 2022) and which address the following:	
Basin 1		
a	*No levels provided for the roadside swales or culverts in Mamre Road so unclear if system can drain.*	Refer to drawing **Co13874.06-SDD431** for invert levels of connecting drainage within Mamre Road, and Mamre Road swale inverts. Further to above, reference to Sections included on drawings **Co13874.06- SDD451-454 & SDD460-463** should be made for sections and drainage details. Drainage by gravity is available and demonstrated in the provided documents.
b	*No maintenance access for bioretention basin 1a.*	Refer to drawing **Co13874.06-SDD431** for maintenance access information pertaining to Basin 1A.
c	*Access to bioretention basin 1B seems to be dumped rock rather than concrete, which is not suitable.*	The access to Basin 1B is confirmed as cement stabilised roadbase. There is no intent to construct the basin access via dumped rock. Refer to plan drawing **Co13874.06- SDD431** for layout and Refer to drawing **Co13874.06- SDD434** for a section and **Co13874.06- SDD454** pavement detail.

Item No.	EHG Item	Response
d	*Retaining wall heights not shown – fall protection and access not properly documented.*	Refer to drawing **Co13874.06-SDD461** which confirms the wall heights and specifications for fall restraints.
e	*Subsoil drainage layout not shown.*	Refer to drawing **Co13874.06-SDD431** for subsoil layout and drawing **Co13874.06- SDD451** for subsoil details.
f	*Unclear if meant to be saturated zone or conventional bioretention(s). If conventional, fall on under-drains has not been considered.*	The bio-retention systems are proposed to be conventional, drainage, systems. A basin layout plan, which includes subsoil drainage locations and inverts which confirm the falls have been included in the design. Refer to drawing **Co13874.06-SDD431.**
g	*Impermeable liner should be shown on all bio and water storage sections (only found on one section).*	Refer to drawing **Co13874.06-SDD451** for details of the impermeable liner.
h	*Provide details (e.g., swales) on how the 5.4ha pads will be drained into bioretention basin 1B.*	Refer to drawing **Co13874.06-SDD400** for swale designs.
Basin 2A		
a	*Section is basic with no details – unclear if sub-soil drains will freely discharge. No details on lining. Unclear if saturated zone or conventional. If conventional, fall on under-drains has not been considered.*	The bio-retention systems are proposed to be conventional, drainage, systems. A basin layout plan, which includes subsoil drainage locations and inverts which confirm the falls have been included in the design. Refer to drawing **Co13874.06-SDD433.**
b	*Access to bioretention basin seems to be dumped rock rather than concrete, which is not suitable.*	The access to Basin 2A is confirmed as cement stabilised roadbase. There is no intent to

Item No.	EHG Item	Response
		construct the basin access via dumped rock. Refer to plan drawing **Co13874.06-SDD433** for layout and refer to drawing **Co13874.06-SDD435** for a section and **Co13874.06-SDD454** for pavement detail.
c	*Subsoil drainage layout and overflow pit/ high-flow weir not shown.*	Refer to plan drawing **Co13874.06-SDD433** for layout and arrangements of subsoil drainage, and overflow pits.
Basin 2B		
a	*No sections – unclear if sub-soil drains will freely discharge. No details on lining. Unclear if saturated zone or conventional.*	The bio-retention systems are proposed to be conventional, drainage, systems. A basin layout plan, which includes subsoil drainage locations and inverts which confirm the falls have been included in the design. Refer to drawing **Co13874.06-SDD433.**
b	*Access to bioretention basin seems to be dumped rock rather than concrete, which is not suitable.*	The access to Basin 2B is confirmed as cement stabilised roadbase, typical of most basin access roads. There is no intent to construct the basin access via dumped rock. Refer to plan drawing **Co13874.06-SDD433** for layout and Refer to drawing **Co13874.06-SDD435** for a section and **Co13874.06-SDD454** for pavement detail.
c	*Retaining wall heights not shown – fall protection and access not properly documented.*	Refer to drawing **Co13874.06-SDD435** which confirms the wall heights and specifications for fall restraints provided.

Item No.	EHG Item	Response
d	*Subsoil drainage layout and overflow pit/ high-flow weir not shown.*	Refer to plan drawing **Co13874.06-SDD433** for layout and arrangements of subsoil drainage, and overflow pits.

2 DEVELOPMENT SITE & BASELINE INFORMATION

2.1 Location

The proposed development is located in the suburb of Kemps Creek on Mamre Road on Lots 59 & 60 DP259135 as shown in **Figure 2.1**.

The site is bounded on the west by Mamre Road, semi-rural farmland to the north, south and east. We understand that the land to south is proposed to be developed by Mirvac (per SSD-10448), the land to the east by Dexus, and the land to the north by Aliro Group. The applications for development by both Dexus and Aliro Group have not been put on exhibition at the time of writing.

The land comprises a total area of approximately 37Ha, with a proposed development area of 33Ha. The current land-use is predominantly rural-commercial and rural-residential.

The site generally falls from north-east to south-west. The highest elevation on the land is RL84m AHD at the north-eastern corner of the site. The lowest levels are located at the Mamre Road frontage at RL 40m AHD. Grades over the land vary from 0.5% to 25% with the grades becoming flatter in the western portion of the land adjacent to Mamre Road.

The site is noted to be located within an area comprising rural/agricultural use, however nearby to existing and future industrial development areas and within the Mamre Road Precinct.

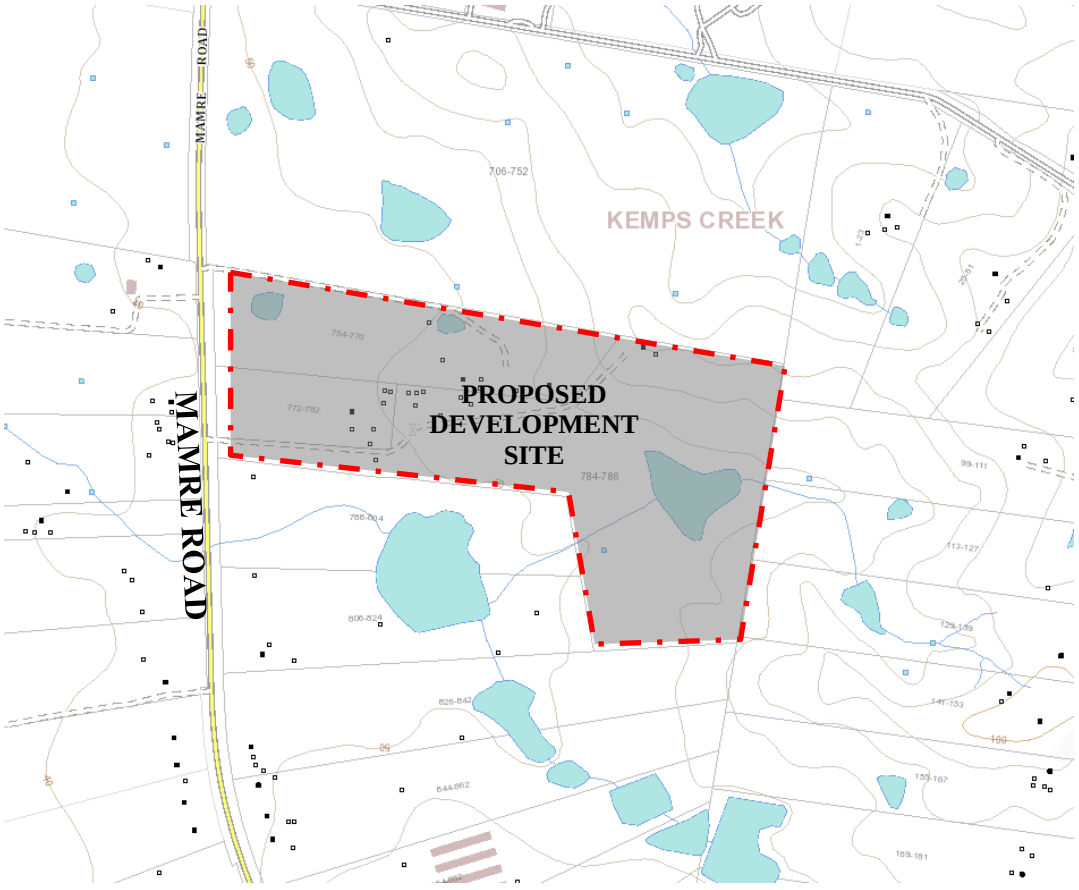

Figure 2.1 Locality Plan

2.2 Existing Site

The site is located on the eastern side of Mamre Road approximately 0.5km south of the intersection of Mamre Road and Bakers Lane, and 2.5km north of the intersection of Mamre Road and Abbotts Road. The nearest residential receivers are approximately 1.5km south-east of the site in Mount Vernon.

The property is currently comprising rural-commercial use. The existing semi-rural sheds are located in the central portion of the site and include several small dwelling-type buildings with detached sheds, carports and other minor structures. Two large, flat material storage areas are present in the northern portion of the site. Otherwise, the majority of the site is undeveloped pasture and grassed fields.

The site is noted to be located within an area comprising rural/agricultural use, however nearby to existing and future industrial development areas, and noted as being recently rezoned by the NSW DPIE as IN1 General Industrial.

The site comprises a pistol-shaped block with a frontage on Mamre Road. The front (Mamre Road) boundary has a frontage of 340m, whilst the rear boundary has a length of approximately 498m. The depth of the site is approximately 1,020m. The area of the total site is 36.89Ha, whilst the proposed development site area is approximately of 33.15 Ha.

Two major catchments are present on the property. *Catchment A* is approximately defined by the Lot 59 boundary and falls to the south-west through the adjacent Lot 58 site at two distinct locations. One discharge point is located along the western boundary interface with Lot 58, the other fronting Mamre Road. *Catchment A* can be broken down into further sub-catchments (Catchment 2 and 3 and US5 as shown on drawing **Co13874.06-SSDA401**).

Catchment B is approximately defined by the Lot 60 site boundary and falls to the west to Mamre Road. *Catchment B* can be broken down into further sub-catchments (Catchment 1 and US4) as shown on drawing **Co13874.06-SSDA401**).

Three upstream catchments also affect the site, as referred to as Catchment US1, US2 and US 3 on drawing **Co13874.06-SSDA401**.

Lot 59 generally falls in a south-westerly direction, from RL 85.00m AHD in the north-east corner to RL 48.5m AHD along the south-western boundary interface with the Lot 58 property. The lot continues to fall towards Mamre Road at RL41.50m AHD. Falls are approximately 20% in the North-eastern portion of the lot, flattening to around 1-2% approaching Mamre Road.

Lot 60 generally falls in an east-to-west direction, from RL 78.00m AHD in the north-east corner to RL 41m AHD at the western frontage to Mamre Road. Falls are approximately 15% in the eastern third of the site, flattening to around 1-2% approaching Mamre Road. Two large, flat pads are present in the centre of the lot associated with previous farming uses.

2.3 Proposed Development

The proposed development is for an industrial estate, earthworks and infrastructure for future industrial development over an area of 33 Ha, though the site has a total area of 37Ha. The lot layout is shown in **Figure 2.2**. Infrastructure works will include bulk earthworks, provision of services, road & intersection construction, and stormwater management and has completed in

accordance with the Development Masterplan. The SSD approval allows for construction of Lot 1 and 3, and supporting roads and basins.

The masterplan layout provided by The GPT Group shows development lots will vary between 4 Ha and 7.5 Ha in size. Siting of the development lots and levels will consider the topography of the land (understanding the constraint to develop large flat building pads), access, and flood planning requirements. A ~4Ha plot of the amalgamated site is proposed to remain undeveloped.

Access to all lots in the ultimate condition would be made via either the new North-South Access Road, or via the new East-West Local Industrial Road which feeds from the Access Road. The new access road and associated intersection will be constructed to The Final MRP DCP requirements (refer Section 4) and ownership transferred to Penrith City Council. Initial access to the site will be via a left in and out intersection with Mamre Road. This will be in place until such time that the internal precinct roads and permanent intersection to the south is constructed by the adjoining landowner, Mirvac.

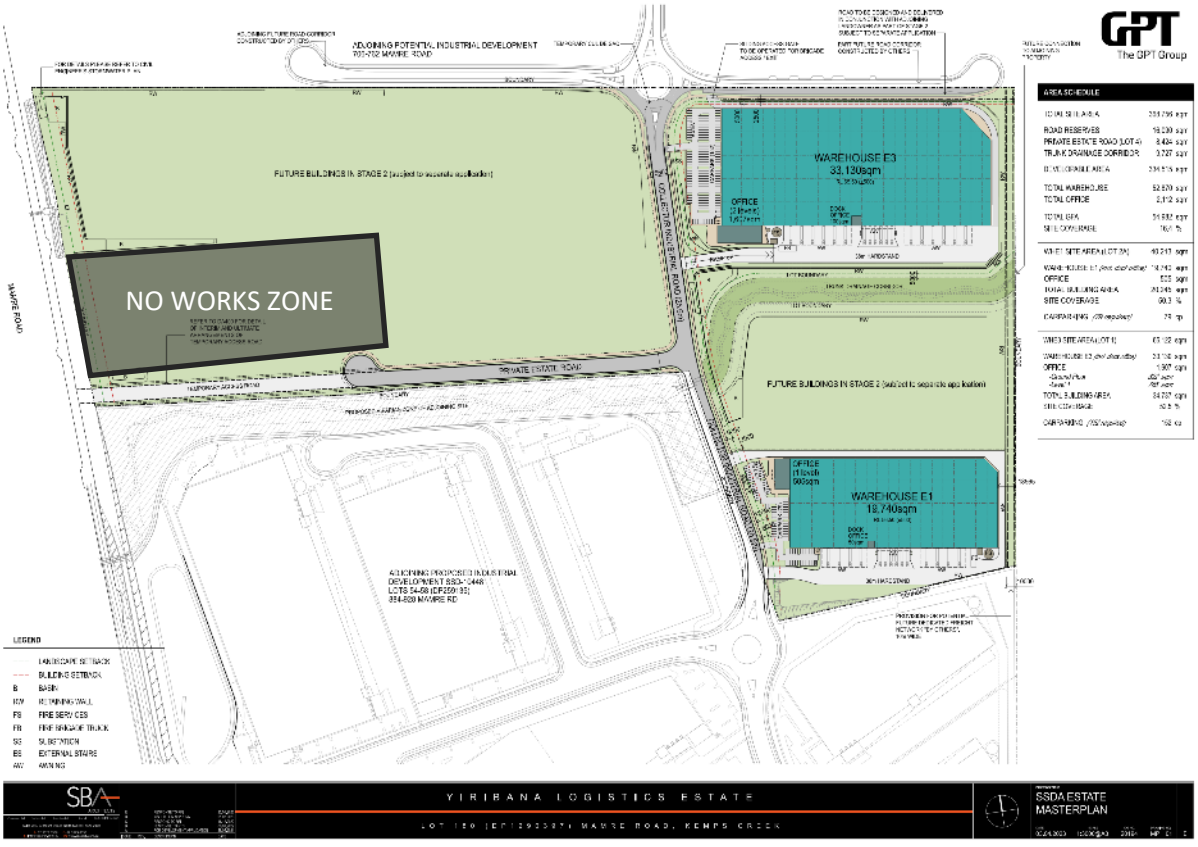

Figure 2.2. Development Masterplan (Source: SBA Architects)

2.4 Soil and Geological Conditions

The 1:100,000 Sydney Geological Map indicates the site is underlain by (Rwb) shale, carbonaceous claystone, laminate, fine to medium-grained lithic sandstone, rare coal and tuff.

Investigations by PSM Geotechnical shows the soil profile to comprise residual clay soils with depths of 1-3m overlaying highly to medium weathered shale.

2.5 Groundwater

A groundwater assessment has been undertaken by Arcadis (ref: 30081949_GMP_FINAL dated 30 April 2021) based on geotechnical assessments completed by PSM.

The geotechnical investigations undertaken by PSM Geotechnical encountered groundwater two of the test locations at a depth of approximately 3m depth. Groundwater was encountered in test pits situated in low-lying areas of the site. It could be expected that groundwater may be experienced at depth or around the normal dry weather water level of South Creek, and that this level would have some seasonal variation and variation associated with periods of high rainfall. In any event, groundwater if present would be at depth below the proposed filled pad levels and interaction with existing groundwater paths would be negligible.

The development does not propose to utilise surface or groundwater water sources. An assessment of the impact on these items is not relevant for the warehouse distribution center construction.

Surface water management, including conveyance of surface runoff, management of water quantity (through on-site detention) and water quantity (through on-site and estate wide management systems using WSUD principles and best practice pollution reduction objectives) has been proposed in the design.

In relation to groundwater affectation, this is expected to be negligible. The geotechnical investigations undertaken by Arcadis encountered groundwater in two of the test locations. Further, the majority of the site and site earthworks involve filling, hence any interaction with existing groundwater or groundwater flow paths would negligible and hence not be impacted.

2.6 Acid Sulphate Soils

An assessment of the potential for acid sulphate soils has been requested as part of the SEAR's requirements.

Reference to the NSW Land & Water Conservation Acid Sulphate Soils Map 92_Liverpool shows the subject land clear of any known occurrence of acid sulphate soils.

An Acid Sulfate Soils assessment has been undertaken by JBS&G for the development – ref JBS&G 60539-136377 dated 31 March 2021 – as included in the EIS. The JBS&G letter showed that the risk of acid sulphate soils were low and this site is not subject to any policies relating to acid sulfate soils. As such no specific requirements relating to management of these soils are considered necessary. Refer to the JBS&G report for more detail on acid sulfate soil management during construction.

2.7 Climate and Meteorology

The Kemps Creek area experiences relatively mild temperatures and moderate rainfall, with a yearly average rainfall of about 780mm, based on records from the nearest observation site at Horsley Park since 1997 (Station 67119).

Typically, the wettest month (mean rainfall) is February, and driest is September. It is noted that July and August show similar mean rainfall amounts to September.

The annual mean minimum temperature is 12.1°C and the mean maximum temperature is 23.9°C. The hottest month is usually January (mean maximum of 30.1°C) and the coldest month is usually July (mean minimum of 5.8°C).

Climate statistics and average annual rainfall data and rainfall patterns relevant to this site (Horsley Park as sourced from Australian Bureau of Meteorology (BOM)) are included for reference in **Appendix C** of this **SMP**.

2.8 Existing Drainage System & Overland Flows

The site is currently undeveloped rural land with undulating topography which has been described in **Section 2.2**. There is no formal drainage currently on the site however several local depressions, natural gullies and farm dams are present. There are also several dams which are used for the currently rural farming operations on the land which lie in relation to the natural gullies.

The site is affected by overland flow from minor upstream catchments to the east of the site. A catchment of approximately 24 Ha (US1 and US2) is conveyed through the site via existing farm dams to Mamre Road.

A smaller catchment (US3) currently drains through the site from the north.

Existing twin 1200x600 RCBC's are located at the low point on Mamre Road and drain runoff from the property west toward South Creek through existing gully within rural properties on the western side of Mamre Road. This has been shown on drawing **Co13874.06-SSDA401 and Figure 2.3** below. Conveyance of these flows has been included in the estate infrastructure stormwater design.

On completion of the neighbouring development works, the upstream catchments noted previously will be discharged into the open drainage corridor between Warehouse 2 & 3. **Co13874.06-SSDA402.**

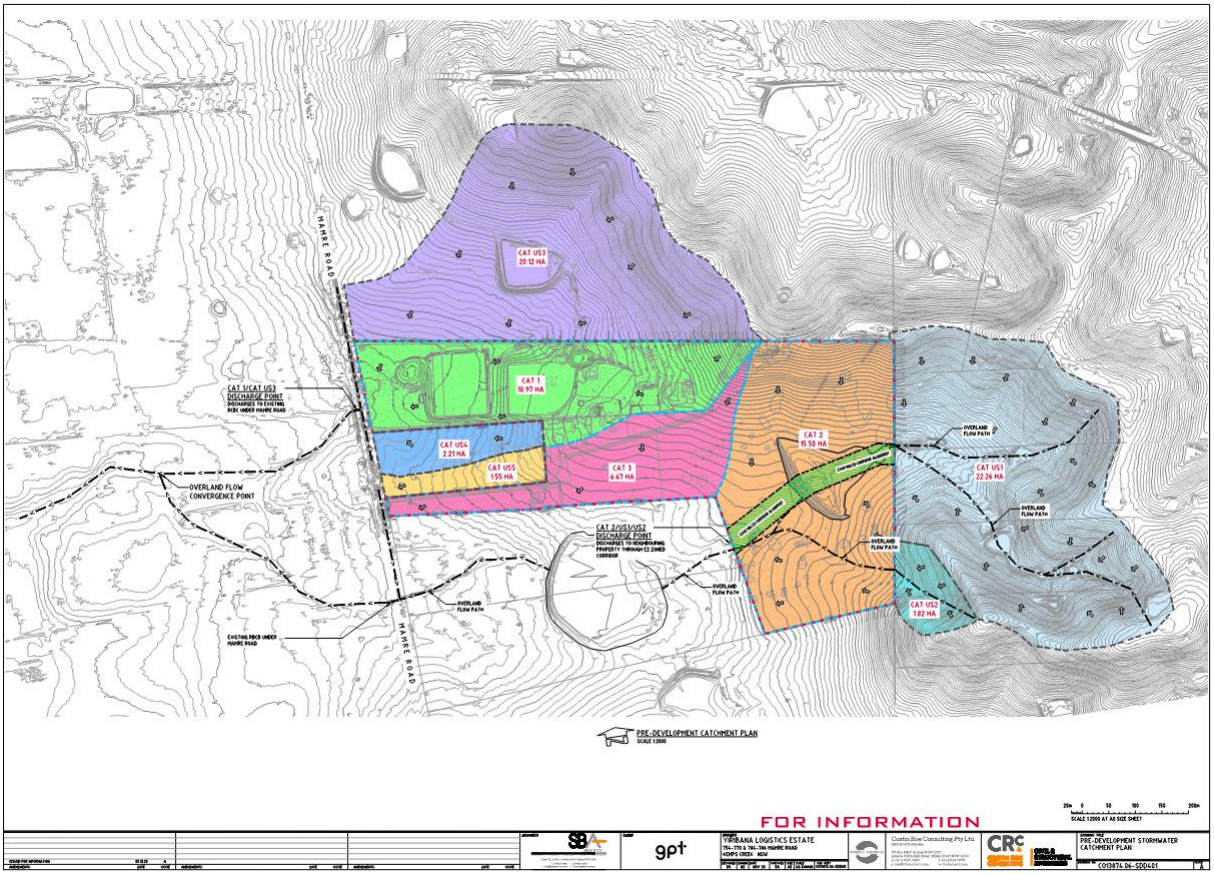

Figure 2.3. Existing Site Catchments and External Contributing Catchment.

2.9 Flooding and Overland Flow

The site has been identified by Penrith City Council as being affected by overland flow from the existing gully and series of farm dams on the north-east of the property.

We note that the site is clear of the South Creek Floodplain however the site contributes to one of the sub-catchments of South Creek and ultimately runoff from the property drains to South Creek.

An overland flow and flood assessment has been completed for the development approval submission in relation to the north-eastern flow path. The following sections of the report describe the catchment description, flood description and proposed flood management.

Detailed technical information pertaining to the TUFLOW modelling and output completed by our office has been included in the EIS and provided to Sydney Water to confirm design compliance.

The contributing upstream catchment to the east is approximately 22Ha and is shown below in **Figure 8.1** and also as **Figure E2.1**. A smaller catchment of approximately 18.6Ha enters the site from the north.

The catchment comprises rural land use and >90% pervious surfaces. Future development is noted to require detention and as such has been modelled as per existing impervious surface breakdown.

Figure 8.1. Upstream Contributing Catchment and Flow Paths.

Penrith Council is noted to have undertaken a regional assessment of local tributaries Penrith Overland Flow "*Overview Study – Flood Analysis for Central Urban (Zone 1), Northern Rural (Zone 2), Southern Rural (Zone 3)*" – Cardno 2006. The site is located within the Southern Rural (Zone 3) and an excerpt of the flood model output is shown in **Figure 8.2 and also Figure E1.1 of Appendix D**. Councils' assessment shows overland flow is present along the series of farm dams in the north-eastern corner of the property. The modelling shows the flood extent to be limited to the gully and dams only, and not extending to areas away from the local watercourse. The area shown on the southern portion of the site as being flood affected in the PMF event is noted to comprise a farm dam only which is fully within the proposed development extent and as such has not been included in the current overland flow assessment.

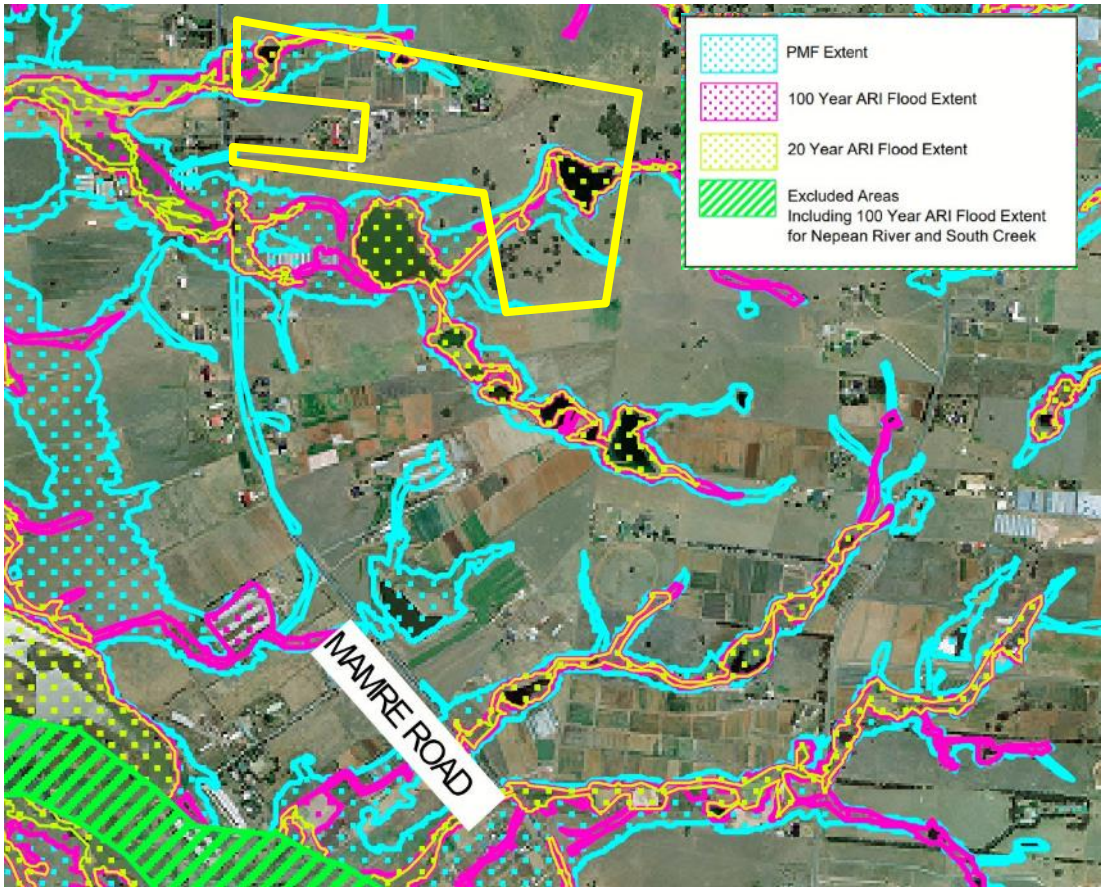

Figure 8.2. Excerpt of Figure 6.1k of Cardno 2006 Study

Conveyance of the overland flow paths is proposed as part of the trunk drainage designs and consultation with the Regional Stormwater Manager (Sydney Water) has been undertaken to ensure design compliance with the relevant infrastructure requirements. Refer to **Section 1.3** and **Section 10** of this report for further information pertaining to trunk drainage and overland flow in the constructed condition.

3 GENERAL REQUIREMENTS

3.1 General Requirements Introduction & Reference Documents

This SMSDR has been prepared with the purpose of confirming the stormwater management design for the SSD-10272349 development.

The civil engineering and stormwater drainage designs are shown on drawings **Co13874.06-SDD** (refer **Appendix A1**), and Trunk Drainage Designs on drawings **Co13874.06-TD** (refer **Appendix A2**).

As noted in **Section 1.1**, we reiterate that this report and drawings do not include any information pertaining to stormwater management during the construction phase of the project. Reference to design and reporting by the CPESC consultant should be made in relation to the construction stormwater management requirements for the development.

3.2 Roles and Responsibilities

1. The applicant and their management team are responsible for the implementation of this SMSDR during operational phase.
2. During construction all personnel have the responsibility to stop works if there is potential for a safety or environmental incident to occur pe the Construction Environmental Management Plan (CEMP) (refer CEMP by Burtons).
3. The key roles and responsibilities for the Project personnel in relation to stormwater management are outlined below in **Table 3.1**.

Table 3.2 Roles and Responsibilities (During Operation)

Role	Responsibilities
Applicant/ Estate Owner	Provide for training in stormwater management for personnel directly involved with the implementation of this plan, as required. Identify and allocate Project resources to implement the requirements of this plan. Oversee the implementation and maintenance of this plan. Ensure all measures are performing adequately throughout the operation of the estate in perpetuity.
Estate Management Body	Ensure maintenance and monitoring of the stormwater management measures are undertaken in accordance with **Section 8**.
Individual Lot Owners/ Tenants	Ensure internal drainage systems function adequately and maintenance and monitoring of their own site-specific stormwater management measures (rainwater tanks,

Role	Responsibilities
	individual drainage system) are undertaken in accordance with **Section 8**. Ensure personnel are educated in the overall estate stormwater management conditions.

3.3 Legal and Regulatory Requirements

The below sets out the legislation and planning instruments considered in the preparation of this sub plan. It is noted that the regulatory framework for the project is set out in the *CEMP.*

The Project has been approved under the *Environmental Planning and Assessment Act* 1979 (EP&A Act).

The SMSDR has been prepared in accordance with the CoC of SSD-10272349 (as set out in **Section 1.3** of the SMSDR).

The plan has been completed in accordance with all relevant approvals and regulatory framework.

Table 3.3 lists regulatory guidelines and documents relevant to the SMSDR.

Table 3.2. Regulatory Documents and Guidelines

Legislation	Description	Relevance to the CSWMP
Environmental Planning and Assessment Act 1979	This Act establishes a system of environmental planning and assessment of development Projects for the State.	The CoCs and obligations issued under Part 4 of the EP&A Act are addressed in this plan.
Protection of the Environmental Operations Act 1997	The objectives of this Act relate to the protection of the environment through pollution prevention and cleaner production, among others.	Relevant sections of the Act, including duties to report pollution incidents and disposal regulations have been incorporated into this plan and incident response procedures. A key legislative requirement applicable to construction soil and water management is Section 120 of the Protection of the Environment Operations Act 1997 which relates to pollution of waters and the need to implement all reasonable and feasible measures to minimise the risk of pollution of waters.

Legislation	Description	Relevance to the CSWMP
		Part 5.7 of the Act requires that a pollution incident causing or threatening material harm to the environment be notified to EPA and other relevant authorities as outlined in the CEMP. Material harm constitutes actual or potential harm to the health or safety of humans and/or ecosystems that is not trivial, or results in actual or potential loss or property damage of amounts in excess of $10,000 in total.
Contaminated Land Management Act 1979	The general object of this Act is to establish a process for investigating and (where appropriate) remediating land that the EPA considers to be contaminated significantly enough to require regulation under Division 2 of Part 3, and to ensure that contaminated land is managed with regard to the principles of ecologically sustainable development.	Contamination on site must be assessed and managed in accordance with this act. Division 2, Part 3, Section 11-17 of this Act details requirements for the Management of Contaminated Land.
Water Management Act 2000	The objects of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations.	Although it is not envisaged that any construction activities would be undertaken on waterfront land, any waterfront activities that do occur would be conducted generally in accordance with the NSW Office of Water's Guidelines for Controlled Activities.
Fisheries Management Act 1994	The objectives of this Act seek to conserve fishery resources, fish stocks and key fish habitats.	This SMSDR has been prepared to maintain existing flow regimes surrounding the site and to contain water onsite within sediment basins until discharged with strict water quality requirements. No impacts to

Legislation	Description	Relevance to the CSWMP
		fisheries are envisaged as a result of Project construction.
Dangerous Goods Regulation (Road and Rail Transport) 2014	The main objects of this Regulation are to give effect to the standards, requirements and procedures of the Code so far as they apply to the transport of dangerous goods by land transport, and to promote consistency between the standards, requirements and procedures applying to the transport of dangerous goods by land transport and other modes of transport.	Provisions relating to the storage and transport of dangerous good, such as fuelling procedures and fuel storage, are incorporated into this plan.
Commonwealth Environmental Protection and Biodiversity Conservation Act 1999	The objectives of this Act seek to promote environmental protection, ecologically sustainable development, biodiversity conservation and the promotion of heritage, among others.	

Additional guidelines and standards considered in relation to the management of stormwater include:

- Penrith City Council, *Engineering Construction Specifications for Civil* Works
- Penrith City Council *Stormwater Drainage Specification for Building Developments*
- Penrith City Council *Design Guidelines for Engineering Works for Subdivisions and Developments*
- Penrith City Council *Water Sensitive Urban Design Standard Drawings.*
- Managing Urban Stormwater – Soils and Construction Volume 1, 4th Edition (Landcom 2004);
- Managing Urban Stormwater: Harvesting and Reuse – 2006 (NSW DEC);
- Managing Urban Stormwater: Source Control – 1998 (NSW EPA);
- Managing Urban Stormwater: Treatment Techniques – 1997 (NSW EPA);
- Managing Urban Stormwater: Soils & Construction – 2004(LANDCOM);

- Water Sensitive Urban Design – "Technical Guidelines for Western Sydney" by URS Australia Pty Ltd, May 2004
- AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage.
- "Australian Rainfall and Runoff" (2019 Edition), Volumes 1 and 2 (AR&R).
- Stormwater scheme Infrastructure Design Guideline DRAFT Western Sydney Version No. 2022-1.0 (Sydney Water)
- Technical guidance for achieving Wianamatta–South Creek stormwater management targets (NSW DPE)
- Mamre Road Precinct Development Control Plan 2021 November 2021 (NSW DPE)

3.4 General SMP Requirements

1. This document and associated drawings are subject to further periodic review throughout the works and operational period to ensure the requirements and measures set out in this SMP are fit for purpose and allow for any changes which might occur during construction not envisaged during the initial preparation of the SMP.
2. All stormwater management control measures will conform to the standards and specifications contained in:
   (i) This document;
   (ii) Conditions of Consent;
   (iii) The guidelines and standards listed in **Section 3.3**; and
   (iv) the approved *CEMP, OEMP* and supporting documentation.

3.5 Contingency Planning

Reference to the unexpected finds protocols within the *CEMP* should be made pertaining to contingency management during construction.

Reference to contingency planning protocols within the *OEMP* during operational phase.

3.6 Incident Classification and Notification

It is the responsibility of all site personnel to report all environmental incidents to the Site Supervisor and/or the Contractor's EM during construction.

Incident response requirements including classification, responses, external notification and incident review protocol are set out in the *CEMP*. Reference to the *CEMP* should be made pertaining to all incident response protocol.

During operational phase it is the responsibility of the estate management to report and act on any environmental incidents. Refer to the OEMP for incident review requirements.

3.7 Environmental Auditing and Reporting

Auditing and reporting will be undertaken in accordance with the *CEMP* during construction. Refer to the *CEMP* for details.

Auditing and reporting will be undertaken in accordance with the *OEMP* during operation. Refer to the *OEMP* for details.

3.8 Non-compliance, Non-conformance and Actions

It is the responsibility of all site personnel to report non-compliances and non-conformances to the Site Supervisor and/or the Contractor's EM.

Non-compliances, non-conformances and corrective and preventative actions will be managed in accordance with the *CEMP* or *OEMP*.

3.9 Review and Improvement

The effectiveness of stormwater management measures will be confirmed through regular inspections, ongoing site inspections by the Construction Contractor, engineer and the ER during construction. Adjustments as required during the construction period will be made based on confirmed site conditions and effectiveness of the implemented measures.

Review and improvement of this plan will be also be undertaken in accordance with the CoCs and the CEMP. Continuous improvement will be achieved by the ongoing evaluation of environmental management performance and effectiveness of this plan against environmental policies, objectives and targets.

During operation, effectiveness of stormwater management measures will be confirmed through regular inspections as set out in **Section 8**. Adjustments as required will be made based on confirmed site conditions and effectiveness of the implemented measures. These will need to be made in conjunction with a suitably qualified engineer who specialises in stormwater and stormwater management.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure. Construction will be undertaken in accordance with the most recent, approved version of this document.

4 STREAM HEALTH AND WATER QUALITY OBJECTIVES

4.1 Key Areas and Objectives

The stream health and water quality objectives included in this detailed report are noted in **Table 4.1**. These targets which have been adopted in the design, in accordance with the MRP DCP and DPIE *Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets*.

As noted earlier in this document, the stormwater management during the construction phase is designed and documented by the CPESC consultant, and forms part of the CEMP. Refer to the CEMP and separate document for construction phase stormwater management items.

Table 4.1. WCM Targets

Element	Target	Reference
Water Quantity	Maintaining or improving the volume of stormwater and peak flows from this site. "*demonstrate that there will be no increase in runoff from the site as a result of the development for all storms up to and including the 100-year Average Recurrence Interval (ARI) event for all storm durations*".	Penrith Council - *Stormwater Management Policy, Section 3.3.3*
Water Quality	Load-based pollution reduction targets based on an untreated urbanised catchment **or** total resultant concentration per the Wianamatta MUSIC Modelling Toolkit: **Opt1 or Opt2** Gross Pollutants 90% **or** <16kg/ha/yr Total Suspended Solids 90% **or** <80kg/ha/yr Total Phosphorus 80% **or** <0.3kg/ha/yr Total Nitrogen 65% **or** <3.5kg/ha/yr Total Hydrocarbons 90%	MRP DCP2021 DPIE Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets
Flooding	Buildings and road set 500mm above 1% AEP. No affectation to upstream downstream or adjoining properties as a result of development.	MRP DCP2021 NSW Floodplain Development Manual.
Water Supply	Reduce Demand on non-potable water uses. Provide minimum 80% reduction of non-potable uses.	MRP DCP2021

<table>
<tr><th>Element</th><th>Target</th><th>Reference</th></tr>
<tr><td>Waterway and Stream Health</td><td>
<table>
<tr><th></th><th>Target</th></tr>
<tr><td colspan="2">Option 1: Mean Annual Runoff Volume (MARV) Approach</td></tr>
<tr><td>MARV</td><td>≤ 2 ML/ha/year at the point of discharge to the local waterway</td></tr>
<tr><td>90%ile flow</td><td>1000 to 5000 L/ha/day at the point of discharge to the local waterway</td></tr>
<tr><td>50%ile flow</td><td>5 to 100 L/ha/day at the point of discharge to the local waterway</td></tr>
<tr><td>10%ile flow</td><td>0 L/ha/day at the point of discharge to the local waterway</td></tr>
<tr><td colspan="2">Option 2: Flow Duration Curve Approach</td></tr>
<tr><td>95%ile flow</td><td>3000 to 15000 L/ha/day at the point of discharge to the local waterway</td></tr>
<tr><td>90%ile flow</td><td>1000 to 5000 L/ha/day at the point of discharge to the local waterway</td></tr>
<tr><td>75%ile flow</td><td>100 to 1000 L/ha/day at the point of discharge to the local waterway</td></tr>
<tr><td>50%ile flow</td><td>5 to 100 L/ha/day at the point of discharge to the local waterway</td></tr>
<tr><td>Cease to flow</td><td>Cease to flow to be between 10% to 30% of the time</td></tr>
</table>
</td><td>MRP DCP2021

DPIE Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets</td></tr>
</table>

A summary of the how each of the WCM objectives will be achieved are described below. Reference to the relevant sections of the report should be made for further and technical details relating to the WCM measures:

- *Waterway Health (Refer **Section 6**)*

  A MUSIC assessment for discharge from the development has been completed based the stormwater flow targets set out in Table 6 of the MRP DCP. The assessment has utilised the MUSIC modelling Toolkit provided by NSW EES to confirm the flow duration and mean annual runoff volumes objectives have been met.

  The assessment is explored further in **Section 6.2 to 6.3**. The assessment confirms the objectives have been achieved for the current level of proposed development (i.e. Buildings 1 and 3 and associated roadways) as agreed with DPIE.

  We note that, as required by Sydney Water (the Regional Stormwater authority), some documented measures (including additional storage and rainwater tanks) would be temporary only, and subject to either decommissioning. Section 9 of this document further explores the strategy for decommissioning of temporary measures.

- *Stormwater Quantity/Peak Flow Management (Refer **Section 6**)*

  The intent of this criterion is to reduce the impact of urban development on existing drainage system by limiting post-development discharge within the receiving waters to the pre-development peak, and to ensure no affectation of upstream, downstream or adjacent properties.

  Attenuation of stormwater runoff from the development is proposed to be managed via three estate level basins. The intention is for no water quantity measures (other than rainwater reuse) to be provided on individual development lots. This will mean that future building developments can be assessed, approved and constructed without the need for site specific detention, based on the provision of the estate level detention basins. There are two proposed basins, the first of which is located at the downstream/ western end of the property adjacent to Mamre Road, and the second is at the downstream end of the drainage corridor waterway toward the east of the property (refer **Section 5.6** and **6.4** for discussion of attenuation).

Sizing of the detention systems has been completed using DRAINS modelling software in accordance with the MRP DCP and Penrith City Council Policy for the 50% AEP to the 1% AEP storm for various durations. The modelling accounts for the drainage system provided for the adjacent sites and conveyance of upstream catchments around the site.

Refer to **Section 6.4** of the document for detailed sizing of detention systems.

- *Stormwater Quality Management (Refer **Section 7**)*

  There is a need to target pollutants that are present in stormwater runoff to minimise the adverse impact these pollutants could have on downstream receiving waters.

  The required pollutant reductions are included in **Table 4.1** of this document and MUSIC modelling has been completed to confirm compliance with the Wianamatta MUSIC Modelling Toolkit (Apr 2022) reduction objectives/allowable mean annual residual loads for the estate.

  A series of Stormwater quality improvement devises (SQID's) have been incorporated in the design of the estate. The proposed management strategy will include the following measures:

  - Primary treatment of the whole of the development catchment (including roads and development sites) will be made via one of two gross pollutant traps (GPT's). GPT's will be located upstream of each of the stormwater management basins.
  - Tertiary treatment of the whole of the development catchment will be made via one of two estate level bio-retention basins. Bio-retention treatment will be provided within the stormwater management basins and are sized to treat the whole of the estate catchment. Refer to drawings **Co13874.06-SDD400, SDD431, SDD433.**
  - Some treatment will also be present by provision of rainwater reuse tanks on development sites through reuse and settlement within the tanks. Allowance for this treatment is noted to not be included in MUSIC modelling produced for the development.
  - Development sites will not require any lot specific treatment systems due to the estate wide management systems proposed.

  Reference to **Section 7** of this document should be made for detailed Stormwater Quality modelling and measures.

- *Trunk Drainage (refer **Section 10**)*

  Trunk drainage is provisioned to manage runoff of catchments greater than or equal to 15Ha in accordance with DCP and Sydney Water Infrastructure Guidelines.

  The trunk drainage corridor is located on the eastern portion of the property being aligned with the existing watercourse on the property at the eastern property boundary (which also aligns with the future development trunk drainage alignment) at the upstream end of the system. At the downstream end, the watercourse aligns with the agreed discharge point within Mirvac Aspect Estate.

- *Water Demand Reduction/ Rainwater Reuse*

  Rainwater reuse measures will be provided as part of future building development designs. Rainwater reuse will be required to reduce demand on non-potable uses by at 80%. The reduction in demand will target non-potable uses such as toilet flushing and irrigation. **Refer Section 6**. These measures are noted to be interim until such time as the regional stormwater scheme is implemented, as discussed in **Section 9** of this document.

4.2 Proposed Estate Drainage System

As per general engineering practice and the requirements of the MRP DCP, the proposed stormwater drainage system for the estate development will comprise a minor and major system to safely and efficiently convey collected stormwater run-off from the development to the legal point of discharge.

The minor system is to consist of a piped drainage system which has been designed to accommodate the 5% AEP (1 in 20-year ARI storm event). This results in the piped system being able to convey all stormwater runoff up to and including the 5% AEP event. The major system will be designed to cater for storms up to and including the 1% AEP (1 in 100-year ARI storm event (Q100)). The major system will employ the use of defined overland flow paths, such as roads and open channels, to safely convey excess run-off from the site. As required of the MRP DCP, and Sydney Water naturalised trunk drainage channels are included where catchments greater than 15Ha are resultant.

The design of the stormwater system for this site will be based on relevant national design guidelines, Australian Standard Codes of Practice, the standards of PCC and accepted engineering practice. Runoff from buildings will generally be designed in accordance with *AS 3500.3 National Plumbing and Drainage Code Part 3 – Stormwater Drainage*. Overall site runoff and stormwater management will generally be designed in accordance with the Institution of Engineers, Australia publication "*Australian Rainfall and Runoff*" (1988 Edition), Volumes 1 and 2 (AR&R).

Water quality and re-use are to be considered in the design to ensure that any increase in the detrimental effects of pollution are mitigated, PCC Water Quality Objectives are met and that the demand on potable water resources is reduced.

The proposed drainage system will be required to convey the overland flow from upstream catchments east of the property through the site.

The legal point of discharge is a point specified by Council where stormwater from a property can be discharged. The legal point of discharge is usually Council's stormwater infrastructure (where available), the street kerb and channel for smaller developments or downstream receiving waters like an existing stream or gully, lake, pond or waterbody.

Legal discharge for the western portions of the site is via the existing culverts on Mamre Road. Legal point of discharge for the eastern portion of the site is via the trunk drainage system/ realigned watercourse through the Mirvac estate to Mamre Road and ultimately South Creek.

The drainage system proposed can be described as follows:

- Road drainage system designed to the 5% AEP (1 in 20yr ARI);
- Stub connections for all development lots connecting to road drainage.
- All road drainage and development site drainage directed to one of the two stormwater management basins;
- Stormwater management basins comprising stormwater detention to limit post development runoff to pre-development runoff and bio-retention system to complete final stormwater polishing.
- Trunk drainage corridor which conveys runoff from Catchment US1 (22.26), US2 (1.82Ha noting inter-allotment drainage below), Lots 1 to 3 and the north-south road. The trunk drainage is designed in accordance with Sydney Water infrastructure guidelines as described in **Section 10** of this document.
- An inter-allotment drain to collect runoff from the northern external catchment (US2), drains from Lot 3, through Lot 2 to the trunk drainage system. This drainage system would be required until such time that the properties east of the development site are developed (whereby the adjacent properties drainage system discharges directly to the trunk drainage system).
- An inter-allotment drain which conveys runoff from Catchment US3 through the north-eastern site portion, noting that the Stage 1 design allows for runoff to be conveyed through the site within an open channel.

It is noted that the design of stormwater management systems within Basin 1 proposes integration of bio-retention elements within the stormwater detention and FDC/MARV basins. The bio-retention elements are noted to be sited such that a maximum depth of inundation of 1.2m occurs during infrequent major storms, and generally less than 0.6m during the majority of storm events.

The main detention storage areas are noted to be sited at a level approximately 1m below the bio-retention elements. This will ensure effective discharge of bio-retention filtration, however, also assists in ensuring maximum storage capacity can be realized within the basin area. Further, this enables depth of water over the bio-retention elements to be limited to less than 0.6m generally as noted above and below.

Based on the design, the water level over the bio-retention elements of the basin would have maximum ponding of 0.4m (being the extended detention depth) for >90% of all runoff events (i.e. events between the 6 month and 1yr ARI). The detention storage would be at 1.4m at the same time the ponding of the bio-retention elements are only 0.4m.

A maximum depth of 0.75m would be realised for all events up to the 5% AEP (1 in 20 ARI), and maximum depths between 0.75m to 1.2m only occur very infrequently for storms > 5% AEP to the 1% AEP event. Depths greater than 0.75m would be considered to occur only several times throughout the life of the system.

5 MUSIC MODELLING PARAMATERS

5.1 Introduction

The MUSIC model was chosen to model water quality and stream health.

The MUSIC model, released by the Cooperative Research Centre for Catchment Hydrology (CRCCH), is a standard industry model for this purpose. MUSIC (the Model for Urban Stormwater Improvement Conceptualisation) is suitable for simulating catchment areas of up to 100 km^2 and utilises a continuous simulation approach to model water quality and flow simulation.

By simulating the performance of stormwater management systems, MUSIC can be used to predict if the proposed systems and changes to land use are appropriate for their catchments and capable of meeting specified water quality objectives (CRC 2002) and stream health.

The stream health measures relevant to this report are MARV and FDC.

The water quality constituents modelled in MUSIC, of relevance to this report, include Total Suspended Solids (TSS), Total Phosphorus (TP) and Total Nitrogen (TN). The pollutant retention criteria set out in the MRP DCP and nominated in **Section 4.1** of this report were used as a basis for assessing the effectiveness of the selected treatment trains and runoff conditions.

The MUSIC model has been prepared to examine the effectiveness of the stream health and water quality treatment train.

The Project Model Name is as follows:

- MUSIC Model"*13874.06-SDD_Rev1.mxproj"*

Reference to **Section 5.6, Figure 5.1** and **5.2** should be made for MUSIC modelling layout of the noted model.

Modelling parameters used are based on those nominated in the Department of Planning and Environment *Technical guidance for achieving Wianamatta–South Creek stormwater management targets.*

5.2 Rainfall Data

As per the recommendation of *Technical guidance for achieving Wianamatta–South Creek stormwater management targets, s*ix-minute pluviographic data for the Sydney Meteorological Office Station was sourced from the Bureau of Meteorology (BOM) as nominated below. Evapo-transpiration data for the period was sourced from the Sydney Monthly Areal PET data set supplied with the MUSIC software.

Input	**Data Used**
Rainfall Station	67113 Penrith Lakes AWS
Rainfall Period	1999 – 2008 (10 years)
Mean Annual Rainfall (mm)	712
Evapo- transpiration	Sydney Monthly Areal PET
Model Time step	6 minutes

5.3 Rainfall Runoff Parameters

Parameter	Value
Rainfall Threshold	1.00
Soil Storage Capacity (mm)	150
Initial Storage (% capacity)	30
Field Capacity (mm)	130
Infiltration Capacity Coefficient a	175
Infiltration Capacity exponent b	2.5
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	1.4
Daily Seepage Rate (%)	0

5.4 Pollutant Concentrations & Source Nodes

Pollutant concentrations for source nodes are based on parameters adopted by the *Technical guidance for achieving Wianamatta–South Creek stormwater management targets* as per **Table 5.1**.

Table 5.1. Pollutant Concentrations

Flow Type	Surface Type	TSS (log_{10} values)		TP (log_{10} values)		TN (log_{10} values)	
		Mean	Std Dev.	Mean	Std Dev.	Mean	Std Dev.
Baseflow	Roof	NA	NA	NA	NA	NA	NA
	Roads	1.20	0.17	-0.85	0.19	0.11	0.12
Stormflow	Roof	1.30	0.32	-0.89	0.25	0.30	0.19
	Roads	2.43	0.32	-0.30	0.25	0.34	0.19

The MUSIC model has been setup with a treatment train approach based on the pollutant concentrations in **Table 5.1** above.

The relevant stormwater catchment sizes are listed below in **Table 5.2** and their configuration within the MUSIC model.

5.5 Treatment Nodes

Sediment ponds, bio-retention systems and GPT nodes have been used in the modelling of the development. Treatment nodes have been aligned with the parameters included in the *Technical guidance for achieving Wianamatta–South Creek stormwater management targets* document.

Table 5.2. Music Model Source Nodes

Catchment	Area (Ha)	Source Node	% Impervious	Stormwater Treatment
Roadside Bio-retention Basin				
Temp Road Bypass	1.06Ha	Sealedroad	70	Bio-Retention
Bio Retention Basin 1a				
Basin 1 Cat	0.453	Industrial	0	Bio-Retention
Road Cat 1 Pavement	1.378	Sealedroad	100	GPT & Bio-Retention
Road Cat 1 Verge	0.8	Industrial	0	GPT & Bio-Retention
WH3 Landscape	0.339	Industrial	0	GPT & Bio-Retention
Lot 4 & 5 Pad A	7.745	Sealedroad	10	GPT & Bio-Retention
Bio Retention Basin 1b				
Lot 4 & 5 Pad B	5.4	Sealedroad	10	GPT & Bio-Retention
Lot 3 Bioretention Basin				
WH3 Carpark/Firetrail	1.087	Sealedroad	85	Oceanguard & Bio Retention
WH3 Hardstand	0.976	Sealedroad	100	Oceanguard & Bio Retention
WH3 Roof to RWT	0.841	Roof	100	Rainwater Tank & Bio Basin
WH3 Roof to Reuse	1.631	Roof	100	Bio-Retention
WH3 Roof to RWT	0.841	Roof	100	Rainwater Tank & Bio Basin
WH3 Office to Ground	0.089	Roof	100	Bio-Retention
Bio Basin 1+2				
Lot 2 Pad	3.935	Sealedroad	10	Bio-Retention
WH1 Carpark	0.367	Sealedroad	85	Oceanguard & Bio Retention
WH1 Firetrail	0.484	Sealedroad	85	Oceanguard & Bio Retention
WH1 Hardstand	0.686	Sealedroad	100	Oceanguard & Bio Retention
WH1 Roof to RWT	0.987	Roof	100	Rainwater Tank & Bio Basin
WH1 Roof to Ground	0.987	Roof	100	Bio-Retention

Catchment	Area (Ha)	Source Node	% Impervious	Stormwater Treatment
WH1 Office Roof	0.051	Roof	100	Bio-Retention
Road Cat 2 Verge	0.305	Industrial	0	GPT & Bio-Retention
Road Cat 2 Pavement	0.53	Sealedroad	100	GPT & Bio-Retention
Bypass				
772 Mamre Road	3.75	Industrial	0	-
WH3 LS Setback	0.331	Industrial	0	-
Drainage Channel	1.65	Industrial	0	-
Total	36.76			

5.6 MUSIC Model Configuration

The estate MUSIC model configuration is shown in **Figure 5.1**, with an overlay of the development site to assist with the modelling definition included in **Figure 5.2**.

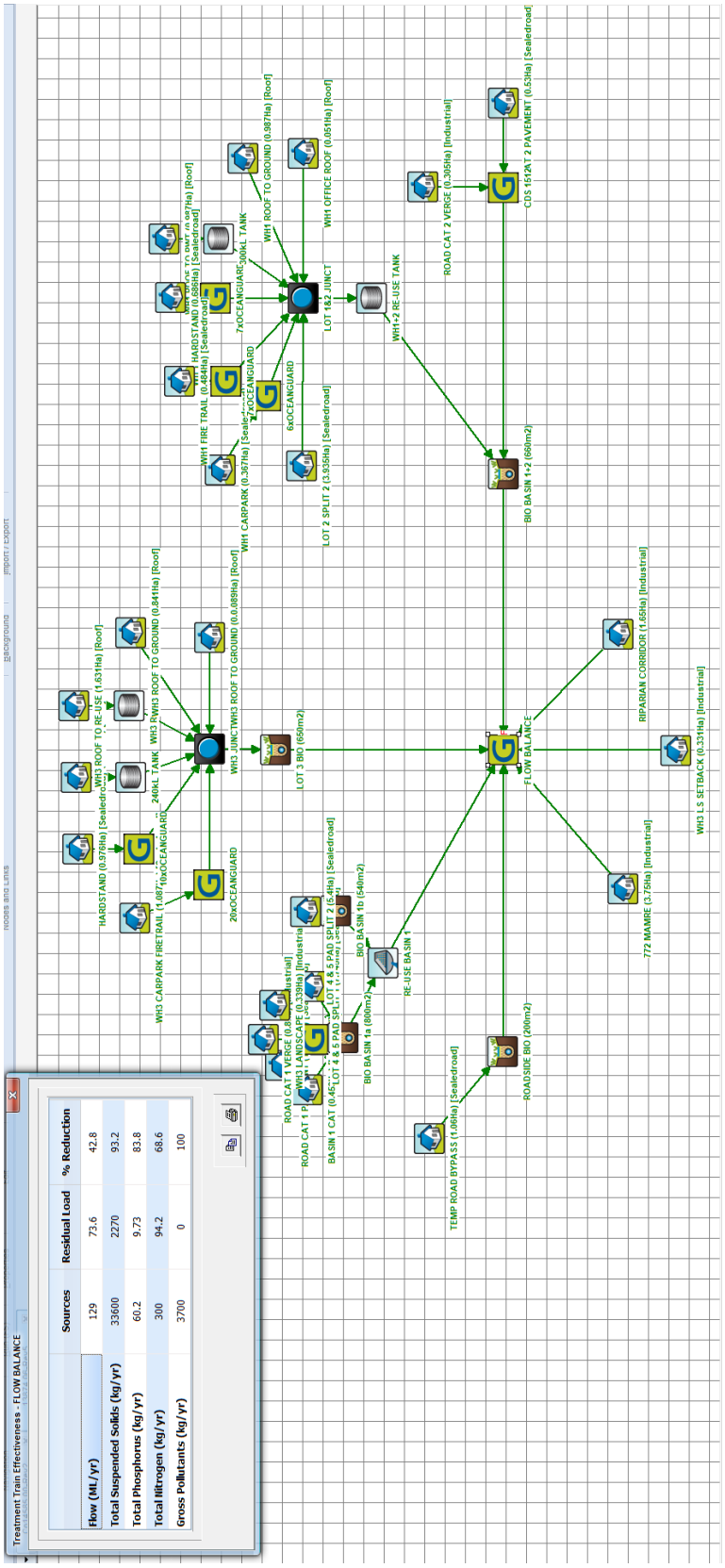

Figure 5.1. MUSIC model layout

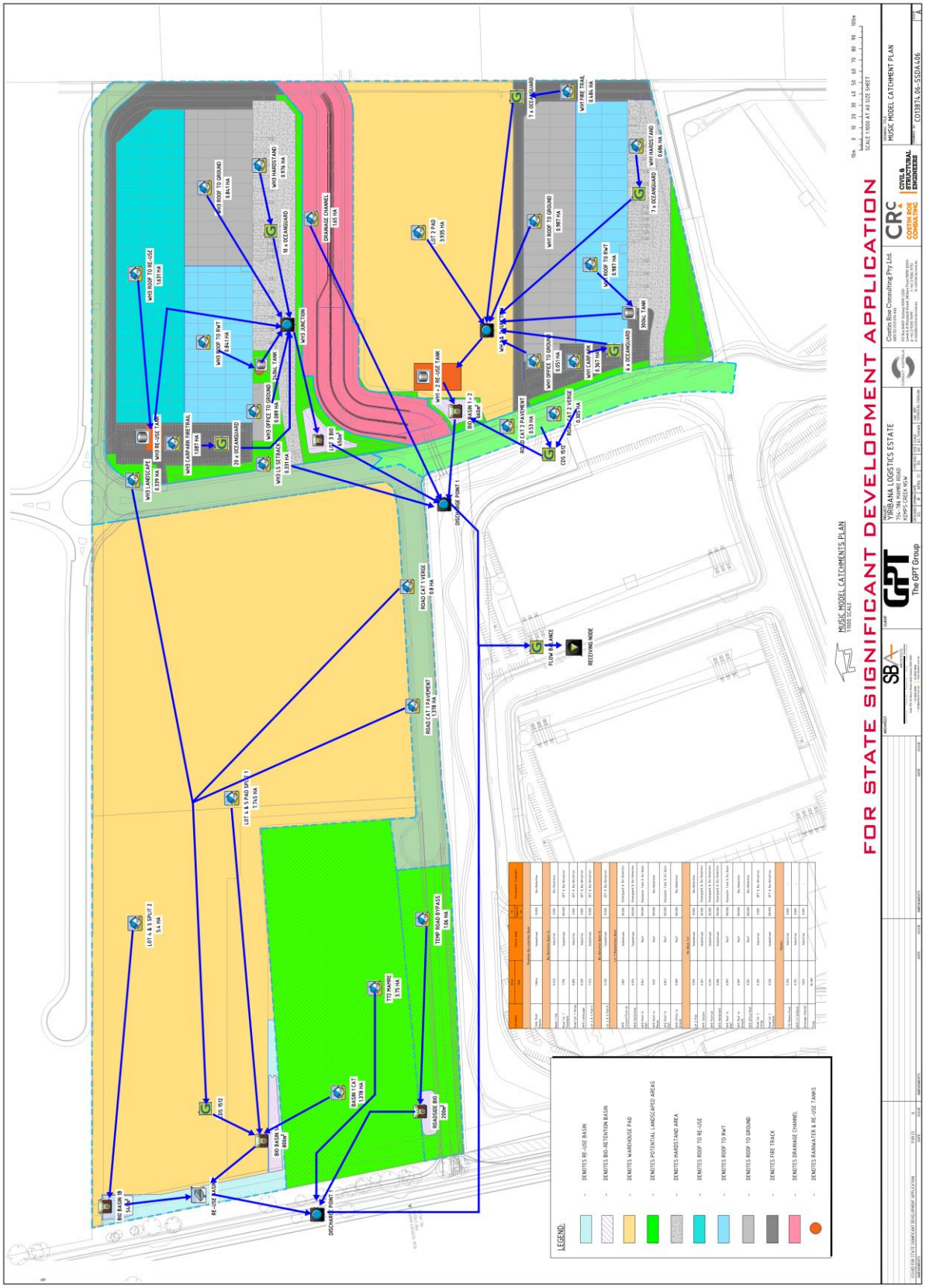

Figure 5.2. MUSIC model layout

6 STREAM HEALTH/ STORMWATER DISCHARGE ASSESSMENT

6.1 Stream Health and Stormwater Discharge Introduction

Assessments relating to stormwater quantity discharge has been completed in accordance with requirements set in *Section 2.4* of the MRP DCP

Stream health, including MARV and FDC assessments have been included in **Section 6.1** through **6.3**, and **Appendix G**.

Peak flow assessments have been included in **Section 6.4**. The peak flow assessments confirm on-site detention requirements for the development which ensure that peak flows are attenuated to pre-development conditions in storm flow events.

6.2 Stream Health Methodology

Stream health has been assessed for this development based on the requirements set in *Section 2.4* of the Final MRP DCP. The assessment is based on the current development extent (Lot 2 building, earthworks pads and surrounding estate roadways). The future precinct-wide system (wetland or similar), which is anticipated to be implemented by Sydney Water (now announced as the waterway manager for South Creek) has not currently been considered in the assessment.

The Flow Duration Curve (FDC)/ Mean Annual Runoff Volume (MARV) alternate proposed by EES in their MUSIC modelling Toolkit dated 2 August 2021 and included in *Section 2.4* of the *Final MRP DCP* has been assessed in MUSIC.

The proposed additional stream flow measures are included in **Table 3.1**, and achieved values (per MUSIC modelling), are included and compared with a *Section 2.4* and *Table 6* of the *Final MRP DCP*.

6.3 Volumetric and Flow Distribution Assessment

An assessment of the estate volumetric and flow distribution discharge against the waterway stream health targets has been completed. Our assessment has reviewed the following target options as detailed in **Table 3.1**:

- *Alternate 1* (Flow Duration Curve); and
- *Alternate 2* (Flow Discharge Curve (FCC) in combination with Mean Annual Runoff Volume (MARV)

The modelling is based on the proposed Stage 1 application for approval of the estate and Building 2 development. Stage 1 therefore comprises construction of Buildings 1 & 3, the roadways and earthworks over the remainder of the estate. The overall estate catchments and basins are defined in **Section 5.5** of this report.

The estate basins are proposed to contain interim water storage retention and reuse which will service estate-level irrigation & staged discharge to ensure the FCD and MARV controls are met. These measures are intended to be decommissioned following Sydney Waters regional system being activated, as further discussed in **Section 10** of this report.

The assessments completed do not allow for development beyond that described in this report, as per the requirements and consultation with DPE. Further modelling and assessments will be

required to consider the construction of future warehouses over the estate, including the "Book End" development scenario (i.e. fully developed).

The discharge rates for the management basins are provided on the drawings in **Appendix A**, while the irrigation/re-use demand is detailed below. Reference to **Annexure A1** should be made for the MUSIC model layout, drawing **Co13874.06-SDD405** for the WSUD layout and following subsections for input confirmation.

6.3.1 Re-use Demand

The Stage 1 Development base water demand has been based on the following allowance for irrigation:

600ml/year/m^2 as PET-Rain for landscape irrigation.

15L/person/day for toilet flushing. Populations are based on those provided by GPT Group.

We note the evaporative misting has not been included as a proposal for water reuse. The potential for evaporative misting in future applications needs to be considered for the future Book End development of the estate, particularly if the Sydney Water regional scheme does not eventuate. Further consultation with the authorities will be ongoing relating to misting reuse potential.

The configuration of Flow Management Measures, as well as water harvesting/re-systems is shown indicatively on drawing **Co13874.06 SSDA405.** The above regime for the landscaped & undeveloped area for the site gives the following yearly indoor & outdoor water demand:

Temporary Re-use Demand

Basin 1 Temp Irrigated Area (0.60kL/year/m^2)	51,670m^2	31,000 kL/year
Lot 1/2 Temp Irrigated Area (0.60kL/year/m^2)	41,820m^2	25,090 kL/year
Lot 3 Temp Irrigated Area (0.60kL/year/m^2)	27,205m^2	16,320 kL/year

Warehouse Rainwater Tank Demand

Lot 1 Internal Irrigated Area (0.60kL/year/m^2)	3,815m^2	2,289 kL/year
Lot 1 Toilet Flushing (15L/person/Day)	150 Persons	2.25kL/Day
Lot 3 Irrigated Area (0.60kL/year/m^2)	2,042m^2	1,225 kL/year
Lot 3 Toilet Flushing (15L/person/Day)	250 Persons	3.75kL/Day

6.3.2 Re-use System Sizing

Storage basins & tanks have been designed, using MUSIC software to balance the supply and demand as part of the Stream Health assessment, based on the calculated base water demands and proposed roof or stormwater catchment areas.

Allowances in the MUSIC model have been made for high flow bypass which will discharge surplus water into the stormwater drainage network.

The final configuration, including the arrangement of downpipes shall be sized and confirmed by the hydraulic engineering consultant during the detailed design of individual warehouses.

Table 6.1. Rainwater Reuse Requirements

Basin/Tank	Contributing Catchment (m^2)	Storage Volume in MUSIC (kL)
Basin 1 Temp Storage	161,150	3,520
Lot 1 & 2 Temp Storage	74,970	1,000
Warehouse 1 Tank	9,870	300
Lot 3 Temp Storage	16,300	1,000
Warehouse 3 Tank	8,410	240

Figure 6.1 shows the Flow Duration Curve for the estate MARV, while **Table 6.2** provides confirmation of target requirements and those achieved**.** The modelling suggests The distribution of flows in the lower frequency events reduces significantly as frequency increases. With reference to **Appendix G**, the modelling demonstrates that the flow metric targets are met.

6.3.3 Stream Health System Modelling & Results

Stream health basins have been designed, using MUSIC software to balance the discharge with the runoff and reuse as described in this report.

Figure 6.1 shows the MUSIC model Flow Duration Curve for the estate stormwater management strategy, while **Table 6.2** shows results of the Stream Health Targets *Alternative 1.* **Table 5.3** provides confirmation of target requirements and those achieved for *Alternate 1***.**

Detailed output from the MUSIC modelling toolkit has been included in **Appendix G**.

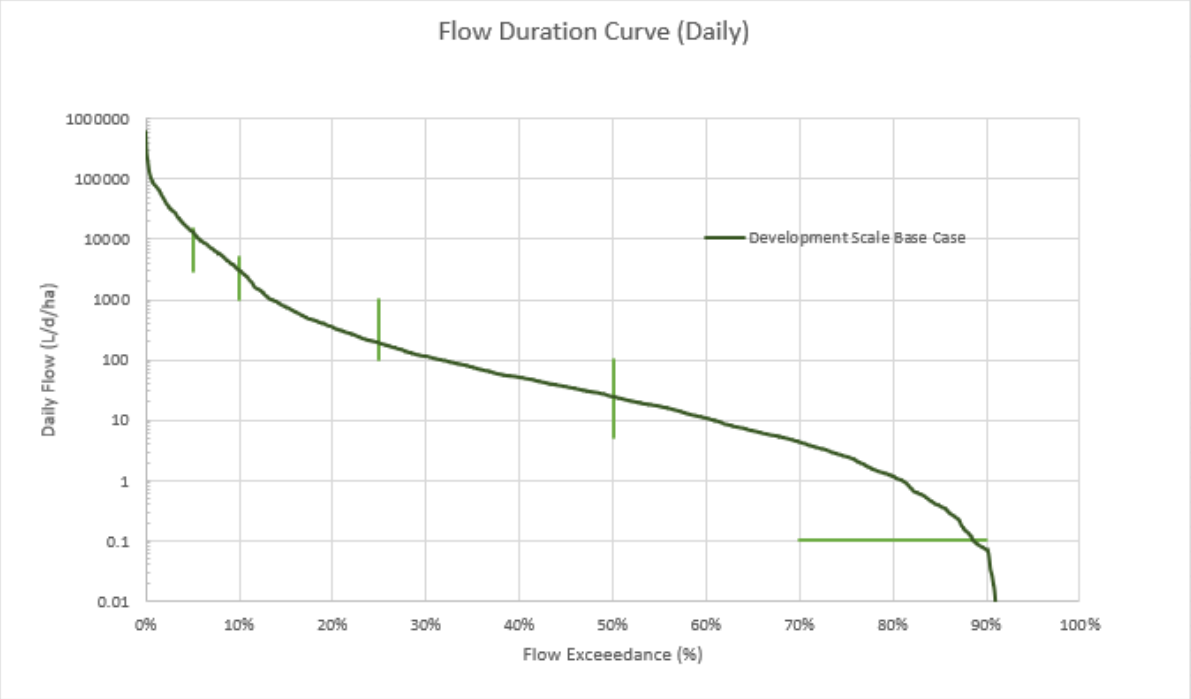

Figure 6.1. MUSIC Model Flow Duration Curve

Table 6.2. Stream Health Metrics

Objective	Required Parameter	Achieved Parameter
Mean Annual Runoff Volume (MARV)	<=2.0 ML/ha/year	1.23 ML/ha/year
90%ile flow	1000 to 5000 L/ha/day	2999 L/ha/day
50%ile flow	5 to 100 L/ha/day	24 L/ha/day
10%ile flow	0 L/ha/day	0 L/ha/day

As demonstrated in **Table 6.2**, the requirements of the MRP DCP for Stream Health FDC/MARV have been met.

6.3.4 Stream Health Discussion

As demonstrated in **Table 6.2**, the requirements of the *Alternative 2* targets have been met. *Alternative 2* targets utilise combined MARV restrictions with FDC metrics.

The MARV is seen to be significantly below the 2.0ML/ha/year limit, and FDC metrics are also within the nominated gates.

Alternative 1 is not met via the Cease to Flow metric, which is achieved approximately 8.4% of the time.

6.4 Peak Flow Management

6.4.1 Water Quantity Management Objectives

The MRP DCP requires inclusion of peak flow management, also known as "On-site Detention (OSD)", to ensure the cumulative effect of development does not have a detrimental effect on the existing stormwater infrastructure and watercourses located within the precinct in accordance with Sections 2.4 and 2.5 of the MRP DCP.

6.4.2 Methodology

A hydrological analysis was undertaken to estimate the impact of the development of the site on peak flows at the downstream extent of the site. Modelling of stormwater runoff quantity was considered for the pre-existing case and for the operational phase of the development.

DRAINS/ ILSAX modelling has been completed to assess the site detention discharge and storage relationship. In order to assess the existing and operational phase peak discharges from the development site, a DRAINS hydrological model was used to estimate peak flows from catchments on the site for various storm durations for Q2 year ARI to Q100 year ARI events.

6.4.3 Existing & Post Development Peak Flows

Table 6.3 to Table 6.5 show the existing and developed flows at the downstream boundary for the three existing catchments on the property.

Table 6.3. Q2, Q20 & Q100 ARI Peak Flows from Catchment 1

ARI	Design Storm Duration	Peak Flow (m3/s)		
		Undeveloped	Developed	
		Site	Site (no atten.)	**Site (+ atten.)**
2	30	1.61	3.36	**0.97**
	60	1.92	3.44	**1.14**
	120	1.60	2.98	**1.03**
20	30	4.84	8.28	**2.91**
	60	5.19	7.90	**3.17**
	120	4.59	7.12	**3.08**
100	30	7.61	11.53	**3.97**
	60	7.82	10.84	**5.03**
	120	6.96	9.73	**4.36**

Table 6.4. Q2, Q20 & Q100 ARI Peak Flows from Catchment 2

ARI	Design Storm Duration	Peak Flow (m3/s)		
		Undeveloped	Developed	
		Site	Site (no atten.)	**Site (+ atten.)**
2	30	0.734	2.522	**0.59**
	60	0.869	2.344	**0.60**
	120	0.710	2.106	**0.60**
20	30	2.690	4,750	**1.390**
	60	2.750	4,160	**1.860**
	120	2.480	3,696	**1.650**
100	30	4.110	5,930	**3.790**
	60	4.050	5,390	**3.500**
	120	3.670	4,760	**2.150**

The post development (with site attenuation) flows can be seen to be lower than the pre-developed flows. The required detention storage for the development site is discussed in the following section.

6.4.4 Proposed Water Quantity Management

As previously discussed, detention storage on the development site is required to reduce local outflows. The proposed site layout allows for provision of a combined OSD/Bio-Retention basin. The ultimate discharge location will be to the existing table drains along the Mamre Road frontage and upstream of the culverts which cross Road 1.

A number of combinations of storages and outlet arrangements have been modelled. The adopted arrangement models the two basin configurations (at Discharge Locations 1 and 2) are shown in **Table 6.4** and the proposed layout can also be observed on drawing **Co13874.06-SDD431 & SDD432**.

Table 6.4 OSD Detention Characteristics (Post Developed)

ARI	Duration (mins)	Peak Flow (m^3/s)					Depth (mm)	Storage (m^3)
		Discharge Location	No Atten.	With attenuation				
				Low	High	Total		
2	120	1	3.439	0.563	0	0.563	1,800	1,975
	60	2a (Lot 1+2)	1.010	0.276	0	0.276	1,572	2,320
		2b (Lot 3)	1.327	0.244	0	0.244	2,080	1,110
20	60	1	7.901	0.579	1.62	2.16	3,090	2,540
		2a (Lot 1+2)	2,360	0.295	0.754	1.049	3,370	2,575
		2b (Lot 3)	1,800	0.360	0.043	0.403	3,550	2,355
100	60	1	8.37	0.543	3.10	3.64	2,080	3,006
		2a (Lot 1+2)	3,050	0.307	1.790	2,097	3,660	2,850
		2b (Lot 3)	2,340	0.379	0.963	1,342	3,940	2,680

The hydrologic analysis shows that, with the provision of the on-site detention systems detailed above, the post development peak flows from the site will be attenuated to less than pre-development; hence the requirements of PCC and MRP DCP have been met.

7 STORMWATER QUALITY

7.1 Stormwater Quality Objectives

There is a need to provide a design which incorporates the principles of Water Sensitive Urban Design (WSUD) and to target pollutants that are present in the stormwater so as to minimise the adverse impact these pollutants could have on receiving waters and to also meet the requirements specified in the MRP DCP.

The requirements for stormwater quality to be performed for the entire estate catchment. The reduction objectives noted in **Section 4.1** and **Table 4.1** of this report are presented in terms of annual percentage pollutant reductions on a developed catchment, or alternative pollutant concentrations, based on the controls included in the *MRP DCP 2021* and the alternative concentrations included in the technical guidelines.

Assessment of compliance of the water quality objectives has been made using MUSIC as set out in the following sub-sections of this report.

7.2 Proposed Stormwater Treatment System

Developed impervious areas including roof, hardstand, car parking, roads and other extensive impervious areas are required to be treated by the Stormwater Treatment Measures (STM's). The STM's shall be sized according to the whole catchment area of the development. The STM's for the development shall be based on a treatment train approach to ensure that all the objectives above are met.

Components of the treatment train for the development are as follows:

- Primary treatment to development lots and proposed roads are via a Vortech type GPT (Rocla CDS, OceanSave or similar SQIDEP approved). Pre-treatment of the stormwater will assist in mitigating the potential for early onset sedimentation of the bio-retention systems;
- Tertiary treatment to the catchment will be provided by bio-retention system within each of the two proposed estate detention systems. As noted, the effective performance of bio-retention systems combined with on-site detention systems is described in detail in **Section 5.3** of this report.

7.3 GPT Sizing

The GPT's are designed in accordance with the *Sydney Water's Draft Stormwater Infrastructure Design Guidelines (2022).*

The specified GPT's meet SQIDEP requirements, and are sized for the relevant treatable flow based on the 6month ARI. No allowance for nutrient removal has been made within the MUSIC model per the document guidelines.

We note the requirements of Sydney Waters document, cross reference those as required of the *Technical guidance for achieving Wianamatta–South Creek stormwater management targets (DPE, 2022)*.

Table 7.1. GPT Specification and Sizing

Oceanprotect Oceansave GPT Model	Treatment Flow
OS-2318-D Catchment CAT 1-4 + CAT Road 1-1 6 Month Flow – 458 L/s	580 L/s
OS-0809-D Catchment CAT Road 2-1 6 Month Flow – 63 L/s	68 L/s

7.4 Stormwater Quality Modelling

The pollutant retention criteria set out in the MRP DCP and nominated in **Section 3.1** of this report were used as a basis for assessing the effectiveness of the selected treatment trains.

The parameters used in the MUSIC model, consistent with the Department of Planning and Environment *Technical guidance for achieving Wianamatta–South Creek stormwater management targets,* are presented in **Section 5**.

Reference to **Section 5.6** should be made for the Water Quality MUSIC model layout and drawing **Co13874.06-SDD405** for the WSUD drawing. Landuse and catchment areas of source nodes are included in **Table 5.2**.

7.5 Water Quality Modelling Results

Tables 7.1 & 7.2 shows the results of the MUSIC analysis and compares to the treatment targets described the MRP DCP, the MUSIC Modelling Toolkit and DPIE *Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets*.

The technical documents provide two options for operational phase water quality targets – these are presented in **Table 3.1** of this report. For a compliant solution, the targets of one of the two options provided must be met to demonstrate compliance. **Option 1** expresses targets as a percentage reduction, whereas **Option 2** expresses targets as a residual concentration or load per Ha. The tables compare the post-development pollutant loads without treatment versus post-development loads with treatment.

Table 7.2. MUSIC analysis results – Allowable Load Reduction

	Total Source Load (kg/yr)	Total Residual Load (kg/yr)	Reduction Achieved (%)	Target Reduction (%)
Total Suspended Solids (kg/yr)	19,100	1,240	93.5	90
Total Phosphorus (kg/yr)	36	5.27	85.4	80
Total Nitrogen (kg/yr)	201	51.9	74.3	65
Gross Pollutants (kg/yr)	2,600	0	100	90

Table 7.3. MUSIC analysis results – Allowable Loads

	Total Source Load (kg yr)	Residual Load (kg/yr)	Target Load (kg/yr)	Per Hectare Residual Load (kg/ha/yr)	Per Hectare Residual Load (kg/ha/yr)
Total Suspended Solids (kg/yr)	19,100	1,240	2,950	33.63	<80
Total Phosphorus (kg/yr)	36	5.27	11.66	0.14	<0.3
Total Nitrogen (kg/yr)	201	51.9	136	1.41	<3.5
Gross Pollutants (kg/yr)	2,600	0	622	0	<16

The model results demonstrate that, through the use of the STM in the treatment train, pollutant residual loads for Total Suspended Solids, Total Phosphorous, Total Nitrogen and Gross Pollutants will meet the requirements of *DPIE Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets* (Operational Phase Stormwater Quality Targets) on an overall catchment basis.

7.6 Hydrocarbon Quality

Hydrocarbon and oil & grease removal cannot be readily modelled with MUSIC software.

As an industrial estate with users for individual development sites which are not known, the exact levels of hydrocarbons would not be known. Given the expected use of the development sites as warehouse distribution facilities or similar, generation of hydrocarbon pollutants would not be expected to be large. Potential sources of hydrocarbons and/or oil & grease which drain to the stormwater system would be limited to leaking engine sumps or for accidental fuel spills/leaks and leaching of bituminous pavements (car parking only).

The potential for these pollutants is low and published data from the CSIRO indicates that average concentrations from industrial sites are in the order of 10mg/L. We would expect source loading from this site, or future sites, to be near to (or below) this concentration.

Hydrocarbon pollution, where present, would be limited to surface areas which will be treated via the proposed water quality treatment measures. The proposed GPT's are estimated to remove between 70-80% (per manufacturer data). Further removal will occur with bio-retention systems where any residual hydrocarbons would be removed in the filtration system. Research by Hseih (2005) has also shown that 97% of hydrocarbons are contained in the first few centimetres of a filtration system (i.e. filter swales and bio-retention systems) and broken down via organic processes in a period of 2-3 days.

Given the expected low source loadings of hydrocarbons and oil/grease and removal efficiencies of the treatment devices and bio-retention systems we consider that the requirements of the MRP DCP have been met.

7.7 Modelling Discussion

The MUSIC modelling has shown that the proposed treatment train of STM will provide stormwater treatment which will meet MRP DCP requirements in an effective and economical manner.

MUSIC modelling has been performed to assess the effectiveness of the selected treatment trains and to ensure that the pollutant retention requirements of Section 2.6 of the MRP DCP and *DPIE Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets* (Operational Phase Stormwater Quality Targets – Option 2) have been met.

The modelling demonstrates that the treatment train meets all percentage-based treatment reduction targets, except for the reduction in Total Phosphorus (79.04% achieved, 80% target). The minor shortfall in the percentage-based TP reduction is attributed to the large area of landscaping and current proposed amount of developed zones present on the site, noting the residual load (per *Option 2*) is well below the required threshold. The water quality system and achieved outcomes are shown to be compliant with the *DPIE Technical Guidance for Achieving Wianamatta South Creek Stormwater Management Targets*, and as such the MRP DCP.

Given the expected low source loadings of hydrocarbons and oil/grease and removal efficiencies of the treatment devices we consider that the requirements of the MRP DCP have been met.

8 WSUD MAINTENANCE AND LIFECYCLE COST ASSESSMENTS

8.1 Stormwater Maintenance Introduction

This section of the report presents the management processes required following construction of the stormwater drainage system.

For the successful operation of the stormwater management system, it is important that each component of the water quality treatment train is properly operated and maintained. In order to achieve the design treatment objectives, a maintenance schedule has been prepared (refer to **Section 8.3** following) to assist in the effective operation and maintenance of the various water quality components.

An assessment of the lifecyle cost of the WSUD measures is included in **Section 8.5**.

8.2 Scope of Inspections & Maintenance

Routine Inspections

Routine inspections are to be carried out to assess the need for maintenance and are primarily concerned with checking the functionality of the stormwater drainage and treatment facilities; items such as drains, drainage pits, box culverts, detention tanks and rainwater reuse tank systems. Maintenance of these items is vitally important for the ongoing drainage and treatment of stormwater.

Should the inspection reveal that maintenance of any item is required, this is to be reported to the building management for action.

Items that are to be subject to Routine Inspections for Maintenance may comprise, but not be limited to those listed in **Section 8.3** below. This table is to be read in conjunction with the Stormwater design drawings.

It is vitally important that each component of the stormwater quality treatment train is properly operated and maintained. In order to achieve the modelled and design treatment outcomes, a maintenance schedule has been prepared (below) to assist in the effective operation and maintenance of the various drainage and water quality components.

Inspection Frequency

Routine Inspections for Maintenance shall be carried out over the life of the development.

The inspections shall occur on a monthly frequency during the construction period, and shall continue on a regular basis as per the frequency specified in Section 3.2 in perpetuity.

In addition to the normal inspection frequency nominated inspections should also be carried out following heavy rain events. Event heavy rain inspections should be carried out as soon as practicable following an intense period of rainfall, (i.e. greater than 100mm over 48 hours), as measured at Prospect Dam Weather Station No. 67019. A process to establish when periods of high rainfall occur should be put in place with Building Management.

Records

Records detailing each of the routine inspections for maintenance should be completed during the inspection, and describe in detail any required maintenance. The inspection records are to be provided to Building Management for action and then filed appropriately.

Records of any maintenance carried out as a result of the inspection should be completed immediately after the works have been finalised, and filed appropriately.

Personnel

Routine inspections for maintenance are required to establish the need for basic maintenance, as described above. On this basis, such inspections do not require professional engineering knowledge and may be carried out by any responsible person, including property management staff or maintenance staff.

Alternatively, professional engineering staff may be employed to complete the routine inspections for maintenance concurrently with the engineering inspections for maintenance.

8.3 Maintenance Schedule

Table 8.1. Stormwater Maintenance Table

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
SWALES/ LANDSCAPED AREAS			
Check density of vegetation and ensure minimum height of 150mm is maintained. Check for any evidence of weed infestation	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Inspect swale for excessive litter and sediment build up	Six monthly	Maintenance Contractor	Remove sediment and litter and dispose in accordance with local authorities' requirements.
Check for any evidence of channelisation and erosion	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed swale profile is maintained
Weed Infestation	Three Monthly	Maintenance Contractor	Remove any weed infestation ensuring all root ball of weed is removed. Replace with

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
			vegetation where required.
Inspect swale surface for erosion	Six Monthly	Maintenance Contractor	Replace top soil in eroded area and cover and secure with biodegradable fabric. Cut hole in fabric and revegetate.
INLET & JUNCTION PITS			
Inside of pits	Six Monthly	Maintenance Contractor	Remove grate and inspect internal walls and base, repair where required. Remove any collected sediment, debris, litter.
Outside of pits	Four Monthly/ After Major Storm	Maintenance Contractor	Clean grate of collected sediment, debris, litter and vegetation.
PROPRIETARY TREATMENT DEVICES (CDS GPT)			
Refer to Manufacturers Operation and Maintenance Manuel	Annually	Maintenance Contractor	Refer to Manufacturers Operation and Maintenance Manuel
BIORETENTION BASIN			
Check all items nominated for SWALES/ LANDSCAPED AREAS above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above	Refer to SWALES/ LANDSCAPED AREAS section above
Check for sediment accumulation at inflow points	Six monthly/ After Major Storm	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements.
Check for erosion at inlet or other key structures.	Six monthly/ After Major Storm	Maintenance Contractor	Reinstate eroded areas so that original, designed profile is maintained
Check for evidence of dumping (litter,	Six monthly	Maintenance Contractor	Remove waste and litter and dispose in accordance

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
building waste or other).			with local authorities' requirements.
Check condition of vegetation is satisfactory (density, weeds, watering, replating, mowing/ slashing etc)	Six monthly	Maintenance Contractor	Replant and/or fertilise, weed and water in accordance with landscape consultant specifications
Check for evidence of prolonged ponding, surface clogging or clogging of drainage structures	Six monthly/ After Major Storm 5-10 years	Maintenance Contractor	Remove sediment and dispose in accordance with local authorities' requirements. Replace filter media & planting – refer to appropriately qualified engineer or stormwater specialist
Check stormwater pipes and pits	Six monthly/ After Major Storm	Maintenance Contractor	Refer to INLET/ JUNCTION PIT section.
FUTURE RAINWATER TANK			
Check for any clogging and blockage of the first flush device	Monthly	Maintenance Contractor	First flush device to be cleaned out
Check for any clogging and blockage of the tank inlet -leaf/litter screen	Six monthly	Maintenance Contractor	Leaves and debris to be removed from the inlet leaf/litter screen
Check the level of sediment within the tank	Every two years	Maintenance Contractor	Sediment and debris to be removed from rainwater tank floor if sediment level is greater than the maximum allowable depth as specified by the hydraulic consultant
STORMWATER SYSTEM			

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
General Inspection of complete stormwater drainage system	Bi-annually	Maintenance Contractor	Inspect all drainage structures noting any dilapidation in structures and carry out required repairs.
OSD SYSTEM			
Inspect and remove any blockage from orifice	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen to inspect orifice.
Inspect trash screen and clean	Six Monthly	Maintenance Contractor/ Owner	Remove grate and screen if required to clean it.
Inspect flap valve and remove any blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate. Ensure flap valve moves freely and remove any blockages or debris.
Inspect pit sump for damage or blockage.	Six Monthly	Maintenance Contractor/ Owner	Remove grate & screen. Remove sediment/ sludge build up and check orifice and flap valve are clear.
Inspect storage areas and remove debris/ mulch/ litter etc likely to block screens/ grates.	Six Monthly	Maintenance Contractor/ Owner	Remove debris and floatable materials.
Check attachment of orifice plate and screen to wall of pit	Annually	Maintenance Contractor	Remove grate and screen. Ensure plate or screen mounted securely, tighten fixings if required. Seal gaps if required.
Check orifice diameter is correct and retains sharp edge.	Five yearly	Maintenance Contractor	Compare diameter to design (see Work-as-Executed) and ensure edge is not pitted or damaged.
Check screen for corrosion	Annually	Maintenance Contractor	Remove grate and screen and examine for rust or corrosion, especially at corners or welds.

MAINTENANCE ACTION	FREQUENCY	RESPONSIBILITY	PROCEDURE
Inspect overflow weir and remove any blockage	Six monthly	Maintenance Contractor/ Owner	Ensure weir is free of blockage.
Inspect walls for cracks or spalling	Annually	Maintenance Contractor	Remove grate to inspect internal walls, repair as necessary.
Check step irons	Annually	Maintenance Contractor	Ensure fixings are secure and irons are free from corrosion.

8.4 Inspection Safety

General

As described earlier in this document, regular inspections and maintenance of equipment/drains are essential for their ongoing stability. However, carrying out inspections and maintenance activities will place those personnel involved with the inspections and maintenance at varying levels of risk. Therefore, to reduce the risk, certain minimum procedures and activities must be carried out before, during and after the inspections.

Inspections/ Maintenance

In order to reduce the risk, any inspections or maintenance activities should be carried out under the following protocols:

- Inspections/Maintenance teams must comprise a minimum of two, preferably three people, in order to prevent inspection personnel working alone;
- Inspections/Maintenance must be carried out within 48 hours of a rain event, preferably within 24 hours;
- Personnel completing inspections/maintenance must be able to communicate and be contactable, eg by carrying mobile phones or UHF radios; and
- For entry to confined spaces, the Contractor should establish if relevant training is required to enter these spaces, as well as provision of appropriate equipment to carry out the inspections.

Prior to Inspection/ Maintenance

It is the responsibility of the Building Management to appoint the appropriate personnel to carry out the inspections and maintenance, and to nominate appropriate times for the inspections to occur, according to the frequencies recommended in Section 3.

Prior to any inspection/maintenance commencing, the Building Management or representative shall:

1. Review and sign off an Inspection/Maintenance Safety Plan provided by the personnel completing the inspection or carrying out the maintenance. Sufficient time should be allowed to review the plan, request changes/alterations, and approve the updated document.

   The Inspection/Maintenance Safety Plan must include:

a. A list of personnel and backup personnel completing the inspections/maintenance, along with their qualifications and experience. The qualifications should include a list of tertiary education (if applicable), "green card" status or equivalent (e.g. Occupational Health and Safety Induction Training for Construction Work – General Course), and any required licences such as drivers licence/Bobcat operators licence;
b. A list of the items and areas to be inspected/maintained, as set out (but not limited to) in Section 3 above;
c. The procedures to be undertaken during the inspections/maintenance;
d. The methodology proposed to complete the inspections/maintenance;
e. A Job Safety Analysis (JSA)/Health and Safety Plan (HASP), or equivalent, that documents the following:

   i. Each Inspection/Maintenance Activity and associated Hazard. Hazards may include, but are not limited to:

   - Rock falls from batter striking personnel or vehicle;
   - Personnel or vehicles falling into drainage system;
   - Vehicle driving off maintenance road;
   - Accessibility to live traffic areas;
   - Traffic management issues to be resolved with SEL Management;
   - Head on collisions;
   - Vehicle damage if speed limits exceeded;
   - Personnel tripping on uneven ground;
   - Snake/spider/insect bites;
   - Dehydration/sun exposure; and
   - Unauthorised dumped material such as sharps or contaminated waste.

   ii. An initial risk assessment;

   iii. Control measures to be implemented to reduce unacceptable risks; and

   iv. A second risk assessment that re-assesses the risk considering the control measures suggested for implementation in Point "iii" above.

f. Details of evacuation procedures and muster points in the event of an emergency;
g. A list of safety equipment to be taken, including a radio, first aid kit; and
h. Where appropriate ablutions and wash facilities are located.

2. Ensure the inspection and maintenance personnel entering the site have filled in a dedicated Sign In/Sign Out register. This register can be located at the Building Management office. Location to be confirmed to all parties involved.

   The register should also record which personnel have custody of any keys that provide access through locked gates/barricades. Any keys should be signed back in at the end of each days work; and

3. Be present during a Tool Box talk that summarises the JSA/HASP, highlighting the main hazards and risks. If Building Management is aware of any hazards and risks not mentioned in the JSA/HASP, they are to be raised during the Tool Box Talk and the JSA/HASP amended accordingly.

Following the completion of these activities, the Inspections and or Maintenance may commence.

During Inspections/ Maintenance

During the inspection and maintenance activities, it is the responsibility of those personnel carrying out the works to ensure that the requirements of the Inspection/Maintenance Safety Plan are adhered to. Safety whilst completing the inspections/maintenance is as important as the functionality of the drains themselves.

Whilst working within the drain pits or through intermediate access points, the inspection and maintenance work teams shall:

- Complete visual inspections of the drain and pits for signs of shifting and or damage;
- Check for accumulations of scale or sedimentation within the pipes/drains;
- Be vigilant with regard to rock falls from the batters;
- Work in minimum groups of two people, preferably three;
- Perform inspections during period of forecast dry weather;
- Ensure that sufficient PPE is worn and utilised. As a minimum (subject to the maintenance activity), the following PPE is required:

  i. High Visibility Safety Vest;

  ii. Steel Capped Boots;

  iii. Helmet;

  iv. Safety glasses;

  v. Mobile Phone/UHF Radio (or other means of telecommunication);

  vi. First Aid Kit; and

  vii. Long pants and long sleeve shirts.

Subsequent to Inspection

At the completion of each days work, all members of the inspection/maintenance parties must complete the Sign In/Sign Out register to note that they have left the site. Any keys issued to provide access through locked gates/barricades must be returned and signed for.

The completed Inspection/Maintenance Records must be handed over to the Building Management for actioning. If a report needs to be furnished, it must be finalised and submitted within 2 weeks of inspection/maintenance works being completed.

8.5 Lifecyle Cost Estimate

A lifecycle cost estimate has been prepared for the WSUD elements, as per the requirements of CoC B28(m). the lifecycle cost estimate has been completed over a 30year period and includes the initial capital cost, ongoing maintenance and replacements, and ultimate decommissioning.

The assessment has been completed using the lifecycle costing tool included in the MUSIC modelling software. This is noted to provide a reasonable cost estimate which is based on historic cost information, the size of the assets and typical maintenance activities. The actual cost will depend on market factors, climatic and rainfall conditions, and other environmental conditions (such as the amount of pollutants in the catchment).

It is recommended that this cost assessment be reviewed by the tenant or developer periodically to check estimated costs compared to actual costs, and redefine the cost estimate with real time data.

Figure 8.1 & **Table 8.1** below shows the lifecyle costing amounts and **Figure 8.2** shows the distribution of costs throughout the 30-year period & **Figure 8.3** shows a sensitivity analysis to real discount rate.

Table 8.1. Lifecycle Cost Summary

Parameter	Value
Span of Analysis	30 years
Real Discount Rate	5.50%
Actual Inflation Rate	2.0%
Base year of Costing	2021
Life Cycle Cost of Treatment Train	$2,974,963
Equivalent Annual Payment Cost of Treatment Train ($2021/annum)	$98,265
Equivalent Annual Payment per m3/s maximum flow reduction	17,355.54
Equivalent Annual Payment/ML flow reduction/annum	$2,258.39
Equivalent Annual Payment/kg Total Suspended Solids/annum	$5.50
Equivalent Annual Payment/kg Total Phosphorus/annum	$3,204.81
Equivalent Annual Payment/kg Total Nitrogen/annum	$651.97
Equivalent Annual Payment/kg Gross Pollutant/annum	$37.81

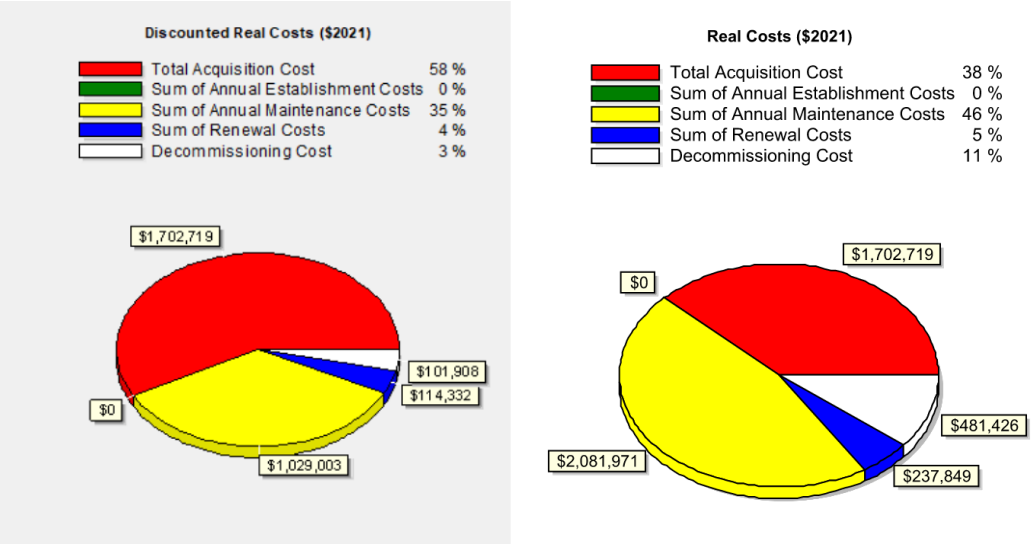

Figure 8.1. Relative Distribution of Real Costs & Discounted Real Costs

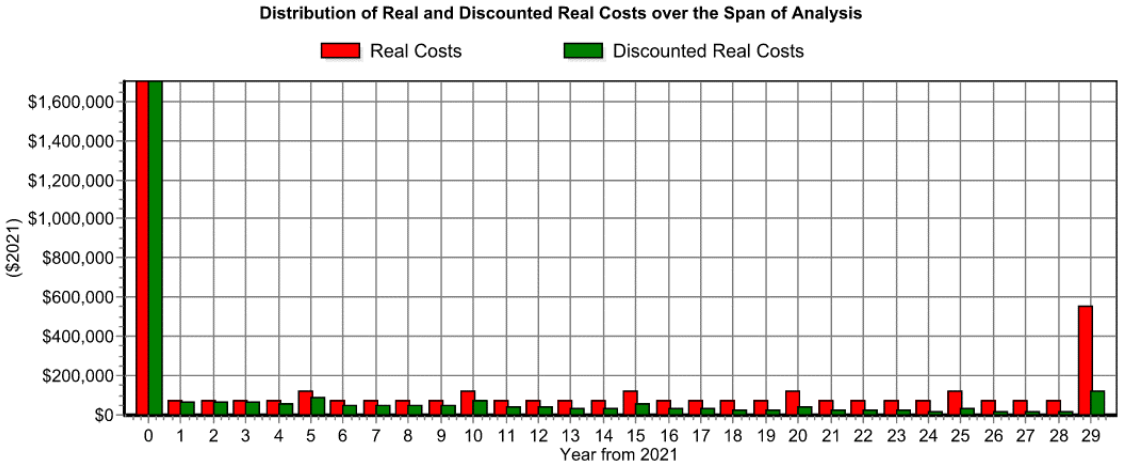

Figure 8.2. Cost Distribution

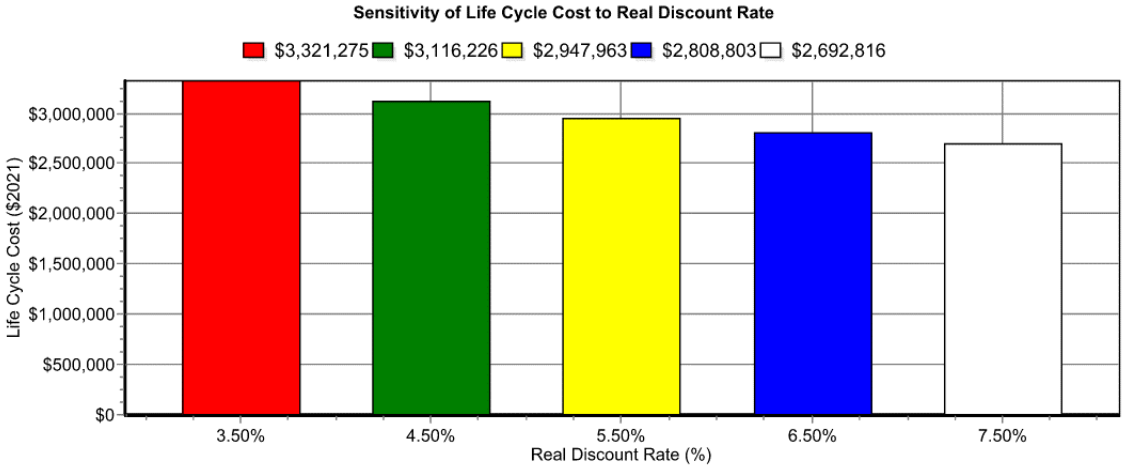

Figure 8.3. Discount Rate Sensitivity Chart

9 DECOMISSIONING OF INTERIM STORMWATER MANAGEMENT MEASURES

9.1 Background

Sydney Water proposes to implement a regional Stormwater Management Scheme to service the Mamre Road precinct. The site, in context with the scheme plan, is shown on **Figure 9.1**.

As reported by Sydney Water in their scheme plan document:

> *This Stormwater Scheme Plan shows the regional stormwater infrastructure required to service the Mamre Ro ad precinct and to be managed by Sydney Water.*
>
> *The Stormwater Scheme Plan was developed in line with NSW Government planning requirements and ensures that development complies with NSW Government waterway objectives and stormwater targets specified in the Mamre Road Precinct Development Control Plan. The scheme outlines the infrastructure required to deliver a regional stormwater harvesting solution to achieving the stormwater targets.*
>
> *This infrastructure will also support the NSW Governments Western Parkland City vision for greening and cooling. Elements of the scheme form part of the blue green infrastructure framework.*
>
> *The key elements of the Mamre Road Precinct Stormwater Scheme Plan are:*
>
> *• Naturalised trunk drainage channels for stormwater conveyance as well as eco logical and social benefits*
>
> *• Gross pollutant traps (GPTs) to remove litter and other coarse pollutants*
>
> *• Constructed wetlands and storage ponds for treatment and harvesting of stormwater*
>
> *• Stormwater harvesting and distribution network that includes gravity and pressure mains as well as pumps, treatment plant and a reservoir.*
>
> *This Stormwater Scheme Plan is a conceptual layout which has been refined following public and stakeholder comment. The infrastructure sizing and locations are fixed from this point with the exception of minor modifications subject to Sydney Water approval.*

The timing of delivery of the scheme by Sydney Water has not yet been confirmed, however anticipated to be in the range of 2-5yrs from the time of writing. Upon implementation of the scheme the requirements of individual lots water quality and quantity requirements will be based on "business as usual" and the stream health metrics will be managed with the precinct basins.

Government however requires individual developments to achieve the stream health requirements (water quality, MARV and FDC) until such time that Sydney Waters delivers their Stormwater Scheme. As such a number of temporary measures have been proposed for the development to ensure that the stream health metrics have been met. These include rainwater reuse, stormwater harvesting and irrigation via additional stormwater retention storages and reuses and discharge controls (as defined in **Section 6** & **7** of this report).

Sydney Water, as part of their development and approval conditions requires confirmation of the decommissioning of the temporary measures.

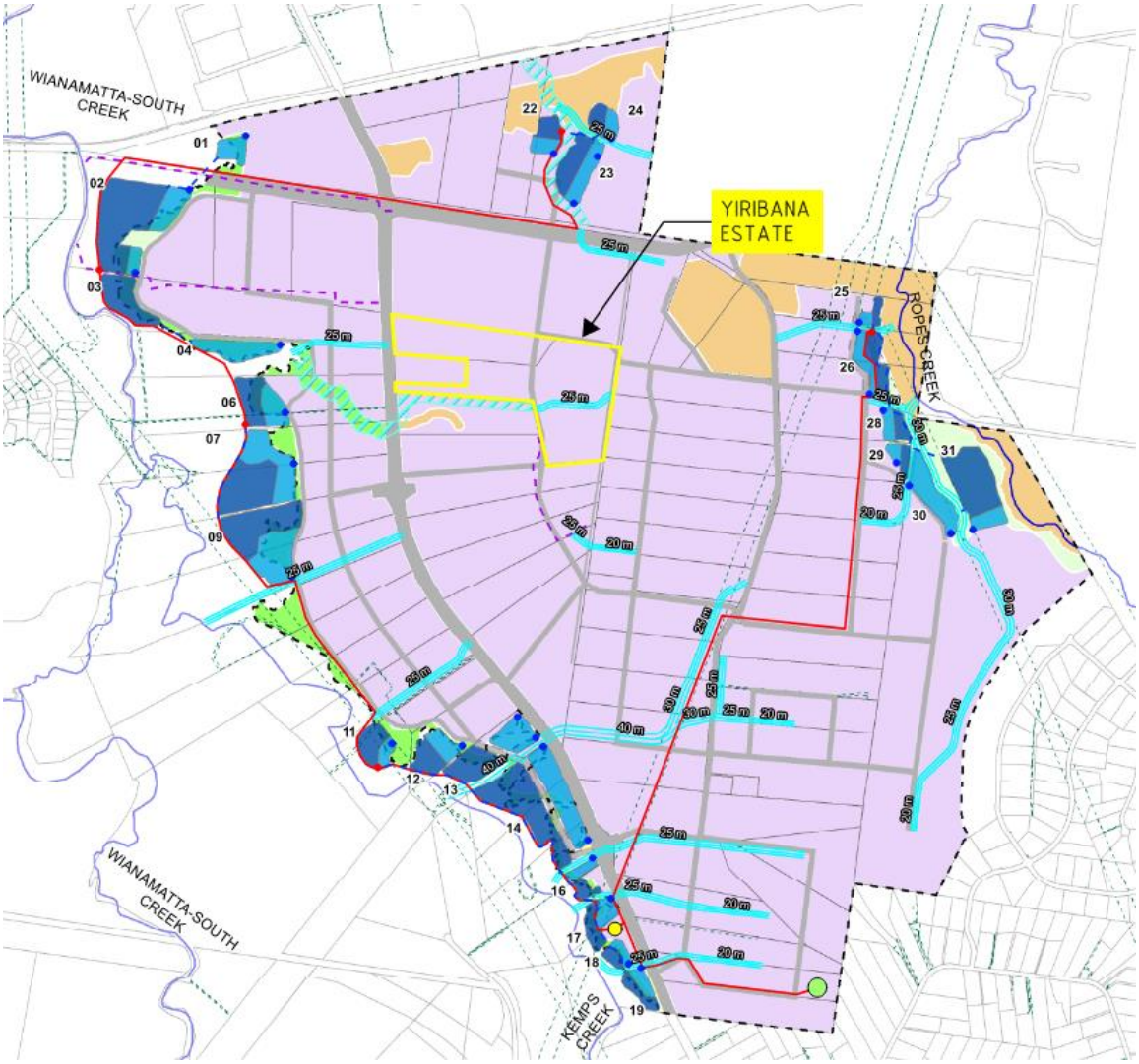

Figure 9.1. Sydney Scheme Plan and Site Location

9.2 Interim Measures

Interim Measures required to achieve MARV, FDC and water quality include:

- Temporary storages (as detailed in **Table 6.1**) including 3500m3 within Basin 1, 1000m3 within Lot 1&2 OSD tanks, 300m3 within Lot 3 tank, 300m3 of rainwater reuse in Lot 1, and 240m3 of rainwater reuse in Lot 3.
- Associated reuse systems are provided for the above storages as defined in **Section 6** of this document.

9.3 Proposed Decommissioning Concepts

We confirm the intention, that the "dead storage" within the stormwater management systems, and the associated reuse required to meet the MARV and FDC requirements at an estate level, will be made redundant.

We note that the final details of the decommissioning arrangements would need to be completed at the appropriate timeframe in and around the activation of the regional scheme by Sydney Water. It is anticipated that detailed consultation and approvals would be required at that time to enable the conversion of the system. The proposed decommissioning arrangements presented, are as such conceptual in nature.

Refer to **Figure 9.1** and **9.2** of this report which show the general concept for decommissioning of the Basin 1 system.

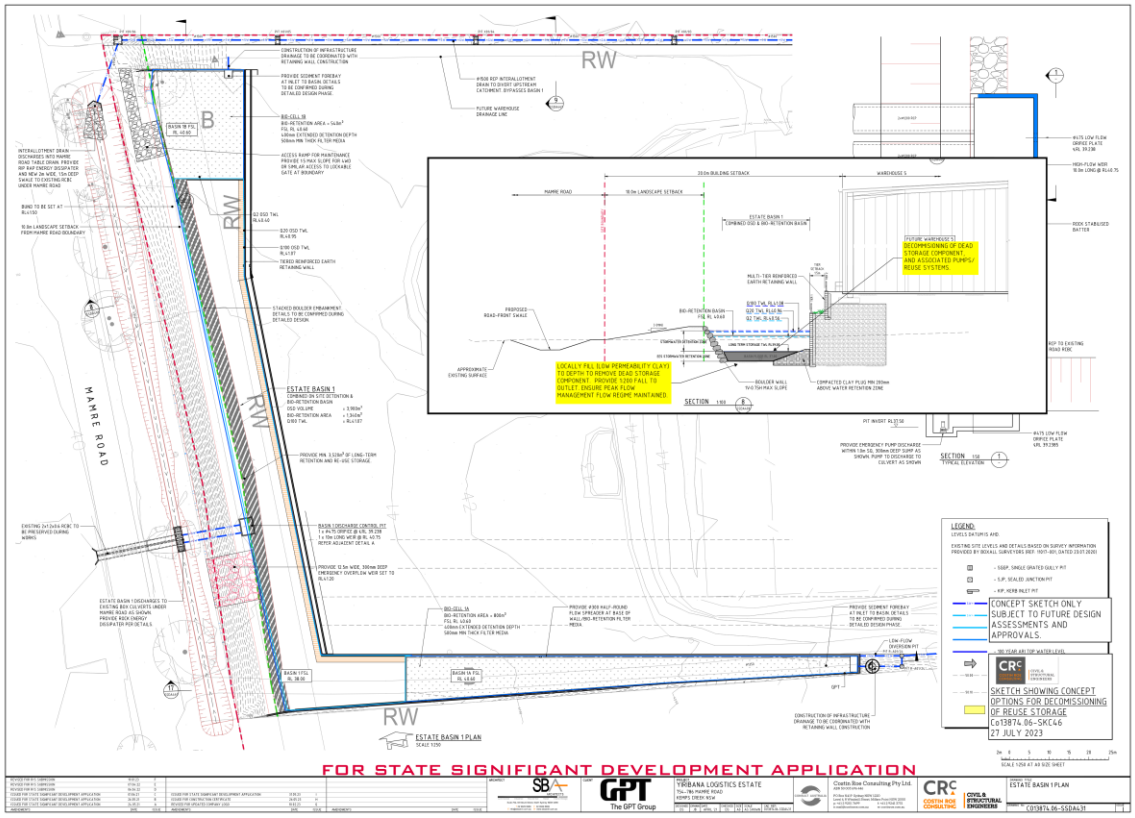

Figure 9.1. Basin 1 Decommissioning Overall Concept Sketch

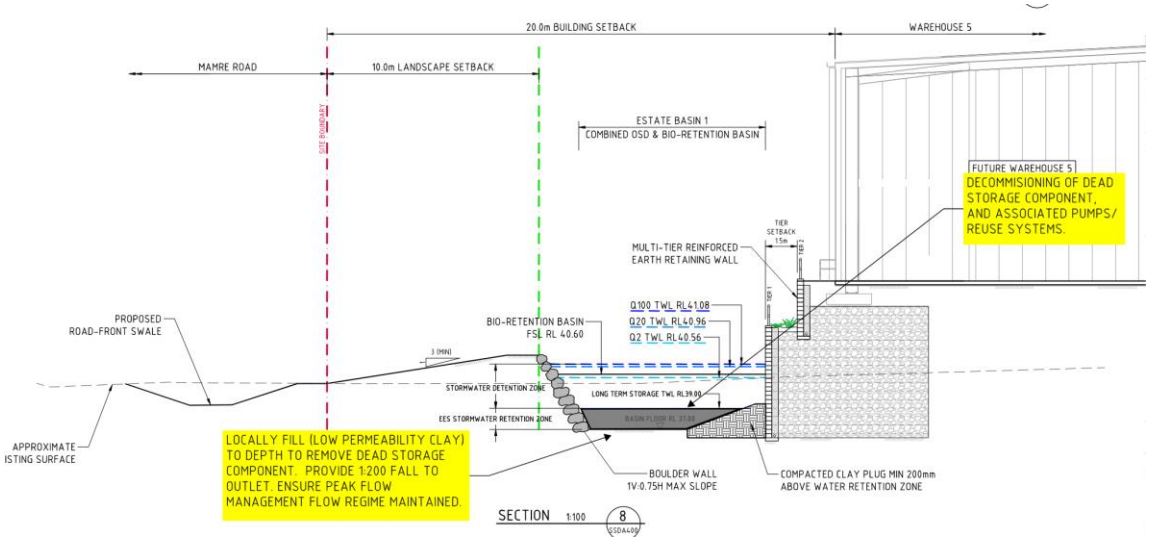

Figure 9.2. Basin 1 Decommissioning Concept Sketch

System 2 includes detention and dead storage tanks for peak flow and MARV/FDC reuse. There are two options available for the decommissioning of the system which have been provided below. Option 1 proposes relocating the discharge to the base of the tank, removing the dead storage component from the system. Option 2 includes filling the dead storage component and keeping the discharge outlet at the invert of the dead storage. Both options would necessitate the irrigation and reuse systems to be decommissioned and made redundant. Refer to **Figures 9.3** to **9.5** below.

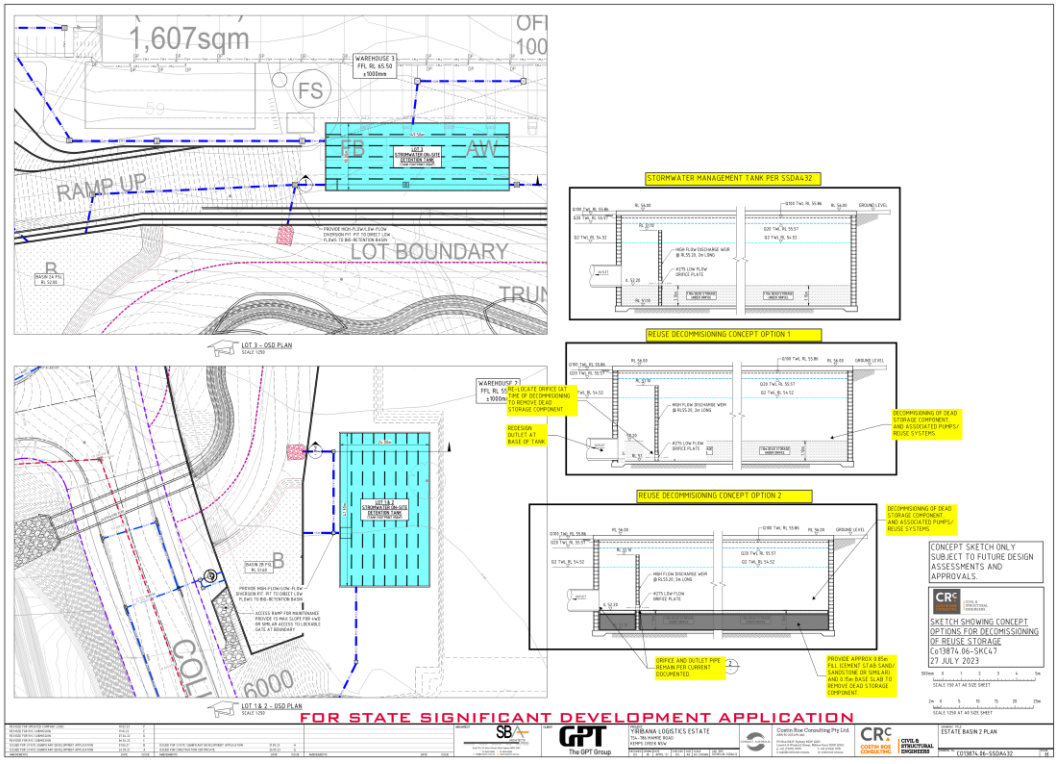

Figure 9.3. System 2A/B Decommissioning Overall Concept Sketch

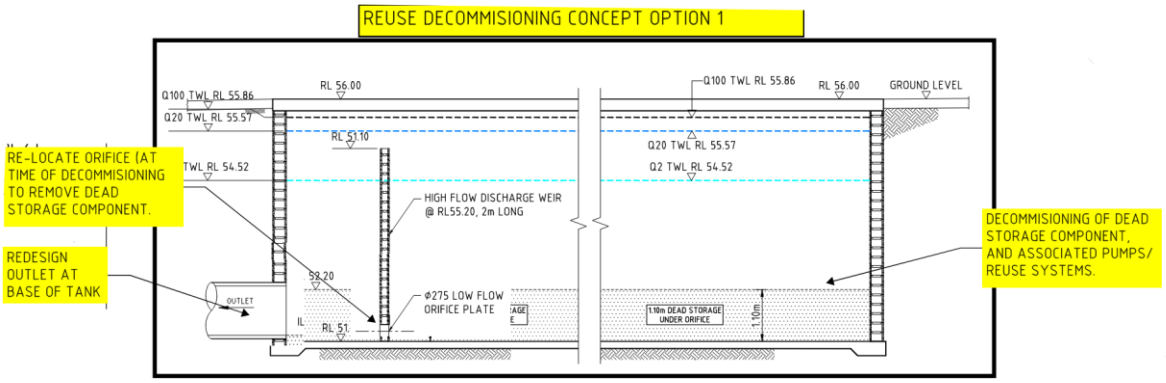

Figure 9.4. System 2A/2B Decommissioning Option 1 Concept Sketch

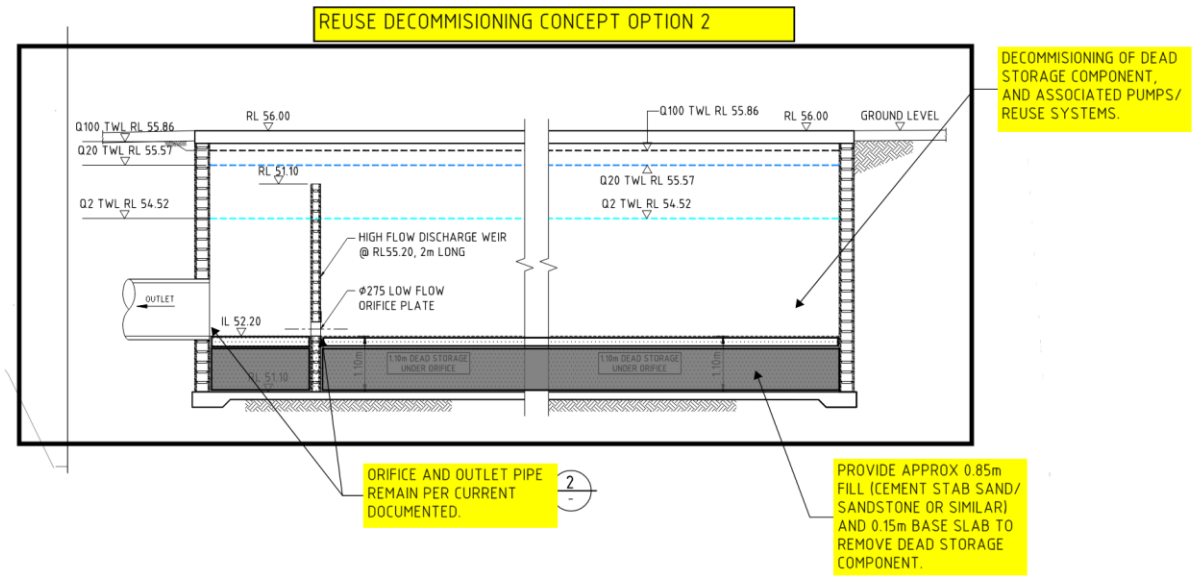

Figure 9.5. System 2A/2B Decommissioning Option 2 Concept Sketch

10 TRUNK DRAINAGE DESIGN

10.1 Trunk Drainage Introduction

With reference to **Figure 10.1** below, an existing gully/ watercourse traverses the site, carrying an upstream catchment greater than 15Ha.

The existing watercourse is noted to be a Strahler system first order watercourse, though not considered as waterfront land as defined by the Water Management Act 2000 as recognised by NSW Natural Resources Access Regulator (NRAR). This was confirmed by NRAR in a meeting held on 3 August 2020 and also in the *Cumberland Ecology* letter referenced *19200 – Let6* dated 16 July 2020.

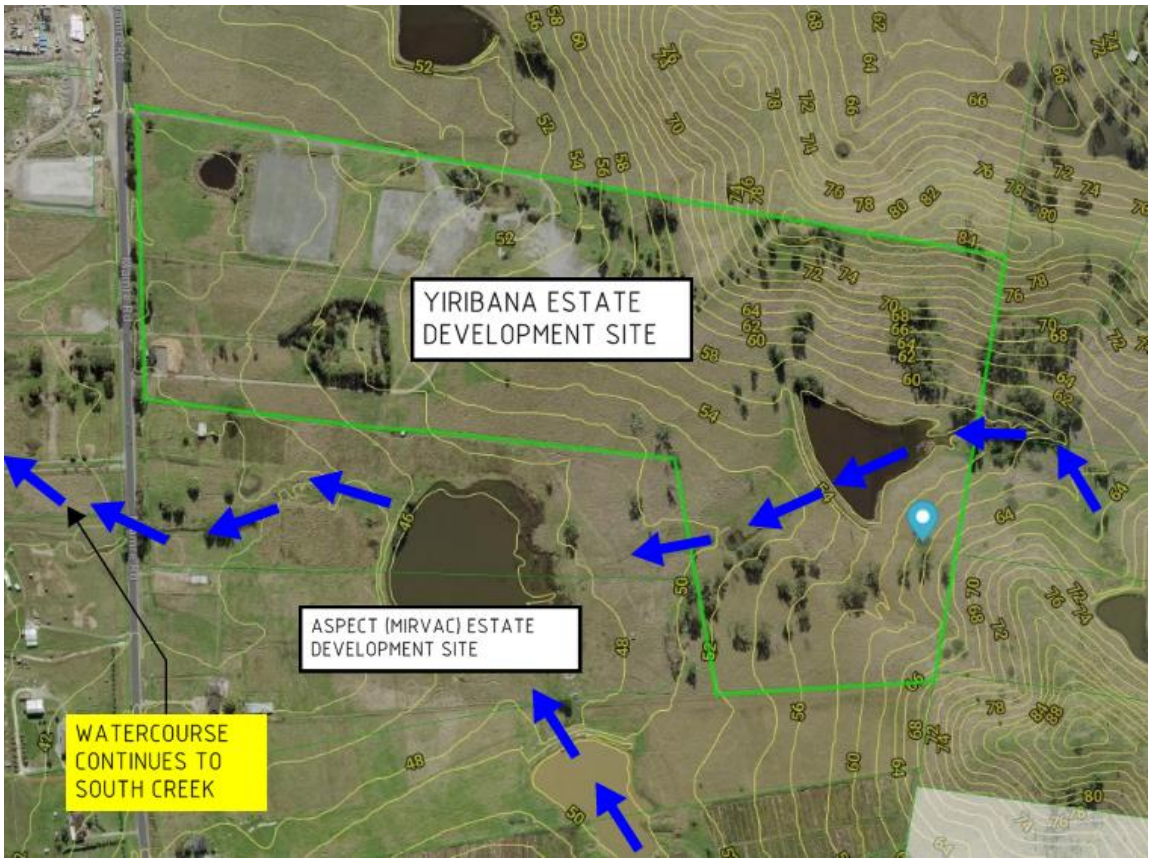

Figure 10.1. Existing Watercourse.

The watercourse is noted to have a contributing catchment of 22.2 Ha and subsequent 1% Average Exceedance Probability (AEP) design flow of approximately 7.2m^3/s. During dry weather there would be limited or no baseflow given the relatively small contributing catchment. The existing watercourse is noted to be located within land currently utilised in a rural capacity and is clear of trees, has several farm dams and limited to no ecological value, as concluded by Cumberland Ecology.

10.2 Proposed Realignment

The GPT Group has been approved to realign the watercourse as part of the development. The re-aligned drainage corridor will function as an open trunk drain which aligns with Sydney Waters Precinct Scheme Plan.

With reference to drawing **Co13874.06-TD420** in **Appendix A and Figure 10.2** below, flows from the contributing catchment are proposed to be conveyed within a new engineered, though naturalised, channel. The channel concept and a typical cross section in shown on the drawings in Appendix A, and the horizontal geometry shown in **Figure 10.2**.

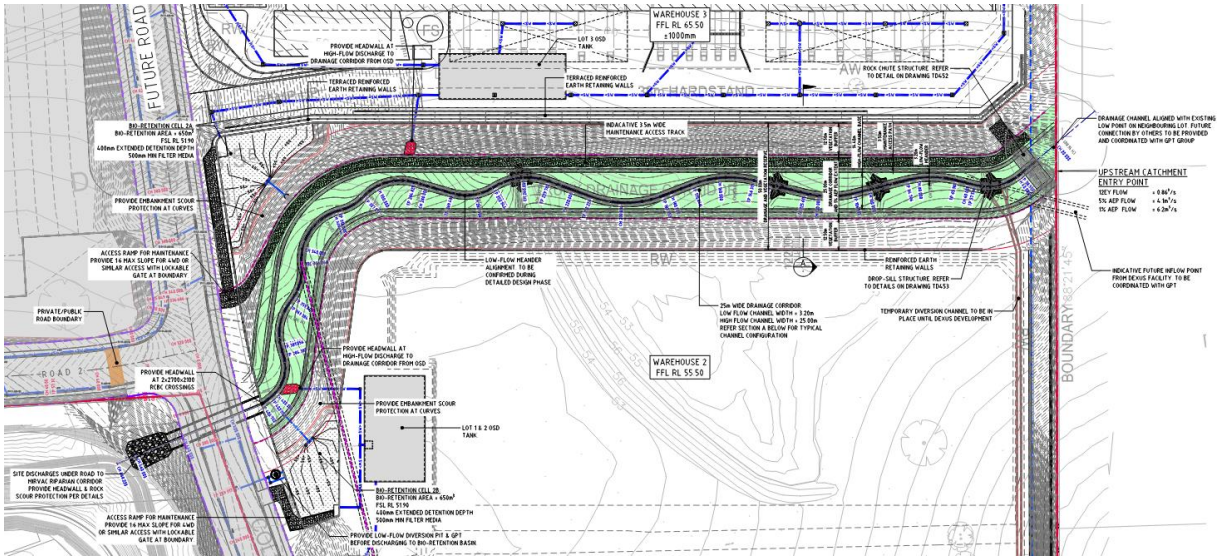

Figure 10.2. Proposed Channel Realignment

The trunk drainage cross section is based on the arrangements included in Sydney Water's *Draft Stormwater Scheme Infrastructure Design Guidelines (Dec, 2022)* and standard drawing AERO-RS1-TDC-SK01 (refer **Figure 10.4**). The arrangement, as shown in **Figure 10.3**, was agreed with Sydney Water prior to the SSDA approval, and further consulted post approval (refer **Appendix A2** and **E** for consultation with Sydney Water).

The channel cross section is noted to contain a 3.2m wide sinusoidal meandering base flow channel, a 14.4m wide low flow channel, with ephemeral planting, maintenance access and riparian edge planting zones. A total width for the corridor of 25m is proposed which includes the base channel and vegetated setbacks. The drainage corridor is also locally widened around the proposed water quality treatment basins at the downstream end of the property adjacent to the north-south road culvert crossing location.

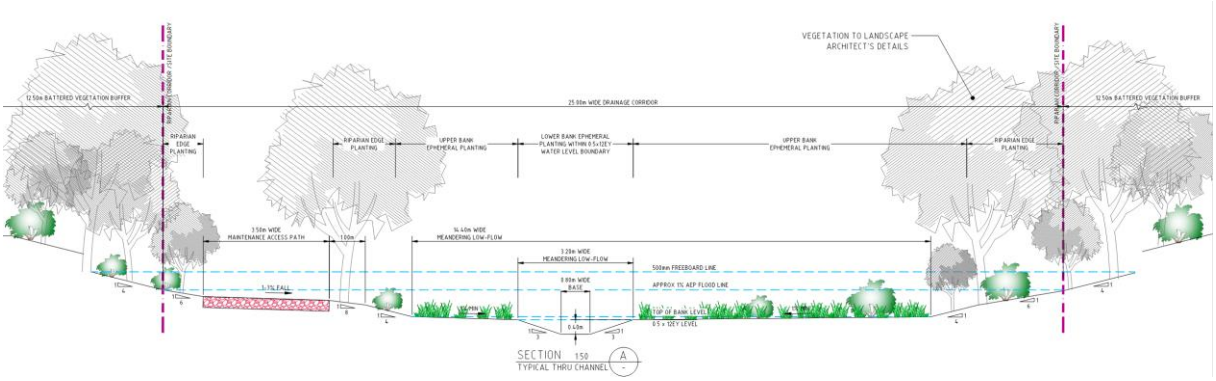

Figure 10.3. Proposed Channel Cross Section

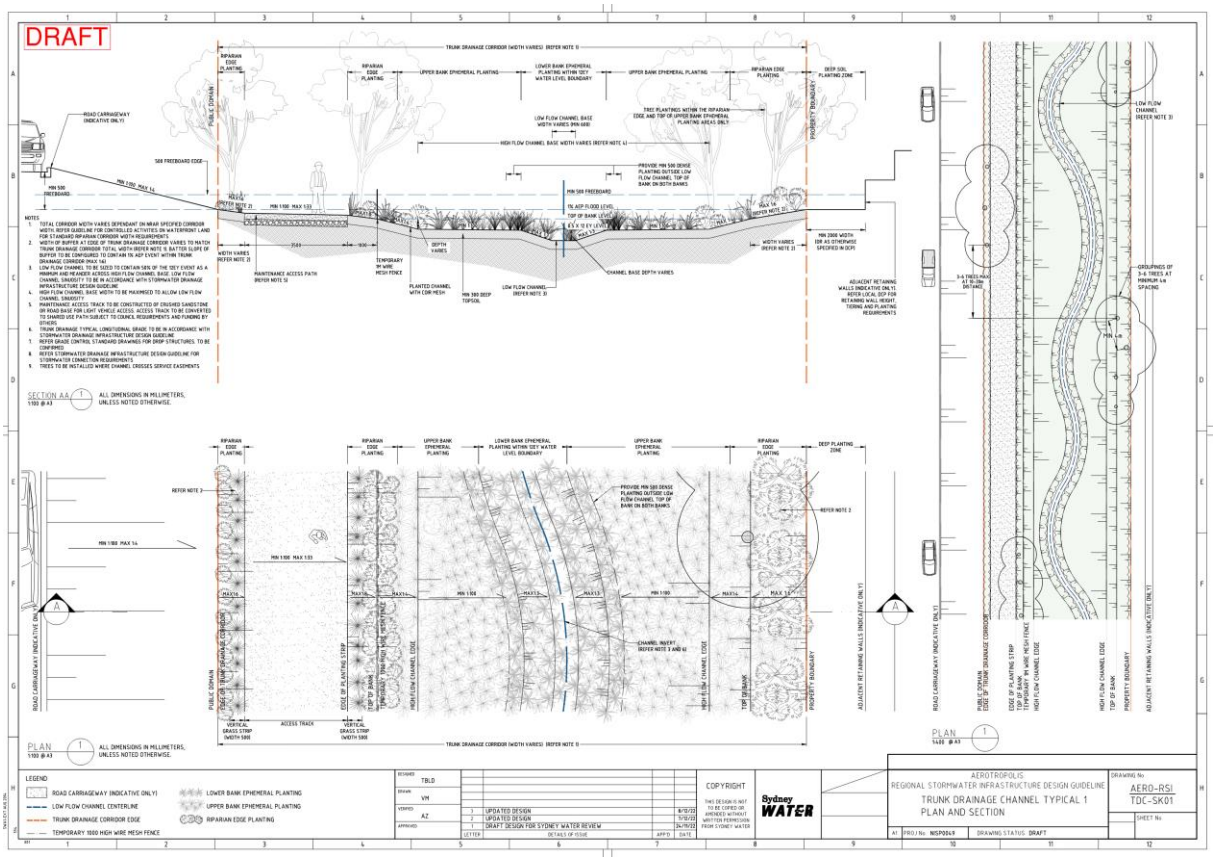

Figure 10.4. Sydney Water Trunk Drainage Standard Drawing

In relation to conveyance capacity and stormwater management, as noted above, the calculated peak flow in the 1% AEP storm event is 4.4m^3/s. This peak flow is noted to be able to be conveyed within the proposed cross section at a depth of approximately 0.8m. The design ensures that the channel is maintained with a naturalised feel, per the recommendations of the DCP and Sydney Water requirements (as confirmed in **Section 10.3**).

The initial sizing of the channel was based on a Mannings open channel assessment and the final sizing of the channel has been confirmed through TUFLOW modelling as required by Sydney Water.

Reference to the detailed TUFLOW flood modelling output included in **Appendix B1** of this report for confirmation of overland flow information pertaining to the post development flooding, hydrology and hydraulics of the watercourse. Reference to the original EIS reporting should be made pertaining to the existing overland flow conditions.

10.3 Design Requirements

Design requirements have been set by Sydney Water in their *Draft Stormwater Scheme Infrastructure Design Guidelines (Dec, 2022)*. These have been further detailed in the Sydney Water letter dated 7 November 2023 and have been outlined in **Table 10.1** below.

Table 10.1. Sydney Water Design Requirements

No.	Item	Response
1	Proposed naturalised trunk drainage design must adhere to the design guidelines provided in Sydney Water's Draft Stormwater Scheme Infrastructure Design Guidelines (Dec, 2022).	The trunk drainage design has been completed in accordance with the noted document, and in consultation with Sydney Water.
2	The drawings for naturalised trunk drainage must demonstrate how the waterway integrates functionally into the surrounding development area and with existing surface levels downstream of the development site.	The design matches proposes to match the existing level and watercourse alignment at the upstream inflow point. At the downstream discharge point, the design matches that of the Mirvac Aspect Estate (in the location agreed with Mirvac) within their trunk drainage system. We note the Mirvac trunk drainage is currently being constructed. It is not applicable to match existing levels at the downstream discharge point noting the discharge to Mirvac trunk drainage system. Refer to long section on drawing **Co13874.06-TD420**.
3	As the proposal affects trunk drainage alignments upstream and downstream of the site, all drawings (as specified below) must demonstrate functional design	Refer to Item 2 response.

No.	Item	Response
	resolution of the full interface with the proposed channels.	
4	Plan drawings must show: • Alignment and relationship to adjacent development (including upstream and downstream of the subject site) • Corridor width per the approved plans. • Low flow channel alignment showing sinuosity per guidelines. • Interface with any service utilities (note that sections must be provided where services intersect/run parallel within the trunk drainage corridor to demonstrate feasibility) • Indicative location of any proposed instream features e.g. Drop structures. • Location of proposed waterway crossings/paths/other social amenity features • Location of proposed access location and maintenance tracks including demonstration that max grades will not be exceeded, typically not to exceed 1:6 for SWC maintenance vehicles • Location of proposed stormwater connections to the naturalised trunk drainage • Location and spot heights of any retaining wall structures proposed along the corridor (these are to be minimised).	The plan drawings **Co13874.06-TD420** show: • The Alignment and relationship to adjacent development as noted in Response **Item 2**. • A Corridor width of 25m. • A Low flow channel alignment showing sinuosity of 1.06 and a minimum radius of 15m (per guidelines). • Interface service utilities • location of proposed Drop structures and stilling ponds. • There are no social amenity features associated with the watercourse. • Location of proposed access location and maintenance tracks on the northern side of the corridor, with connection to the north-south road, as agreed with Sydney Water. The cross section demonstrates a cross fall of 3% and maximum longitudinal grade of below 1:6. • Location of proposed stormwater connections to the naturalised trunk drainage, noting two discharges from development lots and from upstream catchments. • There are no walls proposed within the trunk drainage corridor. The location and spot heights of any retaining wall structures proposed adjacent to the corridor have been shown on the plans.
5	Cross sections • Cross sections of the trunk drainage channel to demonstrate the functional placement of the feature in the developed landscape, including adjacent property where the boundary is shared.	The cross section drawings **Co13874.06-TD431 & TD432** show: • Typical and detailed cross sections of the trunk drainage channel have been provided to demonstrate the functional arrangement

No.	Item	Response
	• Cross sections should generally be provided at maximum 25m intervals or as required to highlight significant changes in site grades, alignment and any atypical situations. • Cross sections should show 'worst case situations' e.g. where retaining walls are unavoidable/highest point of a proposed retaining wall. Where necessary, cross sections should also be provided where services are proposed across the channel. • Cross sections must extend beyond the channel boundaries to show the proposed interface with development adjacent the trunk drainage corridor. • Where the proposed channel is higher than adjacent land details will be provided to demonstrated how this land will be drained without causing unnatural ponding on the land. • Cross sections must show adherence to the typical detail for naturalised trunk drainage (compound channel) as provided in Appendix A of the Draft Stormwater Scheme Infrastructure Design Guideline (Dec, 2022).	• Detailed cross sections have been provided at 25m intervals, and at key locations along the system • Cross sections show 'worst case situations' • The cross sections extend beyond the channel boundaries a distance of 20m. • There are no instances where the proposed channel is higher than adjacent land. • Cross sections show adherence to the typical detail as demonstrated in **Figures 10.3** and **10.4**.
6	Long sections • Long sections of trunk drainage channel inverts and top of bank along each reach that demonstrate adherence to max grades and/or inclusion of drop structures as required. • Long sections must demonstrate tie in with critical points i.e. existing grades at upstream and downstream points of the development. • Long sections should include any proposed major infrastructure crossing or parallel with trunk drainage within the corridor. • Pipe longsections for lines connecting to the trunk drainage channels.	The long section drawings **Co13874.06-TD430** show: • channel inverts and top of bank. • tie in with critical points at the upstream and downstream, including culvert arrangements. • The Long sections include proposed major infrastructure crossing (ie.e the culvert crossing the north-south road). • Pipe longsections for lines connecting to the trunk drainage channels have been included.

No.	Item	Response
Modelling Requirements		
	Hydrological Modelling	
7	Acceptable digital hydrologic methods are runoff routing, storage routing and time area models such as XP-Rafts, RORB, WBNM and Drains (ILSAX). Use of the Rational Method is not appropriate.	RAFTS has been adopted for hydrological assessments. Rational Method has not been used for hydrological assessments.
8	ARR2019 methodology and rainfall data shall be used to assess the 5%, 1%, 0.2% AEP and PMF flowrates, although when assessing the function of the low flow channel more frequent storm events will be required. This can vary, depending on location in the catchment but will typically fall between the 12EY and 4EY critical events.	Modelling of the noted storms has been completed. The modelling includes the 4EY event for the low flow assessments.
9	Use IL/CL loss model Rural Pervious IL 37.1mm CL 0.94mm Developed Pervious IL 14.8mm CL 0.94mm Impervious (All) IL 1.0 mm CL 0 mm	The developed conditions have been adopted in the design RAFTS model, noting the developed upstream conditions provide the most conservative assessments.
10	Where the time of concentration is required, the minimum time is 5 minutes with a maximum of 20 minutes, noting that times over 14 minutes will require justification. Use of the Kinematic Wave equation is limited to flow paths no longer than 30m and shall be over surfaces that are homogeneous in roughness and grade.	The hydrological assessment of the contributing catchments utilising a RAFTS model. The time of concentration is not an input parameter of the RAFTS modelling and has not been included as part of hydrological assessment. The RAFTS model has been calibrated to the flow values as per agreed with John Molteno from Sydney Water in email correspondence dated 28/11/23.
11	Accurately drawn catchment sketches will be provided that show the natural catchments with the developed catchment overlaid, with clear definition between them. Each catchment area and changes between natural and developed to be tabulated on the sketch.	Catchment plans for pre and post have been included as drawings **Co13874.06-TD401** and **TD402** respectively.

No.	Item	Response
12	To facilitate effective operation of the Scheme Plan, wetlands and storage ponds, catchments cannot be varied by more than ±10% of their area as shown in the Sydney Water wetland catchments layer.	The catchments are within the noted 10% threshold.
13	Critical 1% AEP hydrographs shall be provided at site upstream and downstream locations with the developed site hydrograph superimposed over the existing site hydrograph. Given the requirement of onsite stormwater detention, upstream developed catchment hydrographs cannot be assumed to match the natural hydrograph due to the additional volume of runoff generated by urbanisation. This information will be utilised in assessing any cumulative impacts of OSD.	As per email correspondence with John Molteno dated 28/11/23, this is not required as the upstream pre-development sub-catchment runoff has been modelled equal to the upstream post development sub-catchment runoff and the assessment of attenuated post development upstream sub-catchments should only apply further downstream where various OSD solutions in the precinct may have a cumulative influence on the sizing of the trunk drainage channels.
	Hydraulic Modelling	
14	The hydraulic operation of the trunk drainage system is important for the safety of the area being developed as well as for achieving the environmental, cultural and stream health benefits. Applying current best practice is a prerequisite to achieving sustainable and effective naturalised trunk drainage.	The hydraulic assessments of the trunk drainage has been based on the requirements of Sydney Water and industry best practice.
15	Before final endorsement of any proposal, all flow paths and channels shall be modelled using industry standard 1D/2D models refined to a suitable resolution to define flood flow extents and provide accurate shear force representations. Acceptable hydraulic modelling software is TUFLOW, HEC-RAS 2D and Mike-21. Other software may be permissible but should be referred to the Regional Stormwater Authority before establishing the model.	Modelling has been completed using TUFLOW.

No.	Item	Response
16	It is recommended that initial channel sizing justification could be undertaken using basic Mannings models with reference to the standard drawings in the Draft Stormwater Scheme Infrastructure Design Guideline (Dec, 2022). This publication also provides acceptable channel roughness values, grades and sinuosity requirements.	The initial sizing of the system was checked with Mannings open channel calculation as part of the initial consultation with Sydney Water, as included in Appendix 3 of the SSD approval.
17	As a minimum, trunk drainage channels shall be modelled using 5%, 1%, 0.2% AEP and PMF critical flows of the developed catchment. As described above, additional frequent flows are required to assess shear forces within the low flow channels. Shear flow modelling is only required for the developed case with the whole channel assessed using the 5% and 1% AEP critical flows.	Noted.
18	Drop structures must be supported by hydraulic modelling or calculations. Sydney Water's preferences are as follows: Chutes – Chute (eWater), Hec-Ras (1D) or industry standard rock sizing calculations for chutes. Vertical drop structures - Hec-Ras (1D)	Rock sizing has been completed using Browns equation for the relevant velocity and a FOS of 2.
19	Result mapping of the channels shall show: • flood extents and velocities for 1%, 0.2% AEP and PMF flood extents. • flood planning area i.e. the area below the flood planning level. • flood hazard and the flood constraints that apply to the land – utilising ARR 2019 hazard definitions. • model topographical roughness mapping. • where naturalised channels interface with major creek systems hydraulic categories shall be mapped to ensure mainstream flood conditions are not adversely impacted.	The result mapping has confirmed all of the noted conditions. Refer to the EIS document should be made for roughness mapping.

No.	Item	Response
20	Climate change design flood modelling sensitivity analysis comparing the 0.2% AEP flood event as a proxy for assessing sensitivity to an increase in rainfall intensity of flood producing rainfall events due to climate change.	Noted.
21	Street/site drainage, that connects to the trunk drainage, shall be modelled to ensure that it is not adversely impacted by 1% AEP critical flows in the trunk drainage channels. Points of connection shall be minimised with typical connection points on the downstream side of road crossings. On-grade pit inlet capacities should be carefully assessed as most "real life" kerb inlets have limited capacity, often not reflected in the curves provided in hydraulic models.	Noted.

11 FLOODING AND OVERLAND FLOW

11.1 Introduction

The site has been identified by Penrith City Council as being affected by overland flow from the existing gully and series of farm dams on the north-east of the property

We note that the site is clear of the South Creek Floodplain however the site contributes to one of the sub-catchments of South Creek and ultimately runoff from the property drains to South Creek.

An overland flow and flood assessment has been completed for the development approval submission in relation to the north-eastern flow path. The following sections of the report describe the catchment description, flood description and proposed flood management.

Detailed technical information pertaining to the TUFLOW modelling and output completed by our office is included in **Appendix B1**

11.2 Catchment Description & Existing Flood Behaviour

The contributing upstream catchment to the east is approximately 22.26Ha and is shown below in **Figure 11.1** and as **Figure 11.2**. A smaller catchment of approximately 20.12Ha enters the site from the north.

The catchment comprises rural land use and >90% pervious surfaces. Future development is noted to require detention and as such has been modelled as per existing impervious surface breakdown.

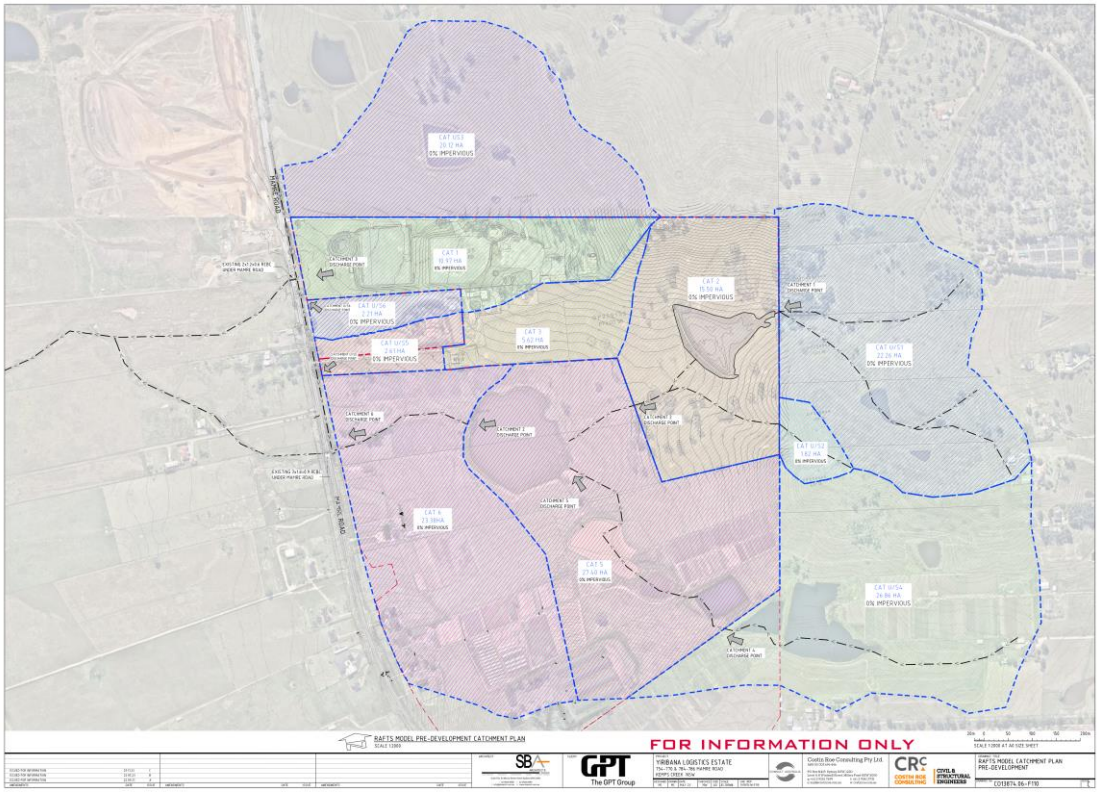

Figure 11.1. Pre-Development Contributing Catchment and Flow Paths.

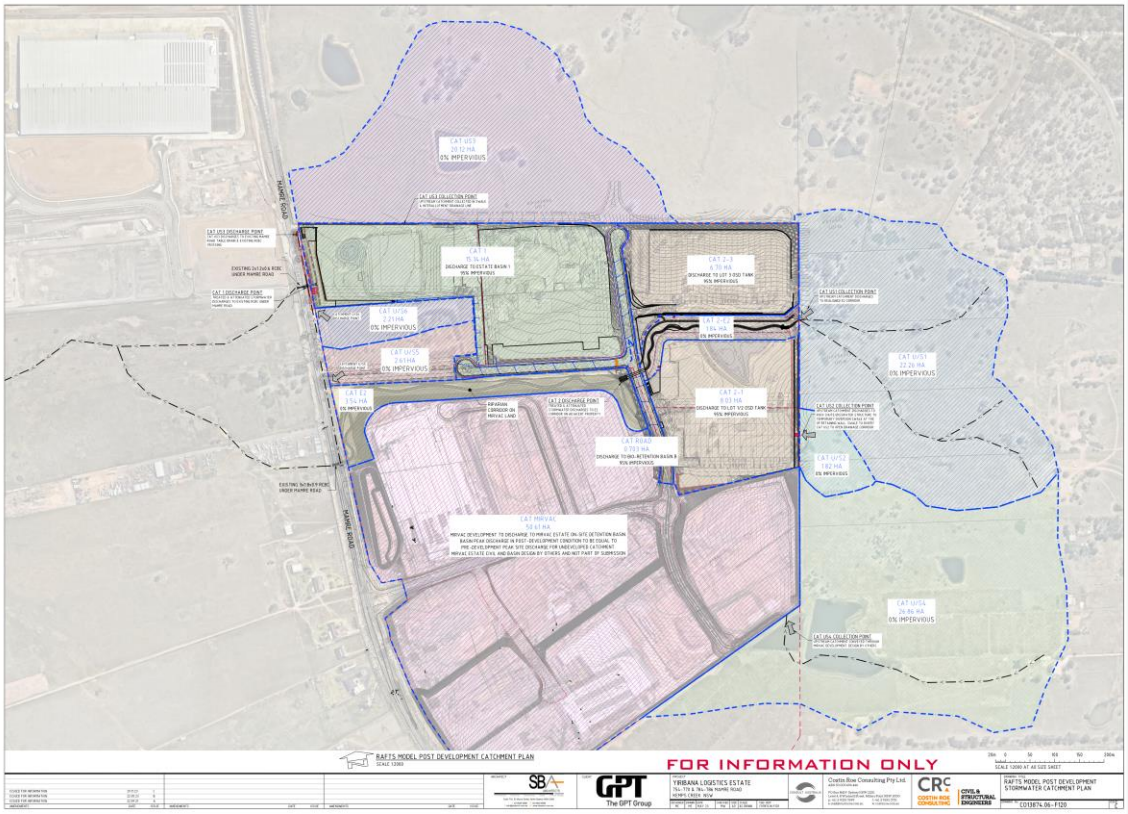

Figure 11.2. Post-Development Contributing Catchment and Flow Paths.

Penrith Council is noted to have undertaken a regional assessment of local tributaries Penrith Overland Flow "*Overview Study – Flood Analysis for Central Urban (Zone 1), Northern Rural (Zone 2), Southern Rural (Zone 3)*" – Cardno 2006. The site is located within the Southern Rural (Zone 3) and an excerpt of the flood model output is shown in **Figure 11.3**. Councils' assessment shows overland flow is present along the series of farm dams in the north-eastern corner of the property. The modelling shows the flood extent to be limited to the gully and dams only, and not extending to areas away from the local watercourse. The area shown on the southern portion of the site as being flood affected in the PMF event is noted to comprise a farm dam only which is fully within the proposed development extent and as such has not been included in the current overland flow assessment.

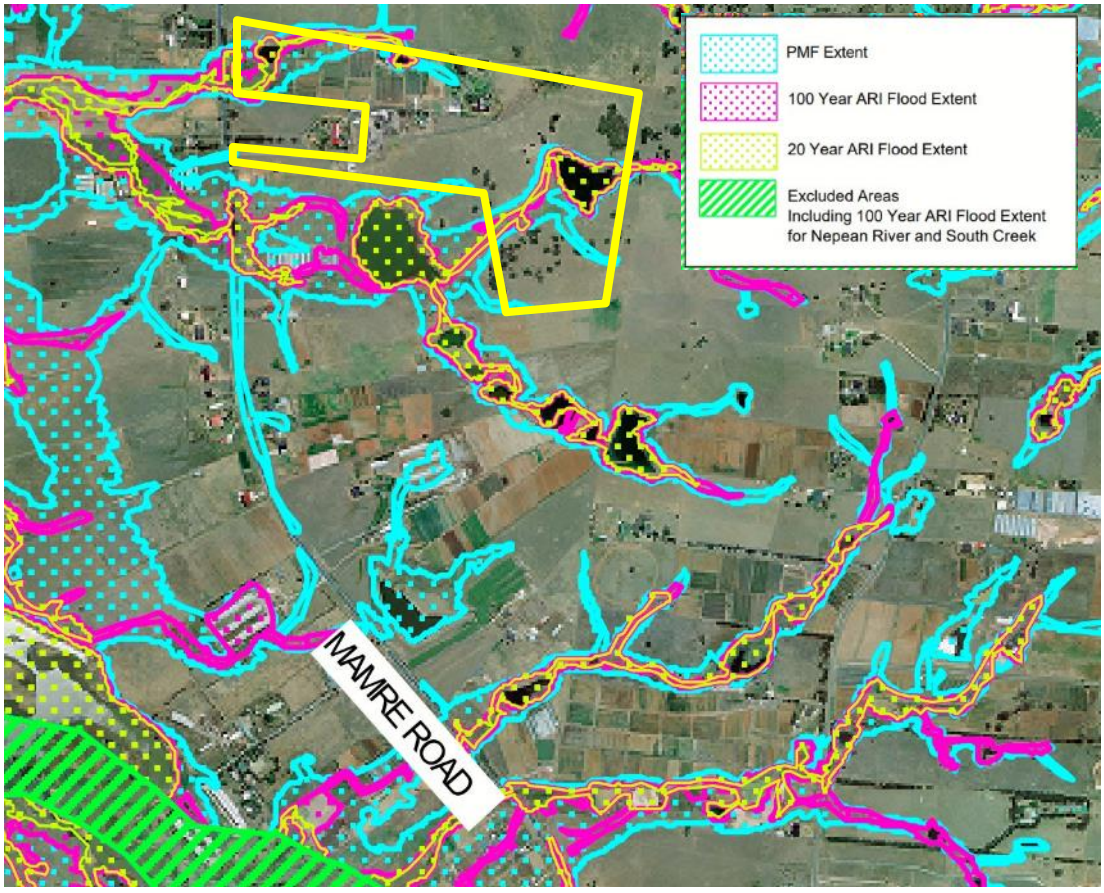

Figure 11.3. Excerpt of Figure 6.1k of Cardno 2006 Study

11.3 Proposed Overland Flow Management Strategy

Council requires an assessment of the pre and post development overland flow conditions for the 1% AEP storm event. Further that the overland flow from the upstream catchment is able to be conveyed through the site without affection of upstream, downstream or adjacent properties in the 1% AEP.

A TUFLOW model has been prepared for the assessment as set out in the following sections of the report. The proposed management strategy involves conveying overland flow from the eastern contributing through the development site within an open channel in the realigned drainage corridor (as discussed in Section 10) and the northern catchment to be drained via an inter-allotment pipe (subject to the final agreed drainage with the northern property developer.

11.4 Costin Roe Consulting Modelling

11.4.1 Introduction

A detailed site specific TUFLOW model of the pre and post development conditions has been completed by Costin Roe Consulting. The assessment being completed with consideration to BCC policy and the *NSW Floodplain Development Manual*. Technical parameters and detail included in the TUFLOW model are included as **Appendix B1.**

The pre-developed model has been prepared utilising the flood levels and hydrographs as completed by our office, with introduction of the proposed stage 1 development proposed by Mirvac in the post development conditions, in addition to the proposed GPT Group development layout. Validation of modelling was completed with comparison to Councils 2006 flood assessment.

11.4.2 Pre-Development 1% AEP

Reference to **Figure 11.4** shows the pre-developed 1% AEP output for depth and levels. **Figure 11.5** shows velocity and **Figure 11.6** show true hazard categorisation.

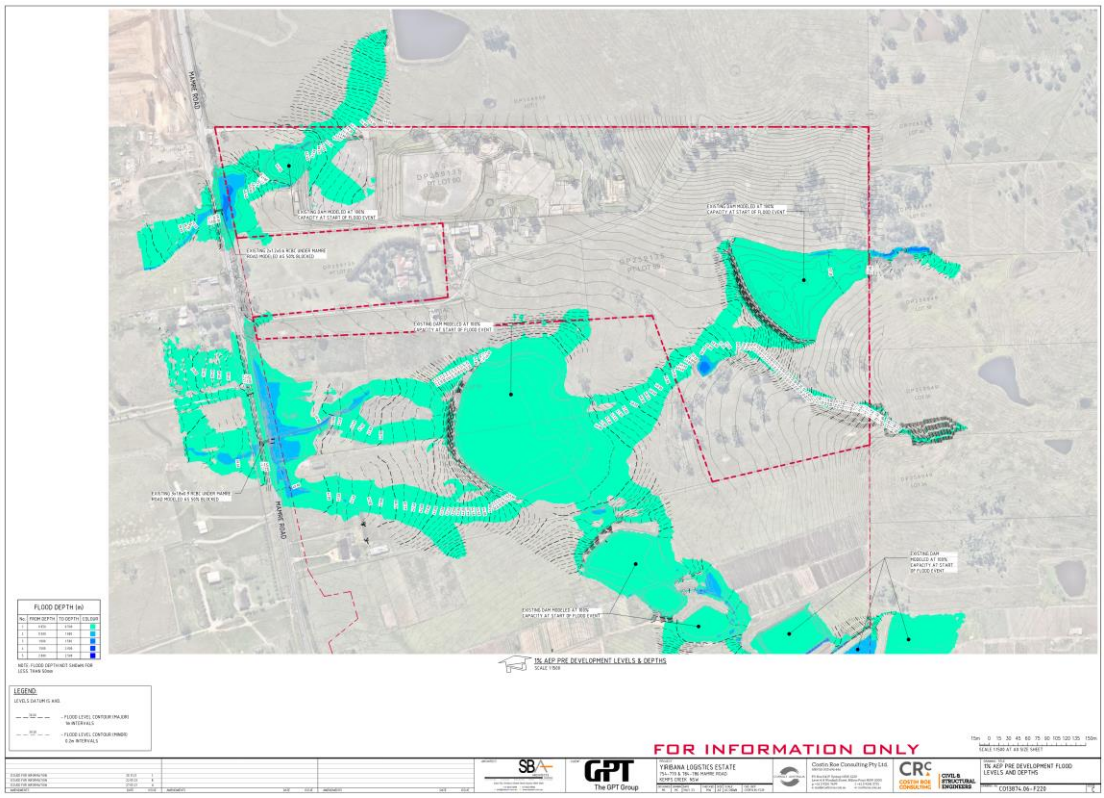

Figure 11.4: 1% AEP Pre-developed Level and Depth Output

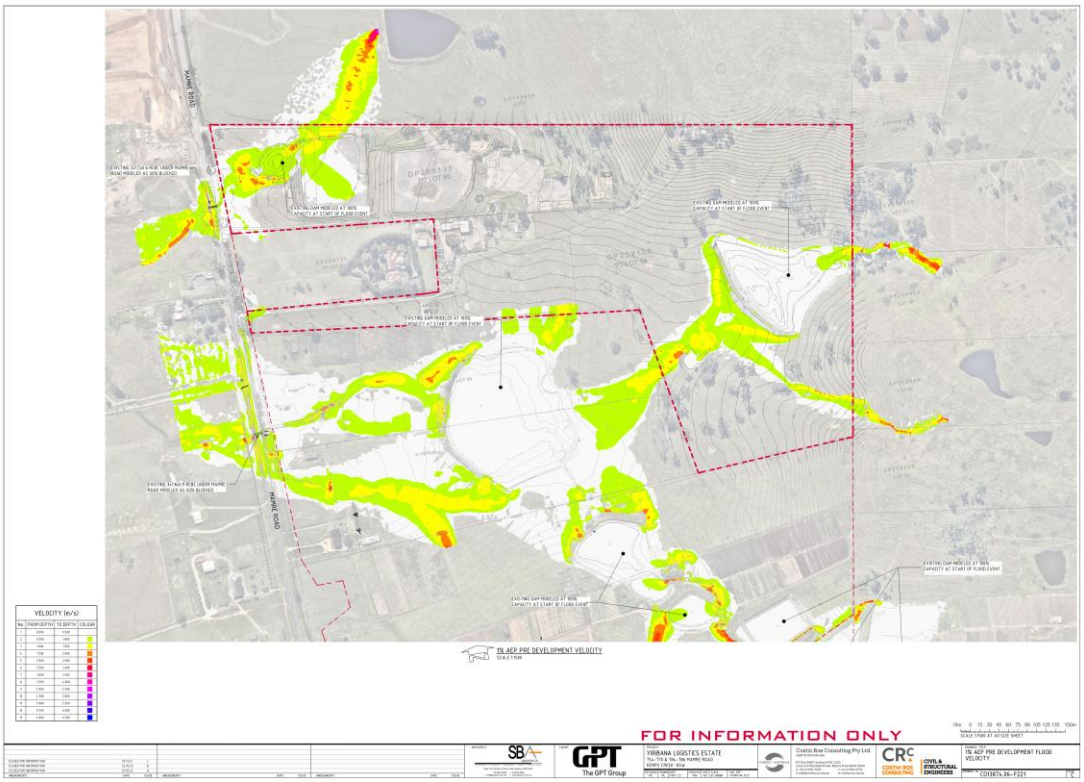

Figure 11.5: 1% AEP Pre-developed Velocity

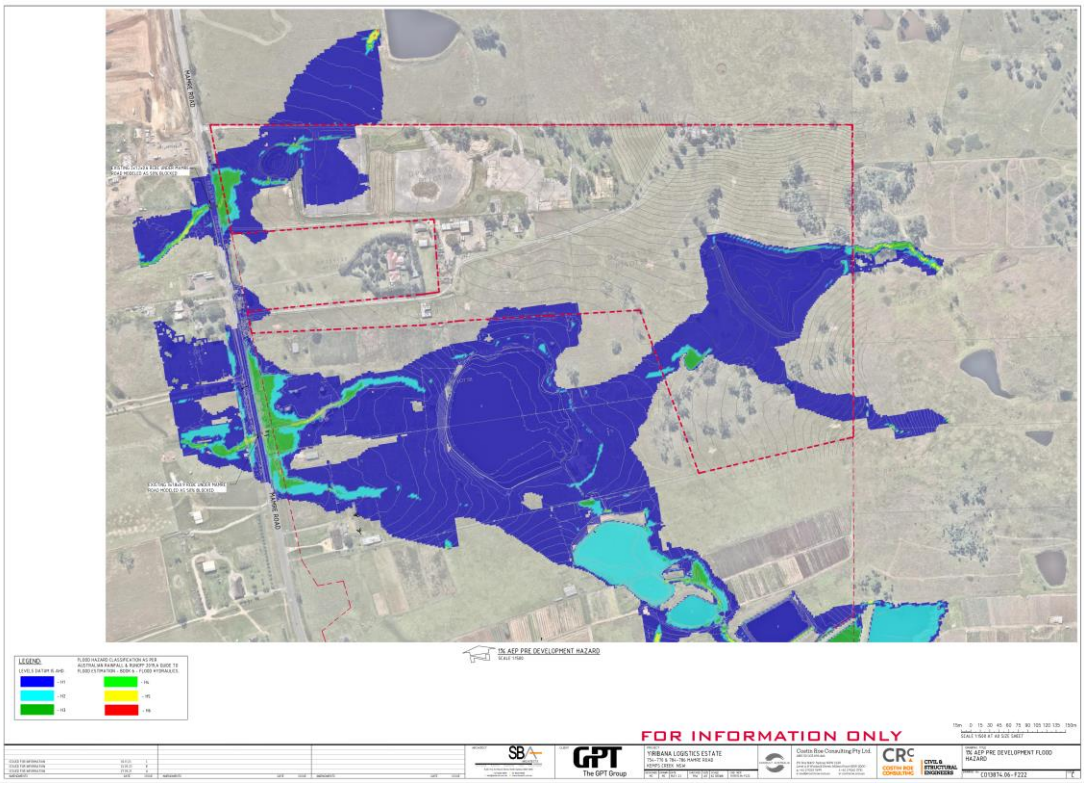

Figure 11.6: 1% AEP Pre-developed Flood Hazard Categorisation

11.4.3 Post-Development 1% AEP

Reference to **Figure 11.7** shows the post-developed 1% AEP output for depth and levels. **Figure 11.8** shows velocity and **Figure 11.9** show true hazard categorisation.

Further figures for the proposed realignment of the trunk drainage channel are provided in **Figures 11.10, 11.11 and 11.12.**

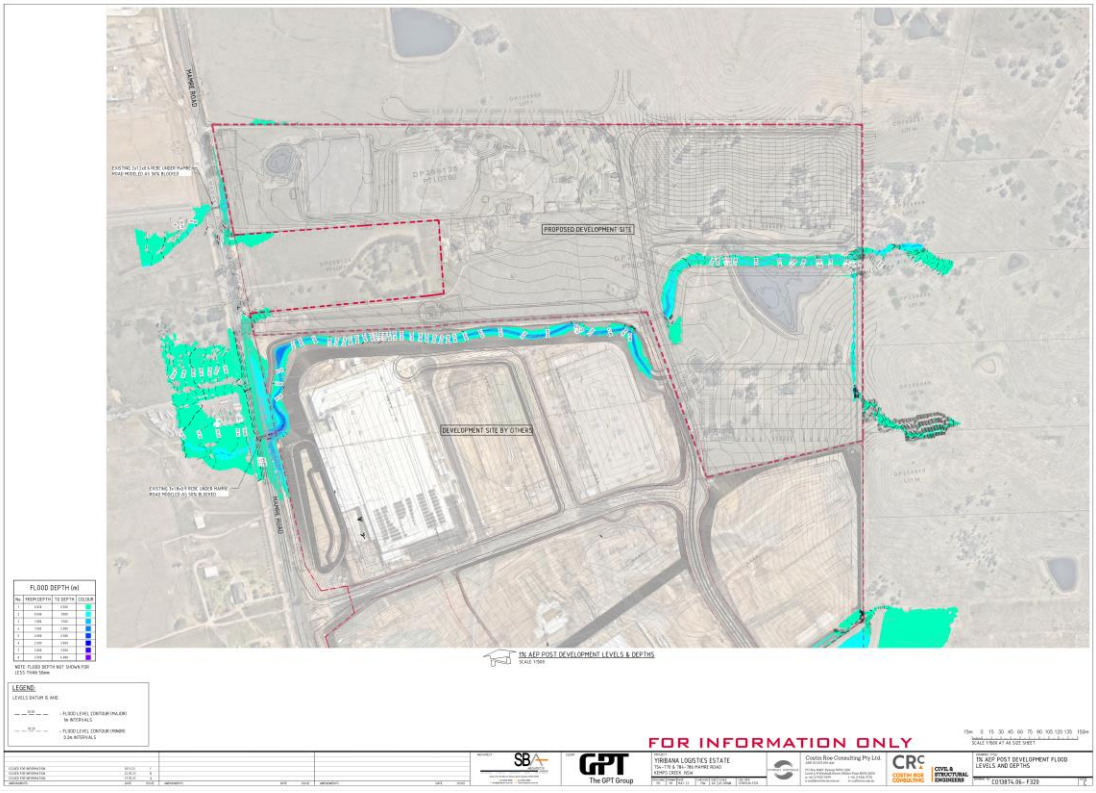

Figure 11.7: 1% AEP Post-developed Level and Depth Output

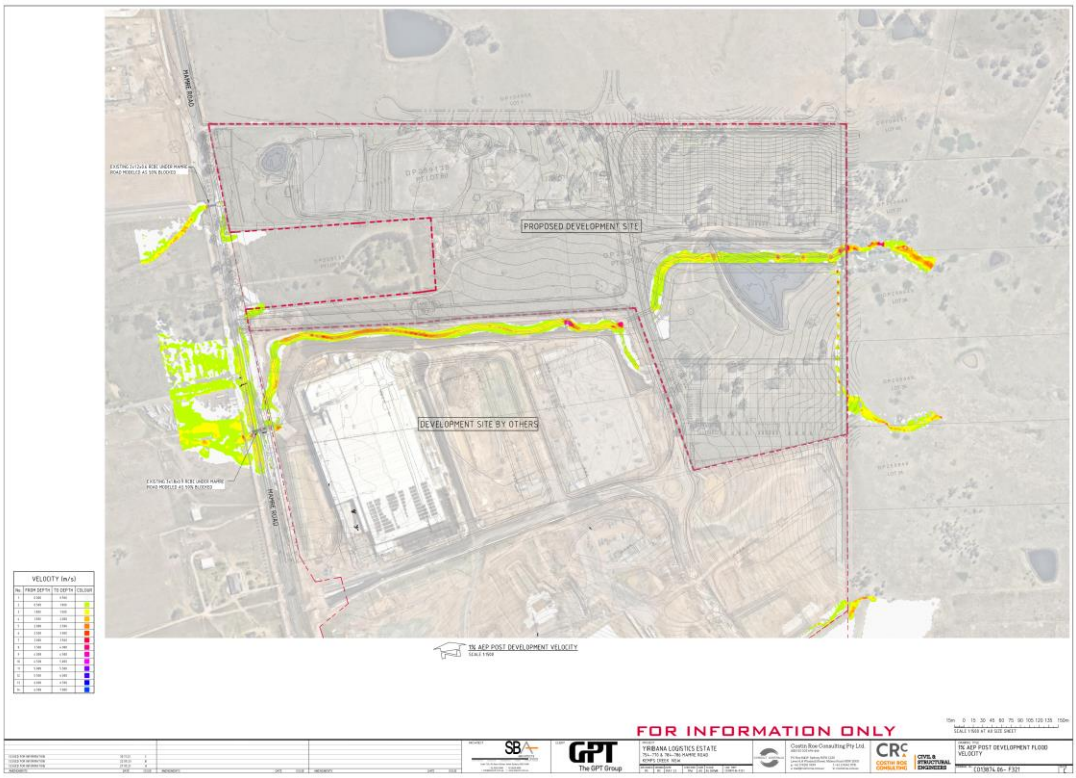

Figure 11.8: 1% AEP Post-developed Velocity

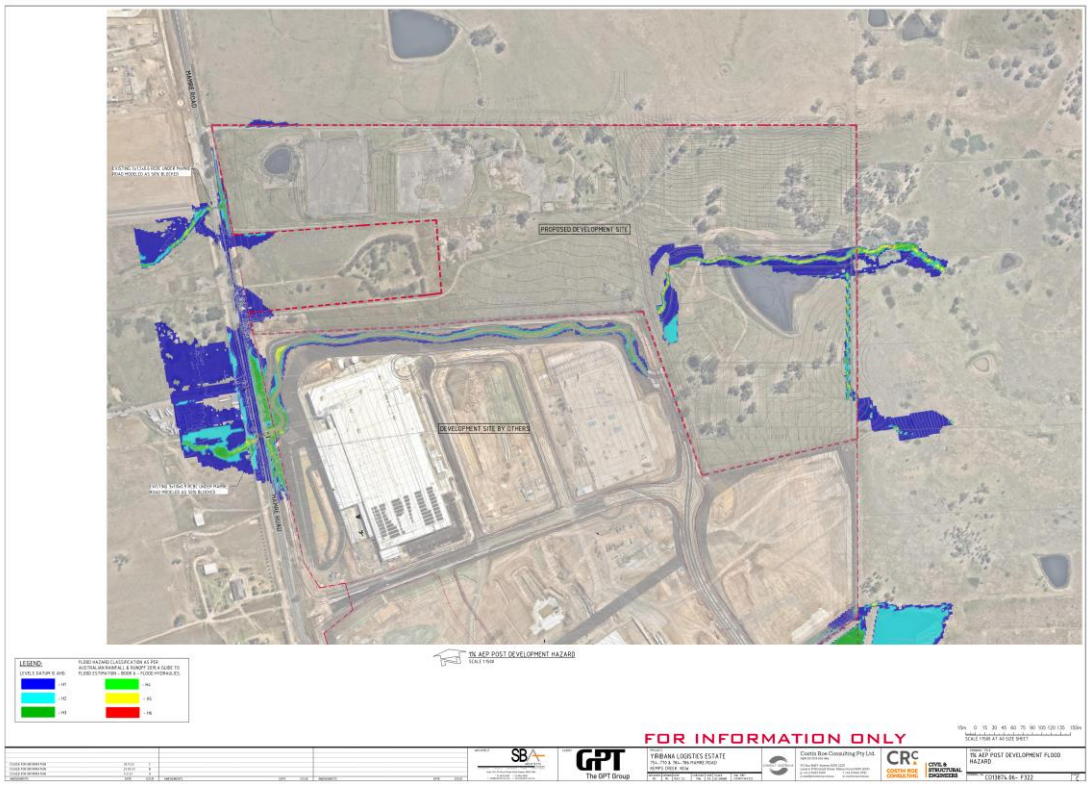

Figure 11.9: 1% AEP Post-developed Flood Hazard Categorisation

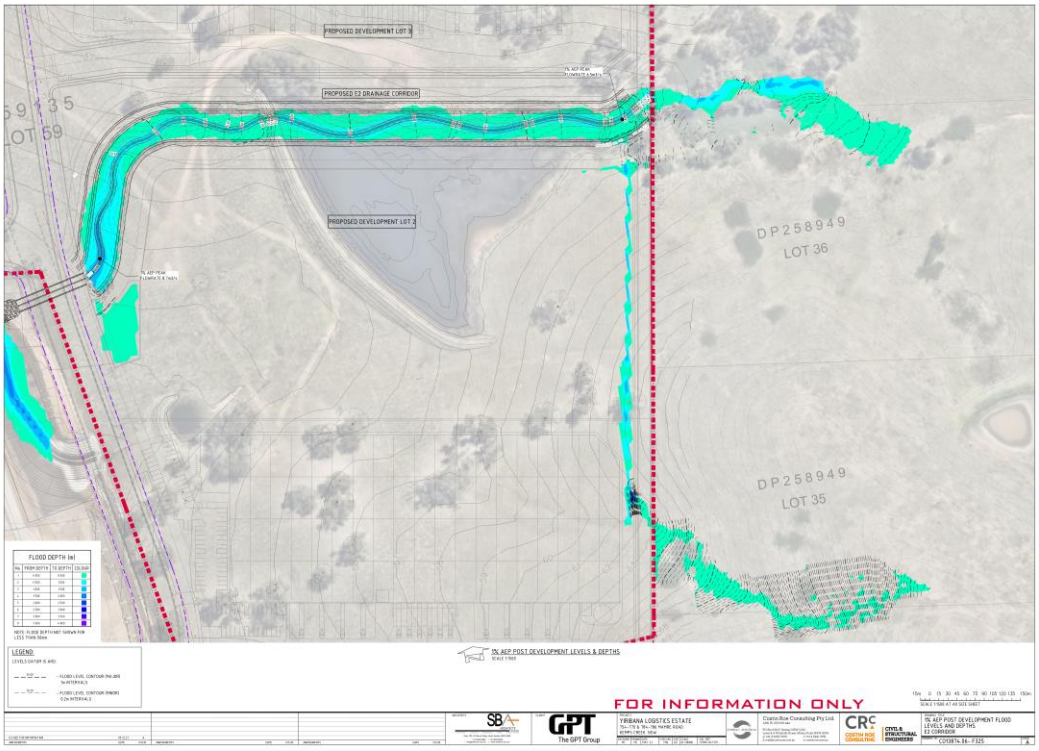

Figure 11.10: 1% AEP Post-developed Level and Depth Output – Drainage Corridor Realignment

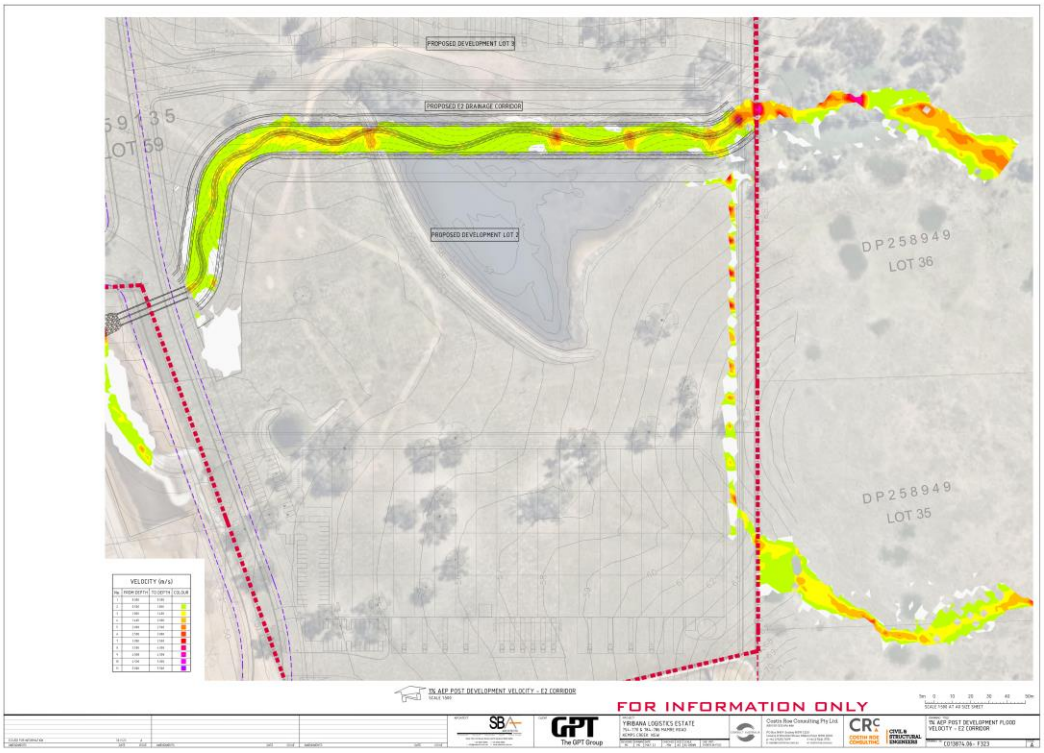

Figure 11.11: 1% AEP Post-developed Velocity Output – Drainage Corridor Realignment

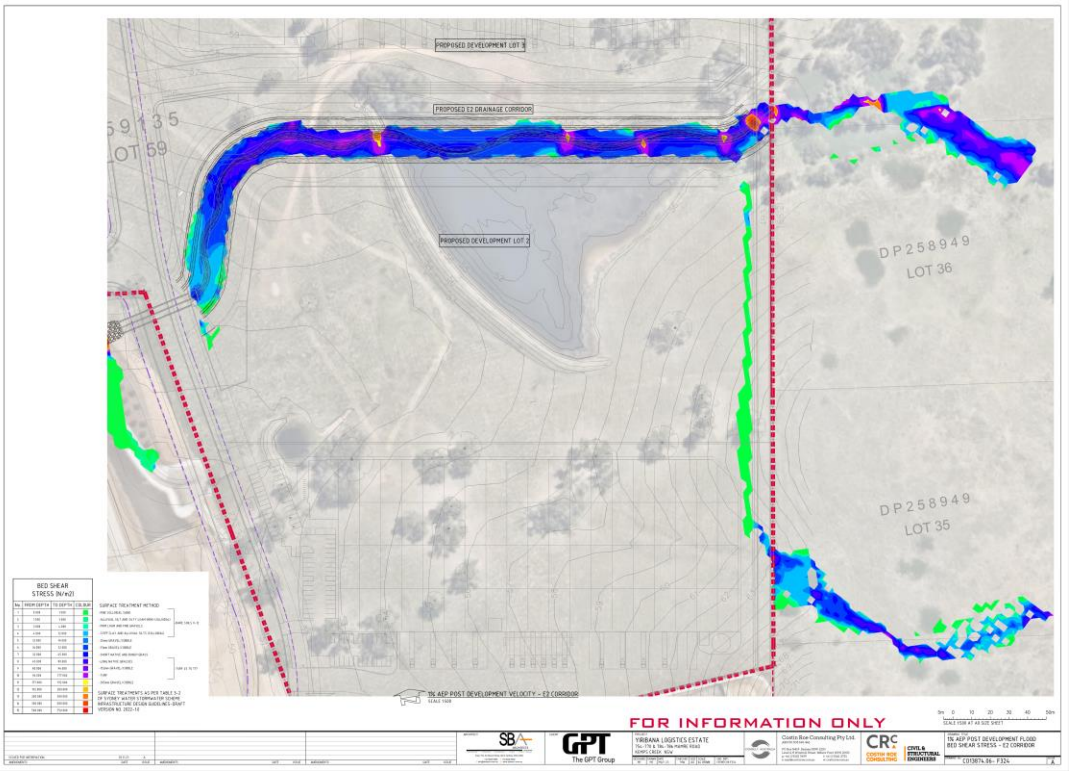

Figure 11.12: 1% AEP Post-developed Bed Shear Stress Output – Drainage Corridor Realignment

11.4.4 1% AEP Comparison

Figure 11.13 shows the 1% AEP flood level afflux (flood level difference) and **Figure 11.14** shows the 1% AEP velocity afflux, associated with the development.

The output for the 1% AEP storm event shows that:

- There is no upstream change to flood levels or velocity for any of the flow paths which enter the site;
- Flows within the drainage corridor are able to be conveyed within the proposed open channel and realigned drainage corridor within the Mirvac Property;
- At the culverts on Mamre Road adjacent to Lot 5, the output shows there is less than 20mm water level change; and
- Afflux at the culverts adjacent to Mirvac development are consistent with the flooding assessment submitted by Mirvac in their EIS, as completed by Cardno. Water levels changes at this location, although shown in our modelling, do not form part of the assessment and approval of the GPT Group development or submission.

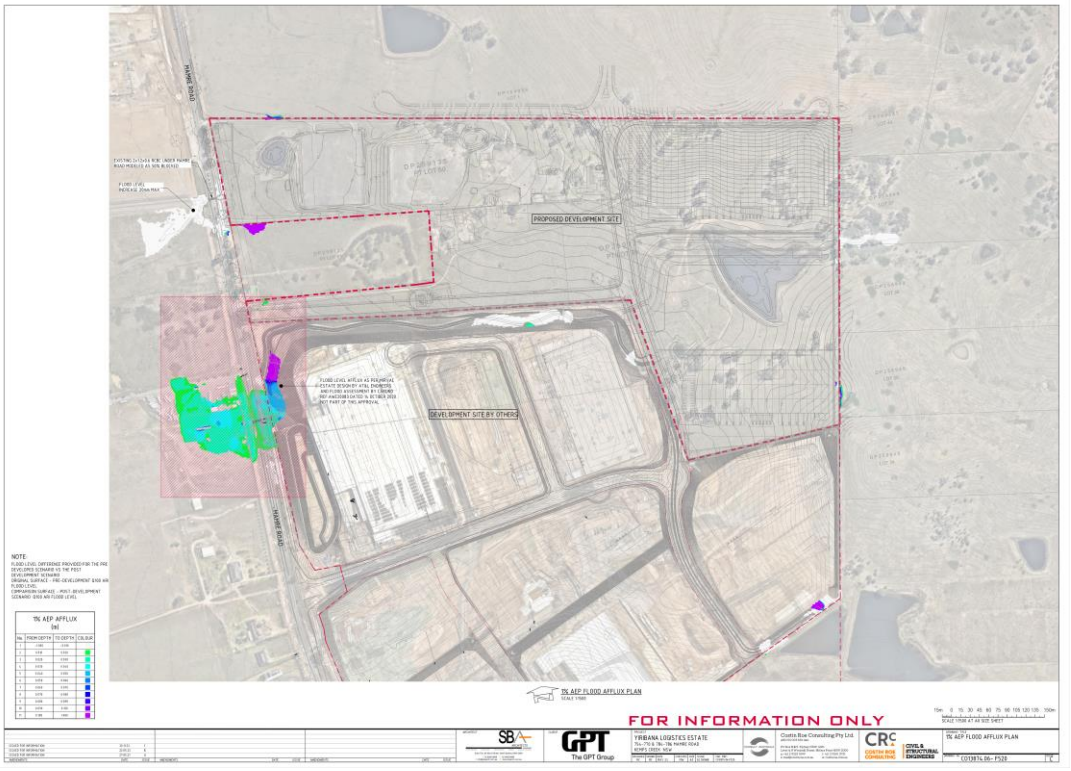

Figure 11.13: 1% AEP Post Developed Flood Level Afflux

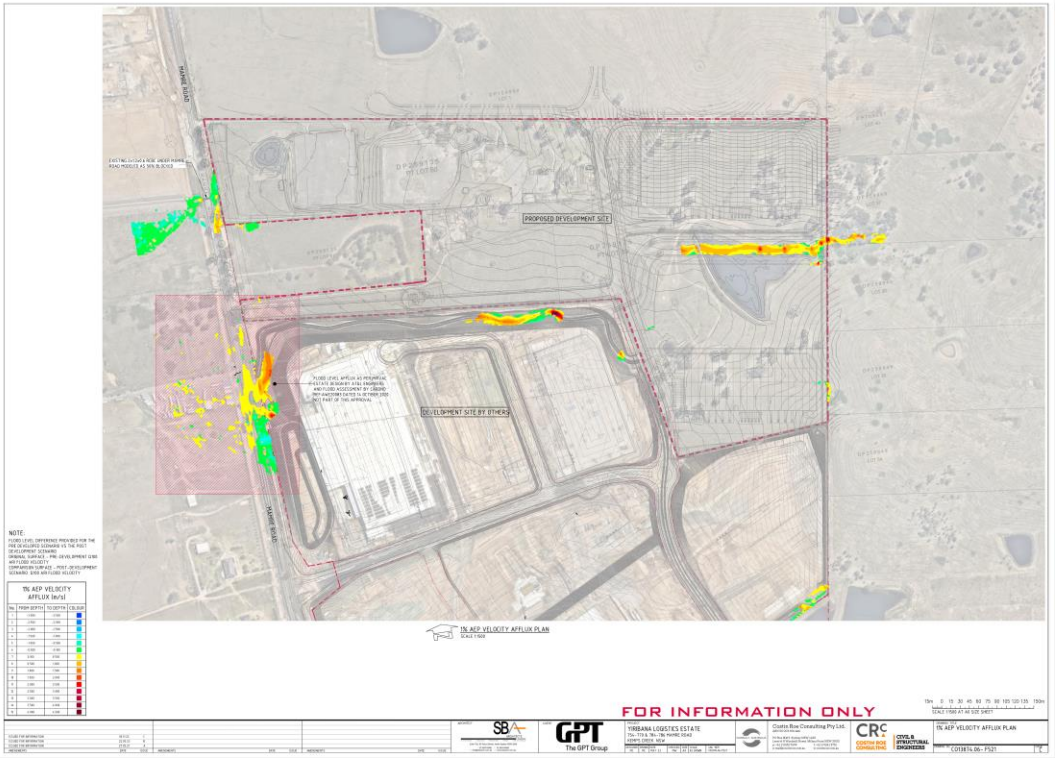

Figure 11.14: 1% AEP Post Developed Flood Velocity Afflux

11.5 Flood Planning and Hazard Categorisation

Penrith City Council has advised that the minimum floor level to be a minimum of 0.5m above 1% Annual Exceedance Probability flood level. The flood planning level (FPL) for the development is based on a minimum floor level of 1% AEP flood level plus 0.5m of freeboard.

For this site the proposed development requires a minimum FPL of RL 56.50m AHD, based on a 1% AEP level of 56.00m adjacent to the existing upstream catchment inflow point to the property on the east of the site.

Flood hazard categories are broken down into high and low hazard for each hydraulic category. High hazard areas are defined as those where there is a possible danger to personal safety and the potential for significant structural damage. Able-bodied adults would have difficulty in wading to safety. With low hazard areas, should it be necessary, a truck could evacuate people and their possessions, and able-bodied adults would have little difficulty in wading to safety.

Flood hazard criteria and mapping has been completed for the 1% AEP and PMF post development conditions as per criteria set out in the *Australian Rainfall and Runoff (2019), A Guide to Flood Estimation – Book 6 – Flood Hydraulics* and *Figure 6.7.9* as included as **Figure 11.15** below. Refer **Section 11.5** and **Appendix B1** for hazard mapping.

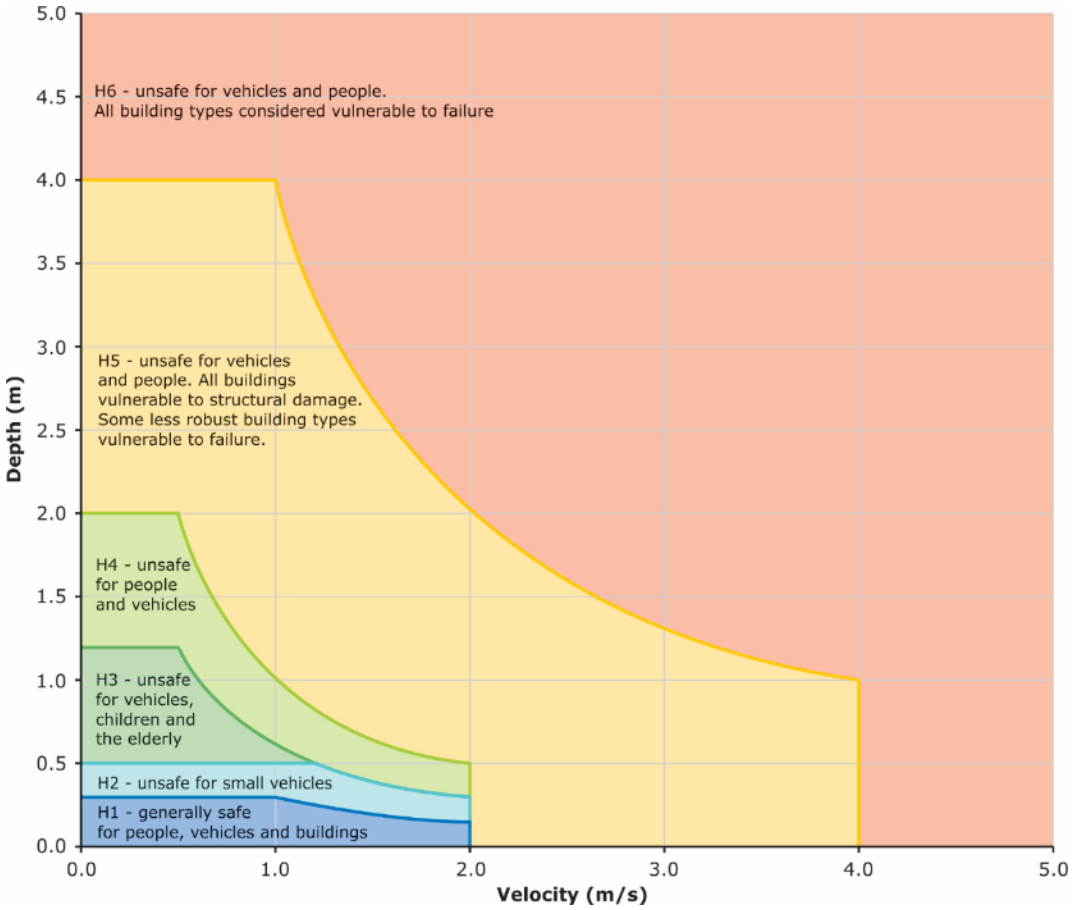

Figure 6.7.9. Combined Flood Hazard Curves (Smith et al., 2014)

Table 6.7.3. Combined Hazard Curves - Vulnerability Thresholds (Smith et al., 2014)

Hazard Vulnerability Classification	Description
H1	Generally safe for vehicles, people and buildings.
H2	Unsafe for small vehicles.
H3	Unsafe for vehicles, children and the elderly.
H4	Unsafe for vehicles and people.
H5	Unsafe for vehicles and people. All buildings vulnerable to structural damage. Some less robust buildings subject to failure.
H6	Unsafe for vehicles and people. All building types considered vulnerable to failure.

Table 6.7.4. Combined Hazard Curves - Vulnerability Thresholds Classification Limits (Smith et al., 2014)

Hazard Vulnerability Classification	Classification Limit (D and V in combination)	Limiting Still Water Depth (D)	Limiting Velocity (V)
H1	D*V ≤ 0.3	0.3	2.0
H2	D*V ≤ 0.6	0.5	2.0
H3	D*V ≤ 0.6	1.2	2.0
H4	D*V ≤ 1.0	2.0	2.0
H5	D*V ≤ 4.0	4.0	4.0
H6	D*V > 4.0	-	-

Figure 11.15. Adopted Hazard Criteria and Provisional Flood Hazard Chart (Australian Rainfall and Runoff 2019)

11.6 Confirmation of MRP DCP Requirements

With reference to **Section 11.4** and modelling results contained in **Appendices B1 & B2** we provide confirmation in **Table 11.1** that the criteria set out in the Section 2.5 Control 17 (and listed in **Section 3.3**) for filling within flood affected land for the 1% AEP event.

Table 8.1. Confirmation of MRP DCP Criteria (1% AEP)

MRP DCP Criteria	Post Development Scenario Confirmation (1% AEP Event)
Criteria 1 Flood levels are not increased by more than 10mm on surrounding developments by the proposed filling.	The development proposes conveyance of flows up to the 1% AEP meeting councils limit on off-site affectation. Offsite water level changes resulting from this development are shown to be below the threshold of 10mm in the 1% AEP event. Refer confirmation in **Section 11.4**. Flood level increase criteria is considered to be met.
Criteria 2	Velocity assessment shows limited change to velocity offsite. Any increases in velocity are noted to be on site

MRP DCP Criteria	Post Development Scenario Confirmation (1% AEP Event)
Downstream velocities are not increased by more than 10% by the proposed filling	and generally around proposed drainage infrastructure and inlets where it would be anticipated that velocities would change. Velocity change criteria is considered to be met.
Criteria 3 Proposed filling does not redistribute flows by more than 15%	Flow conveyance is based on meeting existing inlet and outlet positions for overland flow. As such there is no redistribution of flow proposed as a result of development. Flow distribution criteria is considered to be met.
Criteria 4 The potential for cumulative effects of possible filling proposals in that area is minimal	The development ensure that there is no offsite impacts. Further, future developments proposed to coordinate conveyance of flows within dedicated precinct drainage systems. There is limited or no potential for cumulative impacts as part of this development. Cumulative effect criteria is considered to have been met.
Criteria 5 There are alternative opportunities for flood storage.	The overland flow is noted to be confined to existing gully and farm dams, without limited flood storage. All assessments have been completed based on the existing farm dams being full at the start of the storm event. The proposed development includes for detention storage for all catchments which could act as flood storage for some events. Generally as a conveyance area, flood storage is not required, however as noted above some storage will be available. Flood storage criteria is considered to have been met.
Criteria 6 The development potential of surrounding properties is not adversely affected by the filling proposal	The development ensures that there is limited and has demonstrated acceptable offsite changes. Further, future developments proposed to coordinate conveyance of flows within dedicated precinct drainage systems. There is limited or no potential for adverse

MRP DCP Criteria	Post Development Scenario Confirmation (1% AEP Event)
	effect on future development potential of surround properties as a result of the proposed development.
Criteria 7 The flood liability of buildings on surrounding properties is not increased	The flood liability of surrounding developments is not affected by the development proposal. surrounding buildings or properties.
Criteria 8 No local drainage flow/runoff problems are created by the filling	We confirm that no local drainage flow/runoff problems are created by the proposed filling. All local tributaries and flow paths will either operate in a similar manner to the existing regime or form part of the overall stormwater management system for the estate.
Criteria 9 The filling does not occur within the drip line of existing trees	Filling is proposed within the development land. It is expected that trees within development land will be affected by the civil works and future industrial development, consistent with the nature of the future development and zoning of the land. This is also noted to be consistent with the zoning of the land and discussion with Council.

11.7 Climate Change Sensitivity Assessment

An assessment has been undertaken for the effect of climate change on the development. The assessment takes into consideration potential effect from increased rainfall intensity and sea level rise.

An assessment of the 0.2% AEP and 0.5% AEP was included as a proxy for the effect of climate change and is considered a conservative assessment for a 10% increase in flow to the 1% AEP event. Modelling has been undertaken for the 0.2% AEP and 0.5% AEP and flood afflux results are shown in **Figures 11.16 & 11.17**. Afflux results show minimal flood level change on the western side of the Mamre Road in the 0.5% AEP and 0.2% AEP when compared to the 1% AEP event. There is minor increase in flood afflux within. This assessment shows that the proposed stormwater drainage system and existing overland flow paths would have sufficient capacity to manage the increased peak flows and water volume with minor increase in peak water level at areas surrounding the Mamre Road culvert crossing. We confirm the increase in rainfall intensities will achieve the required minimum 0.5m freeboard to the proposed development levels in relation to overland flow paths from external & local catchments.

Overall, flood immunity of the proposed development sites would not be compromised given a large available freeboard amount much larger than minimum 0.5m values generally adopted.

The site is situated well upstream from any tidally influenced receiving waters including expected potential sea level rise of 0.4m. We confirm the development will not affect or be affected by potential sea level rise.

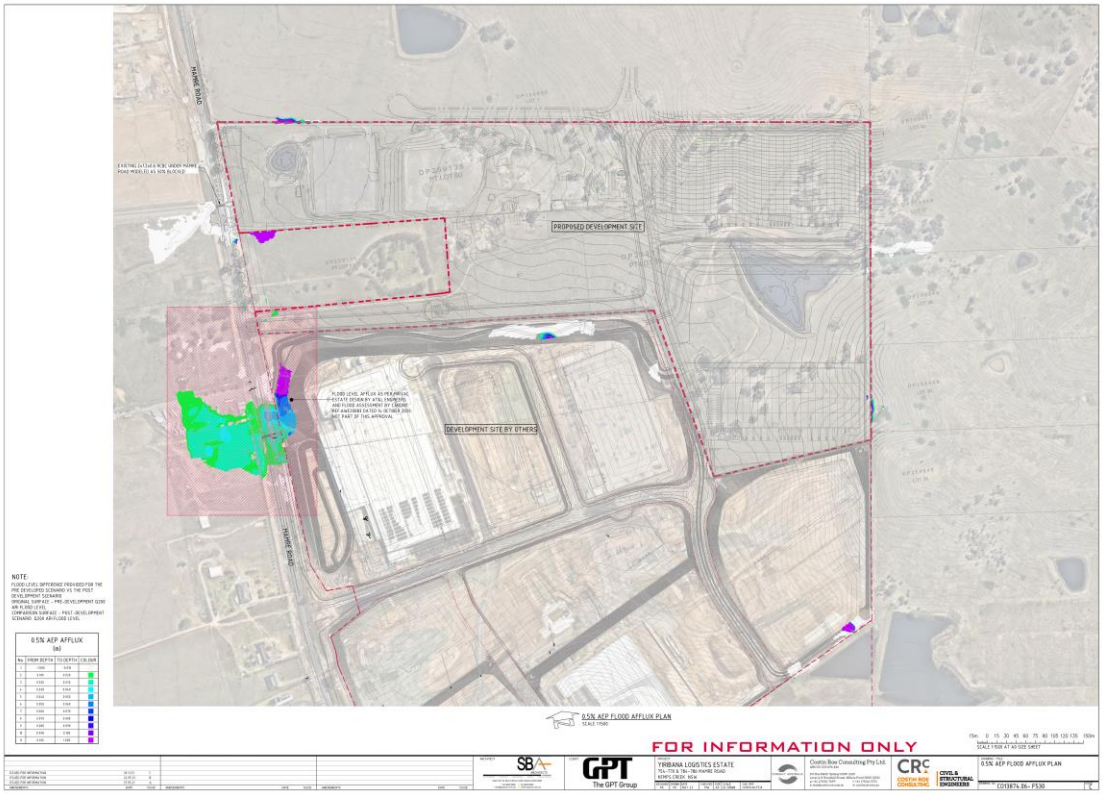

Figure 11.16: 0.5% AEP Post Developed Flood Level Afflux

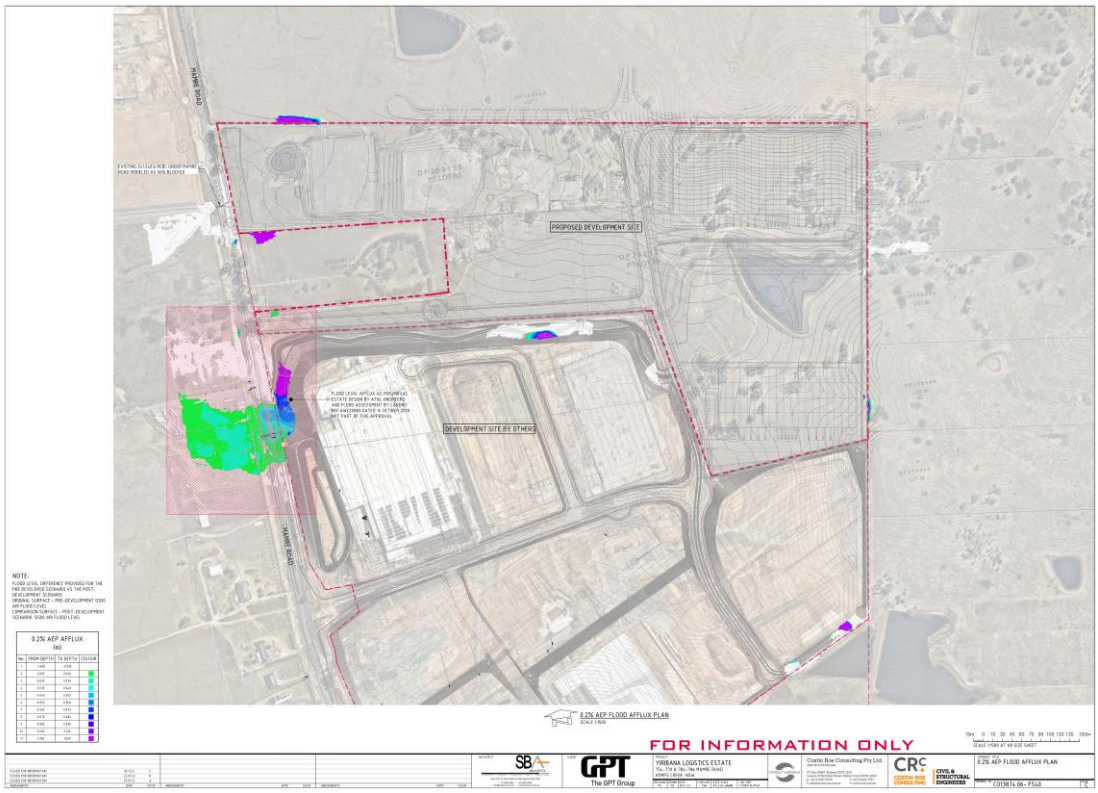

Figure 11.17: 0.2% AEP Post Developed Flood Level Afflux

11.8 Flood Assessment Conclusion

A TUFLOW hydrodynamic flood model has been completed and the pre and post development flood events assessed for flooding as a result of a 1% AEP rainfall event within the catchment.

The assessment of the 1% AEP event confirms that conveyance paths are available to the eastern and northern side of the proposed estate development. There is negligible effect on flood water local to the development. The TUFLOW Modelling completed by Costin Roe Consulting and confirmation of MRP DCP Criteria in **Section 11.6** confirms there is no affectation of upstream, downstream or adjoining properties.

12 CONCLUSION

This *Stormwater Management System Design Report* has been prepared to support the post approval requirements of SSDA-10272349 for the Yiribana Estate, Mamre Road, Kemps Creek, NSW.

A WSUD strategy for the site has been developed which provides a best practice solution within the constraints of the existing landform and proposed development layout. The stormwater management for the development has been designed in accordance with the DPE MRP DCP 2021, the Conditions of Consent, and the post-approval consultation with various authorities.

During the operational phase of the development, a treatment train incorporating the use of a gross pollutant traps, bio-retention filtration systems and other WSUD measures, is proposed to mitigate any increase in stormwater pollutant load generated by the development. MUSIC modelling results indicate that the proposed STM are effective in reducing pollutant loads in stormwater discharging from the site and meet the requirements of the MRP DCP pollution reduction targets. Best management practices have been applied to the development to ensure that the quality of stormwater runoff is not detrimental to the receiving environment.

Stream health requirements, per the MARV and FDC metrics included in the MRP DCP have been confirmed for the current proposed development, benched earthworks lots and construction of the proposed estate roads.

Trunk drainage has been designed and assessed in accordance with Sydney Water requirements and consultation throughout the design and assessment process.

These management requirements are noted to be incorporated into the detailed construction certificate designs.