

# CIVIL ENGINEERING REPORT

Planning Proposal – South Kempsey Enterprise Corridor  
Part Lot 3 DP 1231274,  
476 Macleay Valley Way,  
South Kempsey 2440



Prepared for:

Griffin Superannuation Fund

Prepared by:

King & Campbell Pty Ltd  
1st Floor, Colonial Arcade  
25-27 Hay Street  
Port Macquarie  
PO Box 243  
Port Macquarie 2444  
p: (02) 6586 2555  
e: [info@kingcampbell.com.au](mailto:info@kingcampbell.com.au)

## Revision Schedule

Revision Number	Date	Description	Staff
A	23.09.2024	Issued for Planning Proposal	CJC / SN

## Table of Contents

1.	INTRODUCTION .....	4
1.1.	Legislation, Standards, & Guidelines .....	4
1.2.	Data Used .....	4
2.	SITE CONDITIONS .....	5
2.1.	Location & Title .....	5
2.2.	Land Zone.....	7
2.3.	Flooding .....	7
2.4.	Lawful Point of Discharge .....	10
2.5.	Topography.....	10
2.6.	Soils .....	11
3.	STORMWATER QUANTITY .....	12
3.1.	Objective .....	12
3.2.	Hydrology & Hydraulics (Pre & Post Development) .....	12
3.3.	Modelling Results.....	13
4.	STORMWATER QUALITY .....	18
4.1.	Objective .....	18
4.2.	Modelling Results.....	18
5.	SERVICING STRATEGY .....	20
5.1.	Sewer.....	20
5.2.	Water .....	20
5.3.	Electricity.....	20
5.4.	Telecommunications .....	20
6.	CONCLUSION.....	20
7.	APPENDIX A – SERVICING STRATEGY PLAN .....	21
8.	APPENDIX B – DRAINS AND MUSIC MODELLING DATA.....	23

## Table of Figures

Figure 1 – Extract from Deposited Plan 1231274 (Subject Site).....	5
Figure 2 – Extract from Deposited Plan 1231274 (Easements).....	5
Figure 3 – Extract from LRS Title and 88B instrument (DP1231274) .....	6
Figure 4 - KSC LEP 2013 Land Zoning Extract .....	7
Figure 5 – 5% AEP Kempsey Flood Planning Extract .....	7
Figure 6 – 1% AEP Kempsey Flood Planning Extract .....	8
Figure 7 – 1% AEP with SLR & CC (2100) Kempsey Flood Planning Extract .....	8
Figure 8 – PMF Kempsey Flood Planning Extract .....	9
Figure 9 – Extract from Site Context (King & Campbell, 2022).....	10
Figure 10 – Extract from Survey Sketch of Subject Site (King & Campbell, 2022) .....	10
Figure 11 – Hydrologic Soil Group classification of Subject Site .....	11
Figure 12 – KSC LEP 2013 Acid Sulfate Soils 4350_COM_ASS_011B_020_20130528 Extract.....	11
Figure 13 – Extract from Catchment Plan.....	12
Figure 14 – MUSIC Model .....	19
Figure 15 – MUSIC Properties of Bioretention.....	19
Figure 16 – MUSIC Treatment Train Effectiveness .....	19

## 1. INTRODUCTION

This Civil Engineering Report has been prepared in support of a Planning Proposal seeking approval for a proposed infill LEP amendment to rezone 3.589ha of land at the rear of Lot 3 DP1231274 from its current RU2 Rural Landscape Zone to E4 General Industrial Zone.

The report demonstrates how all stormwater impacts (quantity and quality) generated from the development, can be adequately mitigated through implementation of the Stormwater Management Plan, satisfying the stormwater objectives of Kempsey Shire Council (KSC).

The report firstly identifies the site conditions, including location, flooding, legal point of discharge, land topography, and soil types prevalent. The report then assesses the stormwater quantity impacts of the development and provides DRAINS modelling results of mitigation measures to satisfy Council objectives. Following this, the stormwater quality impacts of the development are assessed, and MUSIC modelling results are provided for mitigation measures to satisfy Council objectives.

In addition to Stormwater Management, this report outlines the civil engineering servicing strategy for implementation of sewerage, water supply, electricity and communications necessary for the future development of the Subject Site.

The report is summarised with a conclusion, highlighting the key results of the stormwater analysis, the mitigation measures identified, and the proposed servicing strategy for future development of the site.

### 1.1. Legislation, Standards, & Guidelines

The following legislation, standards and guidelines are relevant to the subject Stormwater Management Plan:

- + Kempsey Shire Council AUS-SPEC; including D5 Stormwater Drainage Design, and D7 Erosion Control and Stormwater Management
- + Australian Rainfall & Runoff 2019
- + NSW MUSIC Modelling Guidelines 2015

### 1.2. Data Used

The following data was used as part of this Stormwater Management Plan:

- + Partial detail survey (King & Campbell, 2022)
- + Online mapping (Kempsey Flood Planning, eSPADE, Before You Dig Australia Search)
- + PMHC Supplemental Design Information (MUSIC Rainfall and PET Data)



## 2. SITE CONDITIONS

### 2.1. Location & Title

The following details apply to the Subject Site:

- + Address: 476 Macleay Valley Way
- + Legal description: Lot 3 DP 1231274 (Figure 1)
- + Approximate total site area: 7.483 ha
- + Approximate area of land subject to LEP amendment: 3.6 ha (Figure 1)

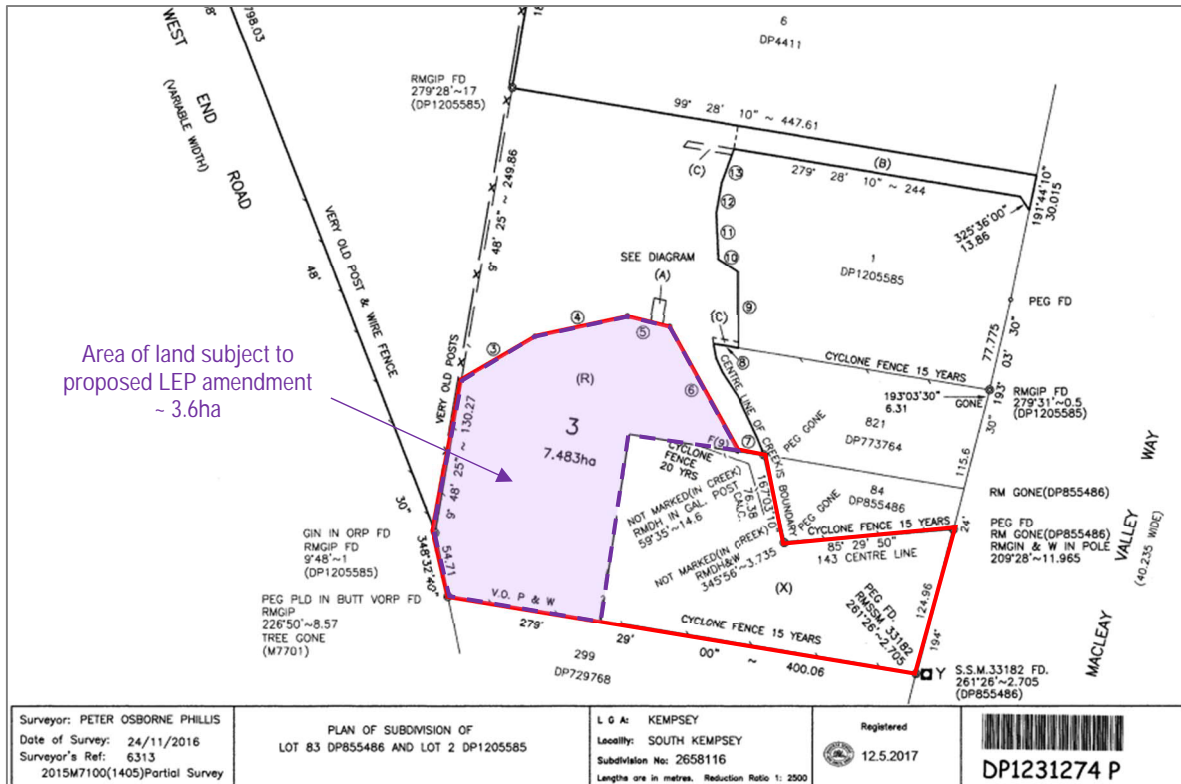


Figure 1 – Extract from Deposited Plan 1231274 (Subject Site)

Easements and restrictions applicable to the Subject Site include:

- + Easement to Drain Water 10 wide (Figure 2)

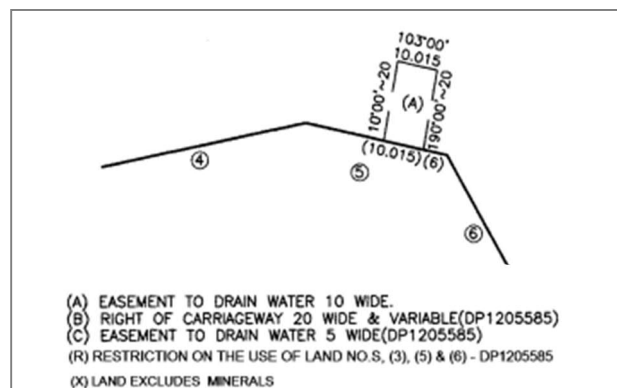



Figure 2 – Extract from Deposited Plan 1231274 (Easements)



**LAND  
REGISTRY  
SERVICES**  
 NEW SOUTH WALES LAND REGISTRY SERVICES - TITLE SEARCH

**Title Search**  
 Information Provided Through  
 Aussearch  
 Ph. 02 9129 6777

---

FOLIO: 3/1231274

---

SEARCH DATE	TIME	EDITION NO	DATE
5/5/2024	2:30 PM	4	19/4/2021

LAND

---

LOT 3 IN DEPOSITED PLAN 1231274  
 AT SOUTH KEMPSEY  
 LOCAL GOVERNMENT AREA KEMPSEY  
 PARISH OF BERANGHI COUNTY OF MACQUARIE  
 TITLE DIAGRAM DP1231274

FIRST SCHEDULE

---

DAVID RAYMOND GRIFFIN  
 LEANNE MAREE GRIFFIN  
 AS JOINT TENANTS (T AQ114912)

SECOND SCHEDULE (7 NOTIFICATIONS)

---

- 1 RESERVATIONS AND CONDITIONS IN THE CROWN GRANT(S)
- 2 LAND EXCLUDES MINERALS WITHIN THE PART(S) SHOWN SO INDICATED IN THE TITLE DIAGRAM
- 3 DP1205585 RESTRICTION(S) ON THE USE OF LAND REFERRED TO AND NUMBERED (3) IN THE S.88B INSTRUMENT AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
- 4 DP1205585 RESTRICTION(S) ON THE USE OF LAND REFERRED TO AND NUMBERED (5) IN THE S.88B INSTRUMENT AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
- 5 DP1205585 RESTRICTION(S) ON THE USE OF LAND REFERRED TO AND NUMBERED (6) IN THE S.88B INSTRUMENT AFFECTING THE PART SHOWN SO BURDENED IN THE TITLE DIAGRAM
- 6 DP1231274 EASEMENT TO DRAIN WATER 10 METRE(S) WIDE APPURTENANT TO THE LAND ABOVE DESCRIBED
- 7 AQ961280 LEASE TO DGI TRADING (AUST) PTY LTD EXPIRES: 2/12/2025.

NOTATIONS

---

UNREGISTERED DEALINGS: NIL

\*\*\* END OF SEARCH \*\*\*

6928

PRINTED ON 5/5/2024

\* Any entries preceded by an asterisk do not appear on the current edition of the Certificate of Title. Warning: the information appearing under notations has not been formally recorded in the Register. InfoTrack an approved NSW Information Broker hereby certifies that the information contained in this document has been provided electronically by the Registrar General in accordance with Section 95B(2) of the Real Property Act 1995.

Copyright © Office of the Registrar-General 2024 Received: 05/05/2024 14:30:02

Number of item shown in the intention panel on the plan	Identity of easement, profit à prendre, restriction or positive covenant to be created and referred to in the plan.	Burdened lot(s) or parcel(s):	Benefited lot(s), road(s), bodies or Prescribed Authorities
1.	Easement for Drainage of Water 10 Wide	Lot 2	Lot 3

Figure 3 – Extract from LRS Title and 88B instrument (DP1231274)

## 2.2. Land Zone

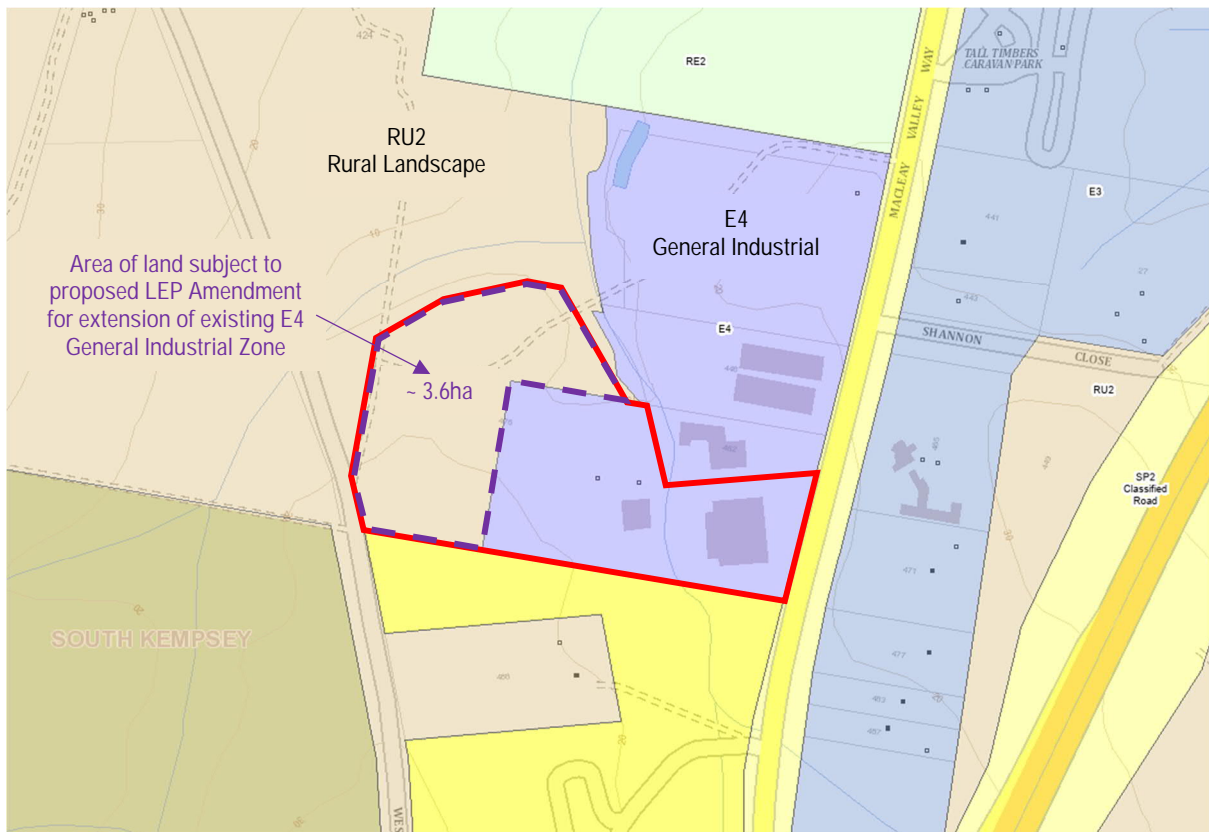


Figure 4 - KSC LEP 2013 Land Zoning Extract

## 2.3. Flooding

The subject site is mapped as follows on the Kempsey Flood Planning Map (accessed 27 August 2024).

<https://experience.arcgis.com/experience/0a9b0fa2fc4f43ca828fc3c8ef4d4d63/>



Figure 5 - 5% AEP Kempsey Flood Planning Extract



Figure 6 – 1% AEP Kempsey Flood Planning Extract



Figure 7 – 1% AEP with SLR & CC (2100) Kempsey Flood Planning Extract

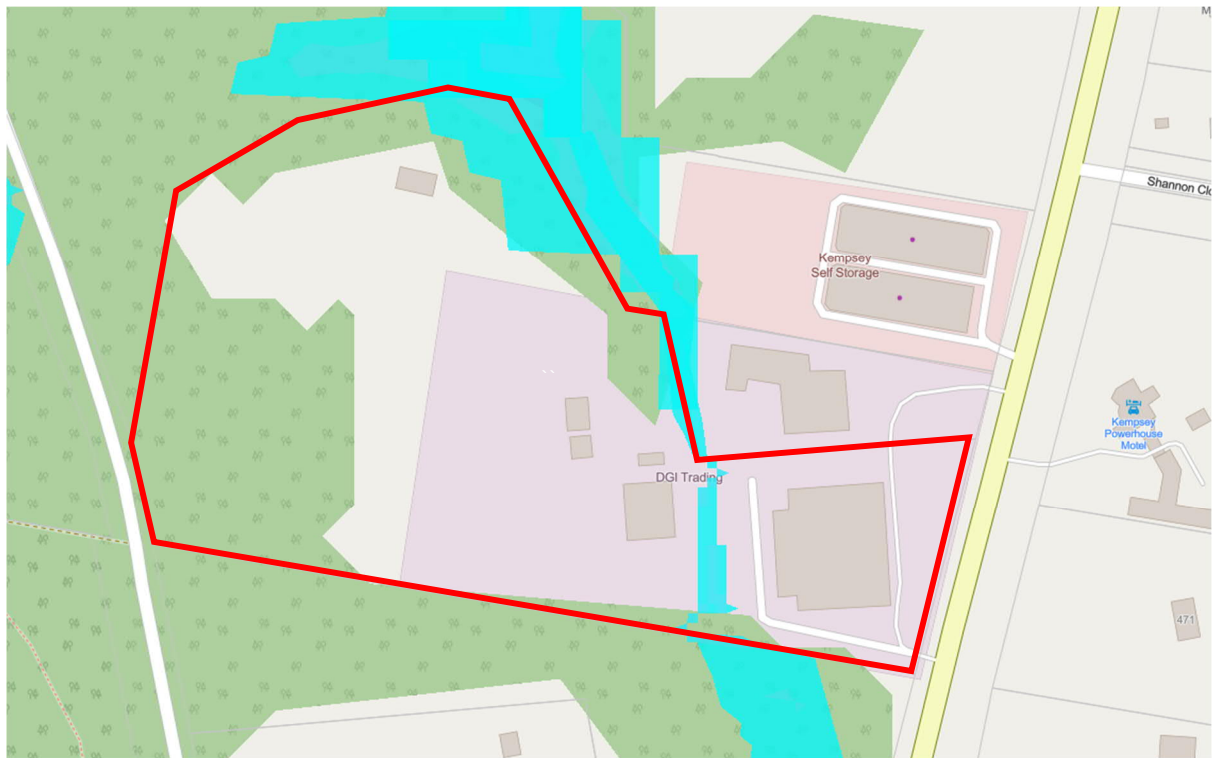


Figure 8 – PMF Kempsey Flood Planning Extract



## 2.4. Lawful Point of Discharge

The lawful point of discharge for the Subject Site is proposed to be the existing easement to drain water at the northern boundary of the Subject Site (labelled [A], Figure 2). It is proposed to discharge site stormwater via controlled outlet at equal to, or less than, the pre development flow rates for the 20%, 5%, and 1% AEP storms.

## 2.5. Topography

The Subject Site is located approximately 4 km south of Kempsey, fronting Macleay Valley Way, and situated within the middle to upper reaches of its respective catchment. The majority of the catchment upstream is zoned RU2 Rural Landscape and RU3 Forestry. Directly downstream of the site are the Kempsey Golf Club and a bridge/culvert crossing Macleay Valley Way. Refer to Figure 9 for site topography showing the overall landform, streams and surrounding catchments.

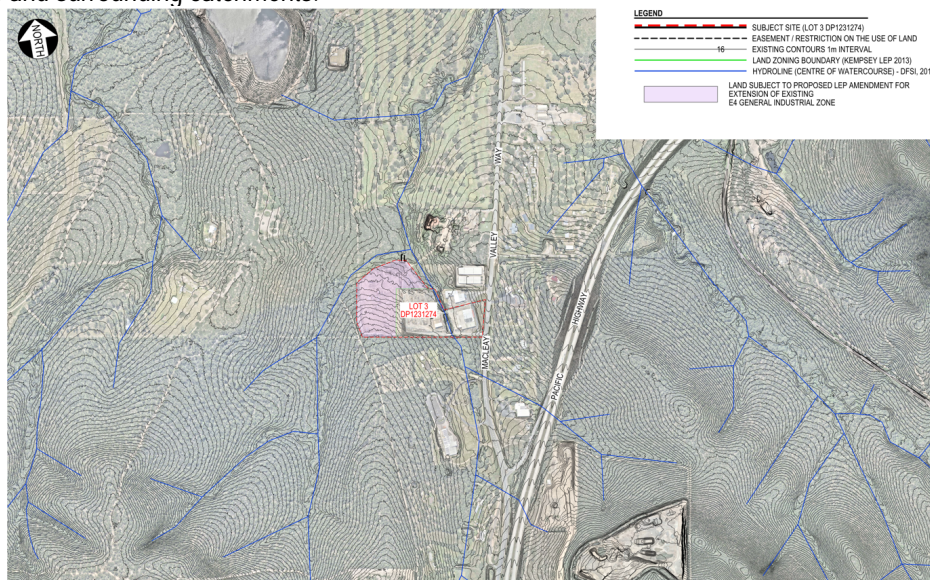


Figure 9 – Extract from Site Context (King & Campbell, 2022)

The subject site generally slopes towards the north and northeast, with sections of the site having grades of up to 8%, as shown by the 1.0m contour intervals in Figure 10. An existing stormwater basin is located directly upstream of the drainage easement, as illustrated in Figure 10.

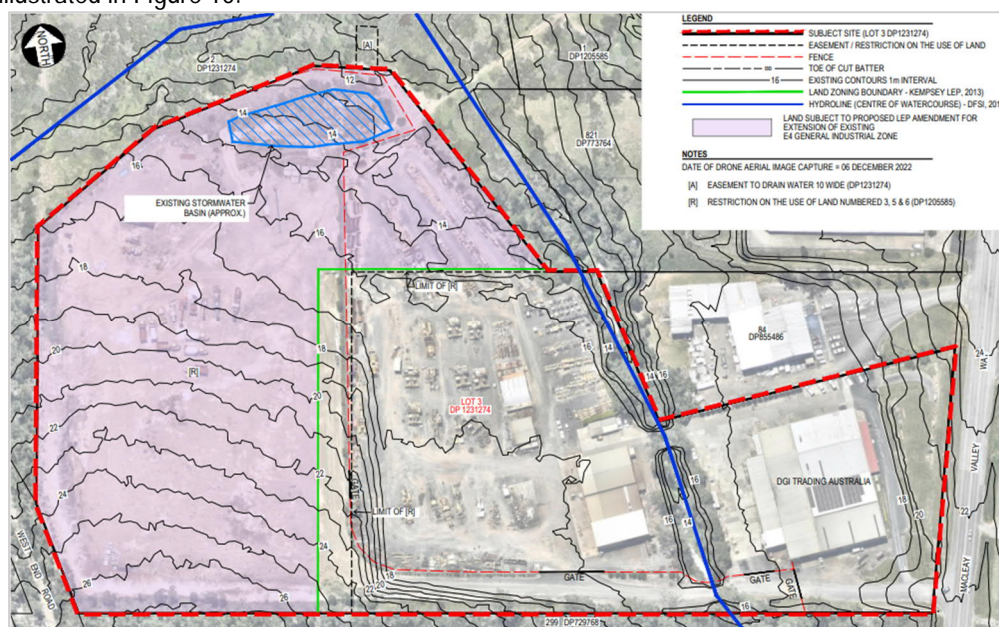


Figure 10 – Extract from Survey Sketch of Subject Site (King & Campbell, 2022)

## 2.6. Soils

The subject site is classified as Class D – very slow infiltration, as per the NSW Hydrologic Soil Group classification and eSPADE mapping system as shown below.

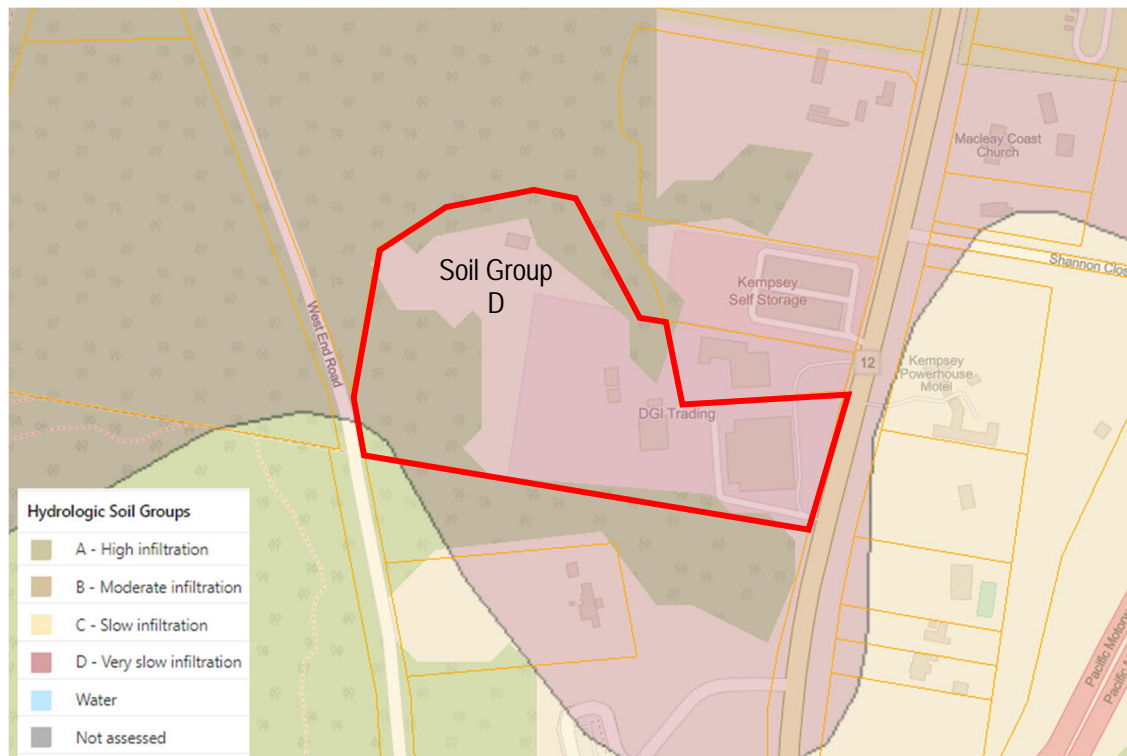


Figure 11 – Hydrologic Soil Group classification of Subject Site

The subject site is classified by KSC LEP 2013 Acid Sulfate Soils Map as Class 5, shown below. Acid sulphate soils are typically not found in Class 5 areas. Areas classified as Class 5 are located within 500 metres of adjacent class 1,2,3 or 4 land.

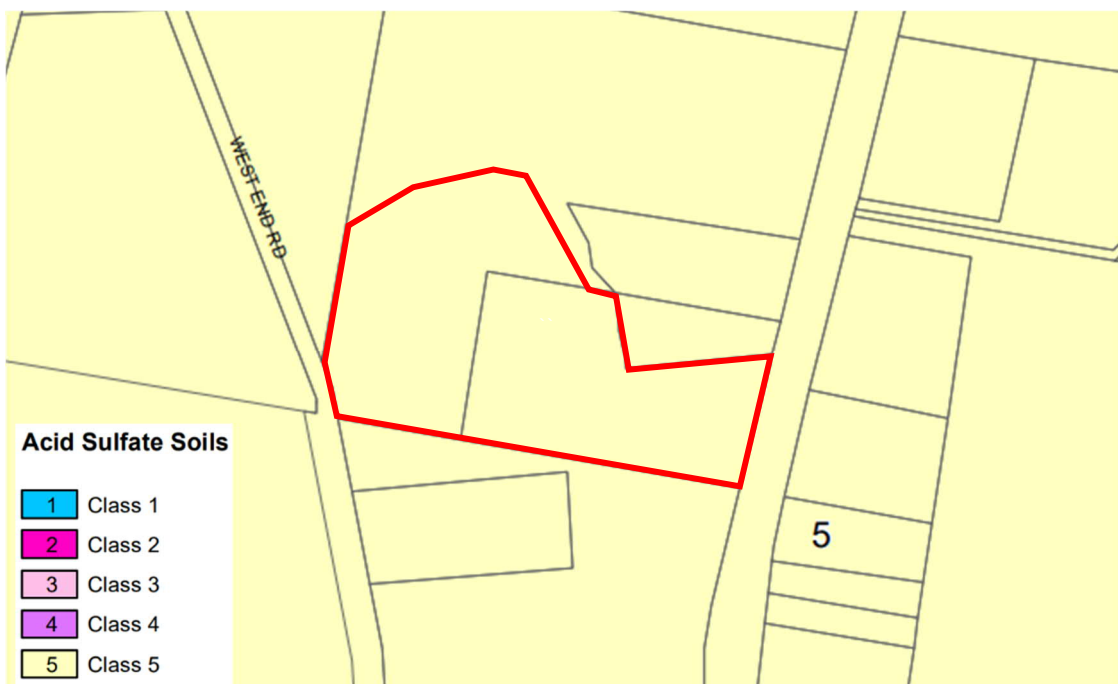


Figure 12 – KSC LEP 2013 Acid Sulfate Soils 4350\_COM\_ASS\_011B\_020\_20130528 Extract



### 3. STORMWATER QUANTITY

#### 3.1. Objective

Provide an on-site stormwater detention system, or equivalent, that meets the objectives of Kempsey Shire Council, AUS-SPEC D5. The design must ensure that post-development stormwater discharge rates do not exceed pre-development rates for the 20%, 5%, and 1% AEP storm events. The primary goal of the stormwater detention system is to reduce the site's peak stormwater runoff and minimize the cumulative impact on downstream infrastructure, including the culvert/bridge crossing Macleay Valley Way.

The proposed on-site stormwater detention system is designed to accommodate runoff from the future development of the rezoned land, up to 95% impervious. This includes detaining runoff from 3.8 hectares of rezoned land at the rear of Lot 3, along with 0.6 hectares of upstream forest catchment. As a result, no additional detention facilities would be required for individual lots, as a single detention facility will serve the entire development, eliminating the need for individual on-site storage.

#### 3.2. Hydrology & Hydraulics (Pre & Post Development)

The proposed development increases the percentage impervious from 20% (forest) to 95% (industrial) as shown below. Note that the pre-development condition is assumed green field, with percentage impervious selected from PMHC AUS-SPEC clause 5.11.

Catchment	Pre-Development % impervious	Post-Development % impervious
3-1	20% (forest)	20% (forest)
1-1, 1-2, 1-3, 1-4	20% (forest)	95% (industrial)

It is assumed that the existing site operations (DGI Trading) discharge stormwater via the creek that traverses the site. It is proposed that this discharge method be retained post-development; therefore, the catchments for existing operations have been excluded from the stormwater basin sizing.

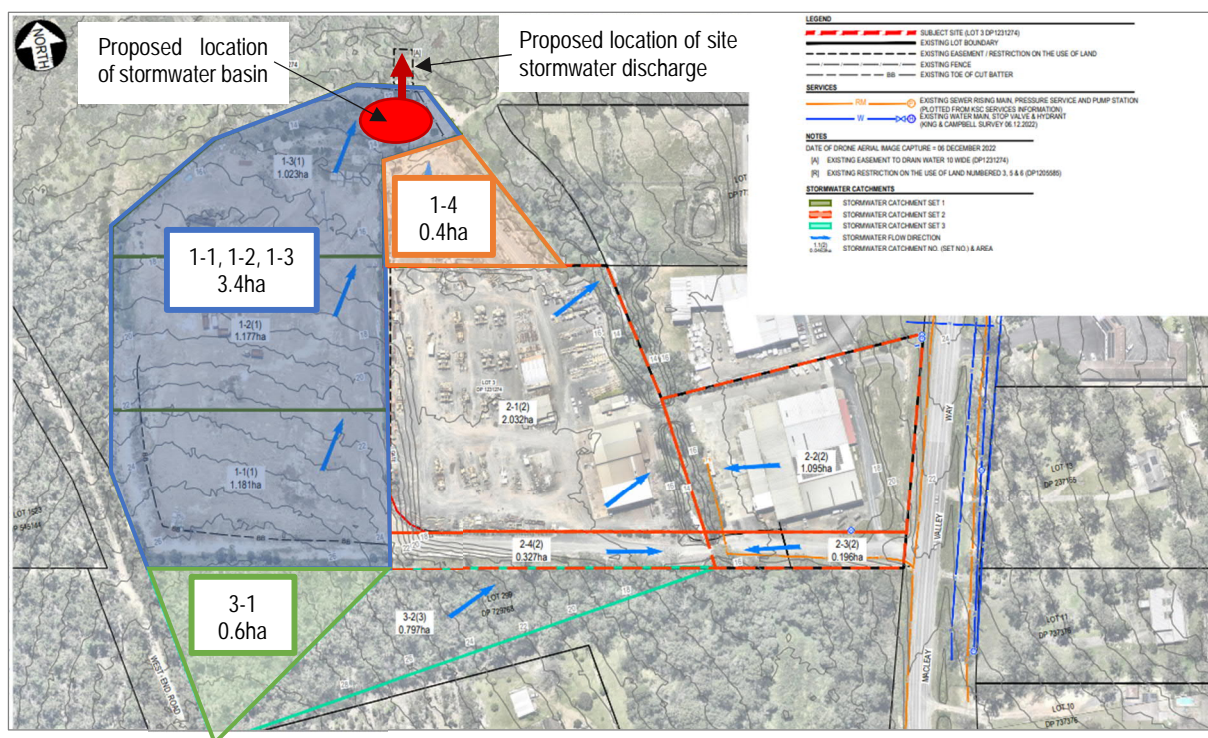


Figure 13 – Extract from Catchment Plan

### 3.3. Modelling Results

DRAINS software version 2023.02.8444.20204 with ARR 2019 methodologies has been adopted to model the stormwater quantity requirements. Parameters inputs are in accordance with AUS-SPEC D5.

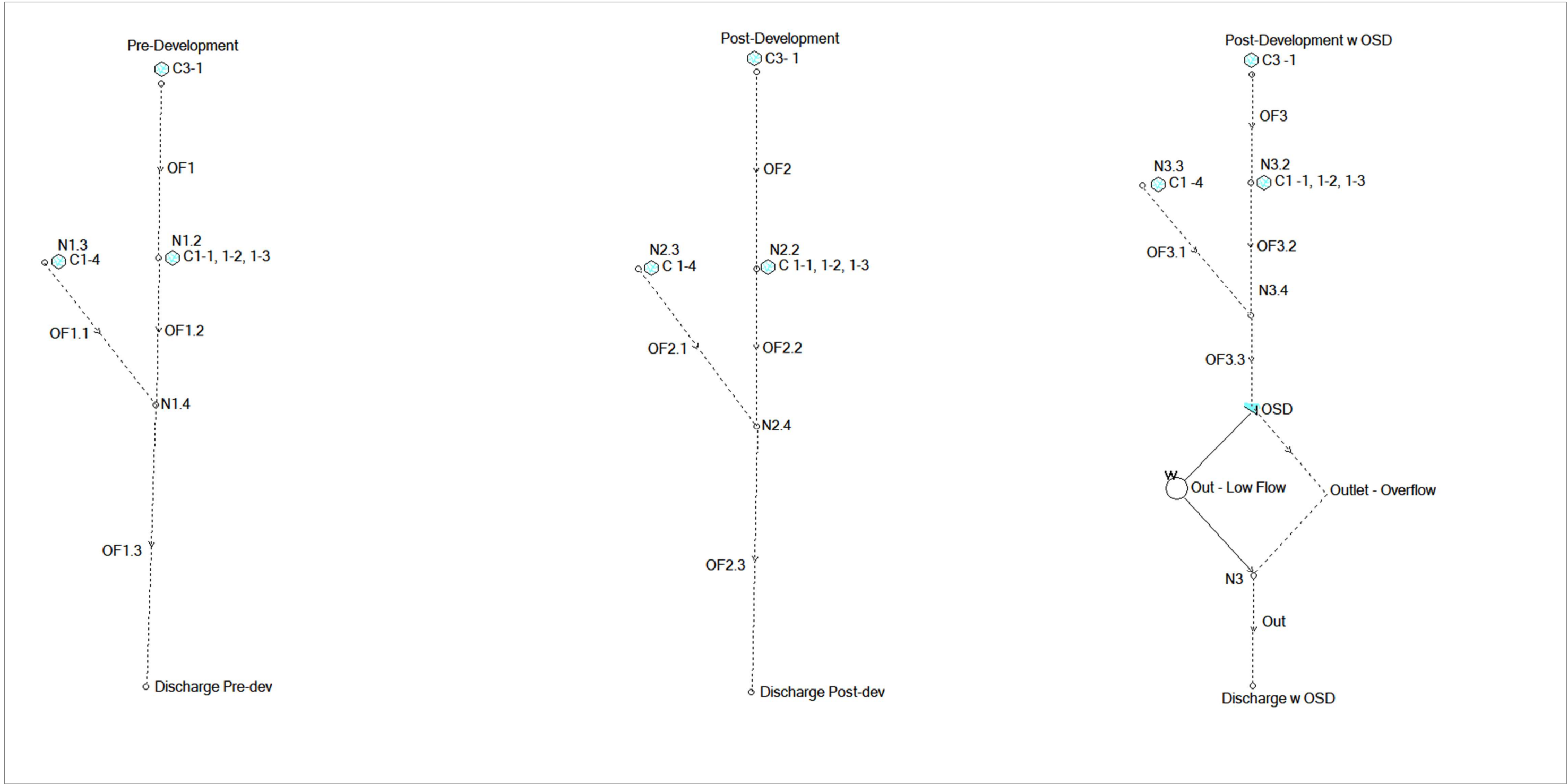
The DRAINS model includes the following OSD system:

- + 450m<sup>3</sup> detention system (nominal 1000mm deep).
- + 300mm deep extended detention for water quality.
- + 600mm diameter outlet pipe for low flow, with a letterbox type inlet pit at 300mm above basin floor.
- + 5m wide high flow (overflow) weir at 900mm above basin floor.
- + A custom discharge outlet designed to suit the site specific basin dimensions will be required.

The below table illustrates that the post-development site stormwater discharge, with the incorporation of a detention basin, does not exceed the pre-development discharge rates for the 20%, 5% and 1% AEP storms:

AEP (%)	Pre-Development (l/s)	Post-Development with OSD (l/s)	Post with OSD ≤ Pre?
20	1,580	1,500	OK
5	2,380	2,160	OK
1	3,080	2,850	OK

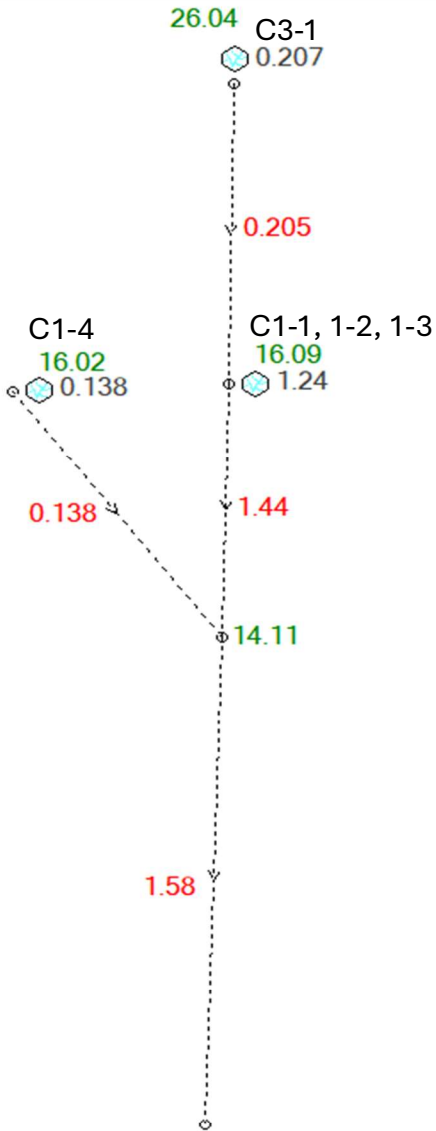
Please see the following pages for screenshots of the DRAINS model and results.



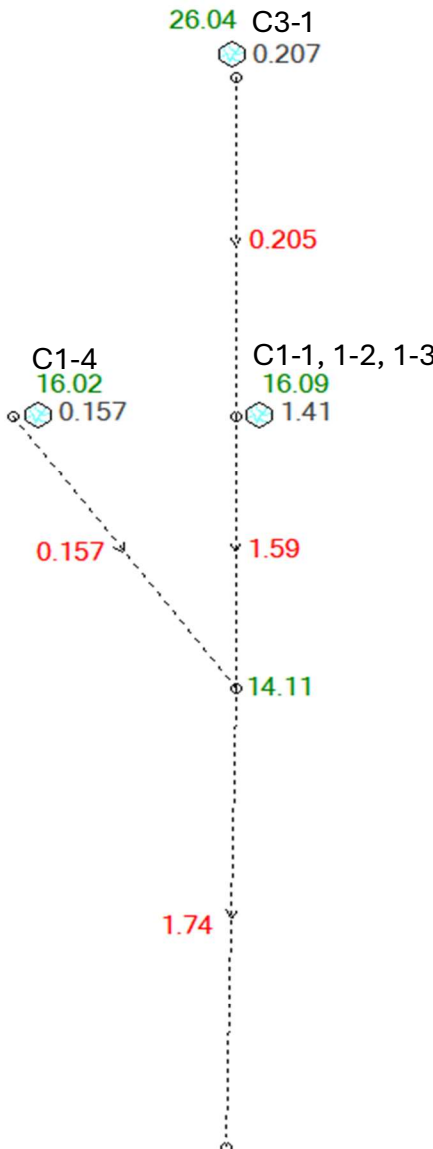
**DRAINS NETWORK**



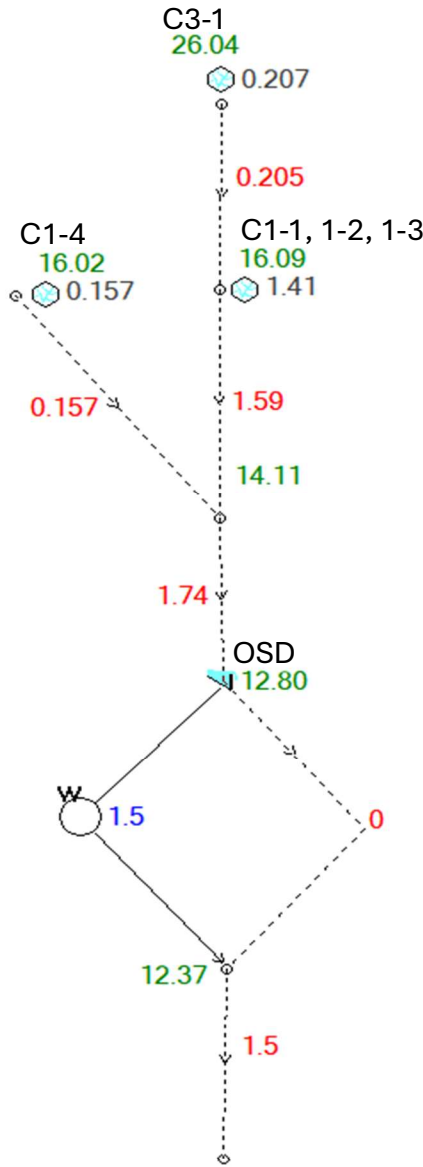
Results for median storm in critical 20% AEP ensembles using Full Unsteady hydraulic model.



## Pre-development



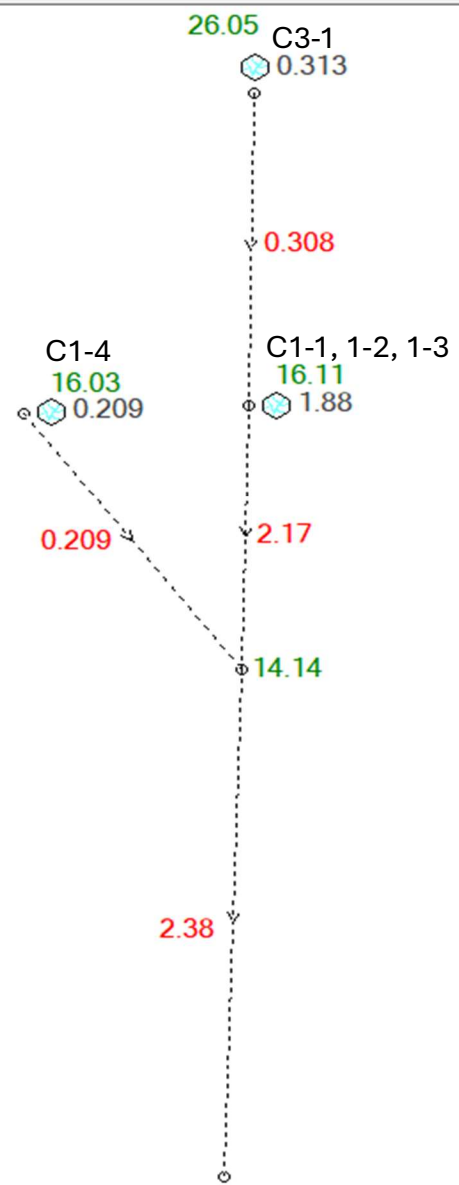
## Post-development



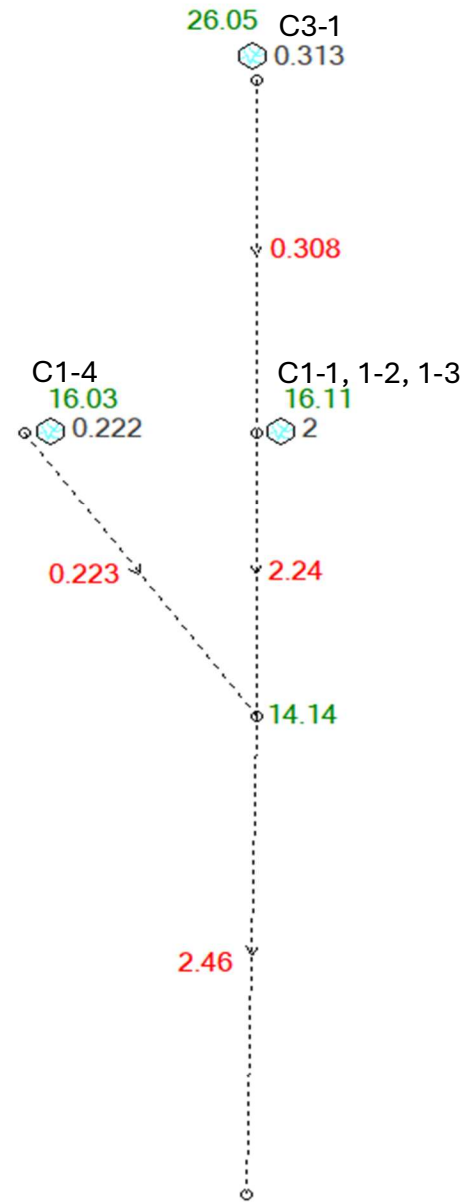
## Post-development w OSD

## 20% AEP

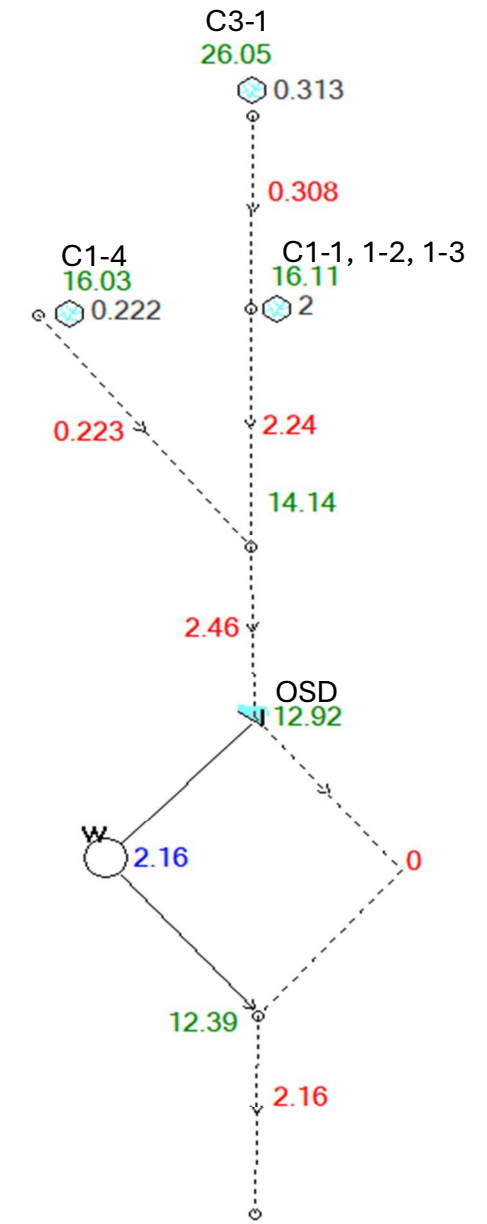
Results for median storm in critical 5% AEP ensembles  
using Full Unsteady hydraulic model.



Pre-development



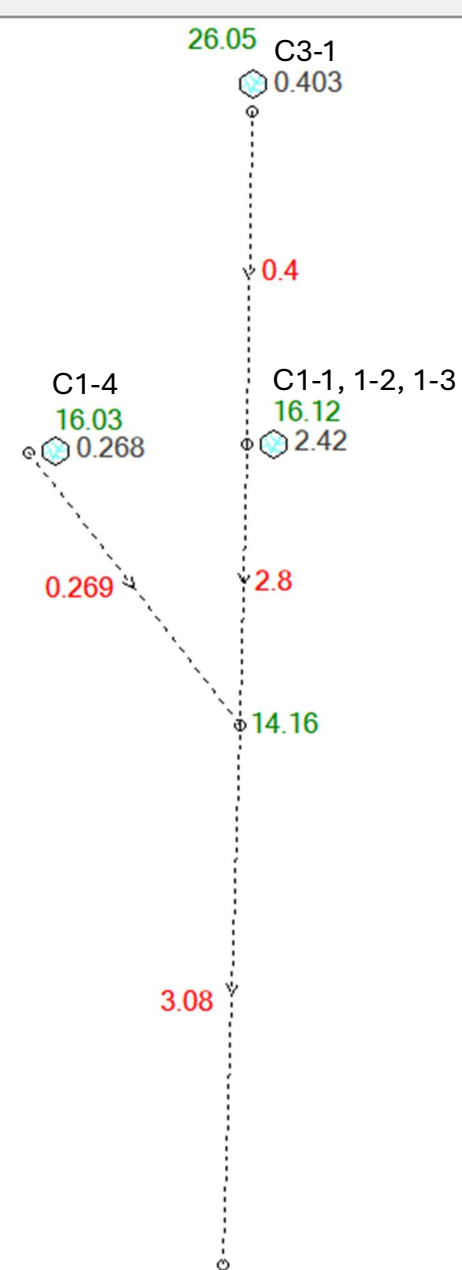
Post-development



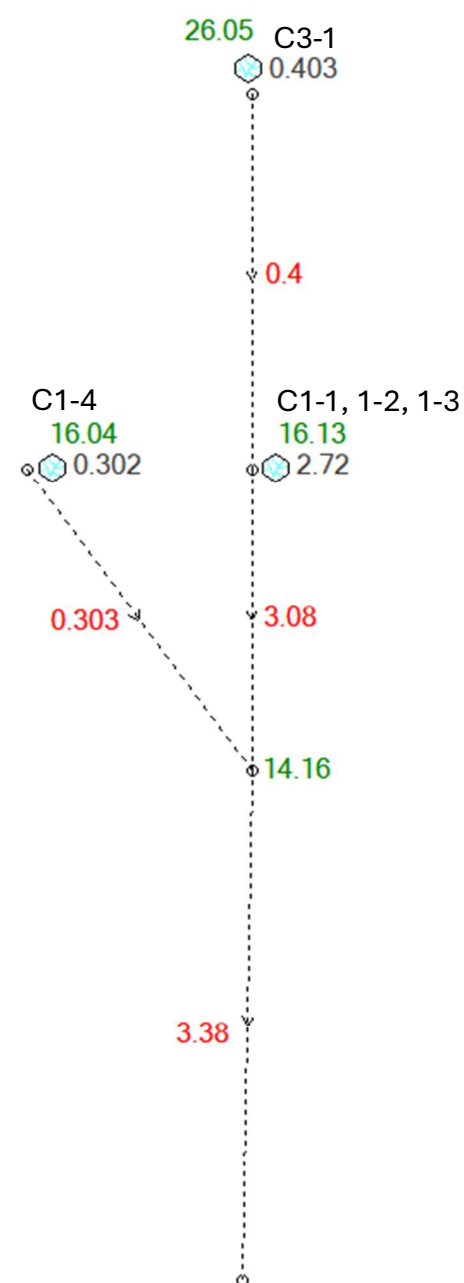
Post-development w OSD

5% AEP

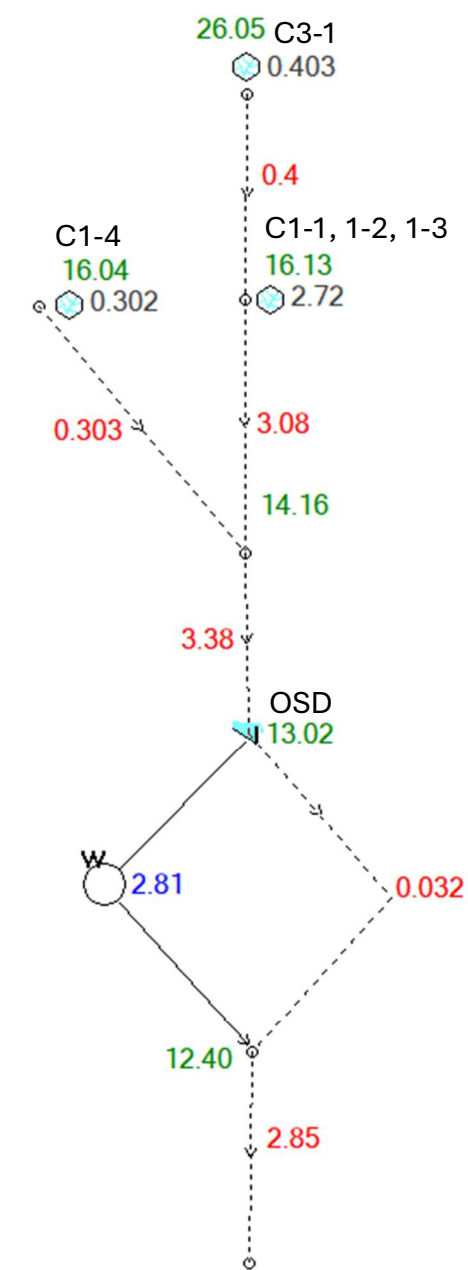
Results for median storm in critical 1% AEP ensembles  
using Full Unsteady hydraulic model.



Pre-development



Post-development



Post-development w OSD

1% AEP

## 4. STORMWATER QUALITY

### 4.1. Objective

Specific pollutant reduction targets are not specified in the Kempsey Shire Council development standards. Therefore, the following standard reduction targets, considered "industry best practice" water quality objectives, have been adopted:

- + 80% reduction in Suspended Solids;
- + 45% reduction in Phosphorus; and
- + 45% reduction in Nitrogen.

Additionally, total pollutant loads post-development must be lower than pre-development loads after treatment, in line with "industry best practice."

### 4.2. Modelling Results

MUSIC software version 6.3.0 has been adopted to model the stormwater quality requirements. Parameter inputs are in accordance with AUS-SPEC D7 and NSW MUSIC Modelling Guidelines 2015. Rainfall data has been obtained from PMHC Supplemental Design Information (<https://www.pmhc.nsw.gov.au/Plan-Build/Industry-resources/AUS-SPEC>).

The model includes a 150m<sup>2</sup> bioretention basin which is proposed to be incorporated as part of the larger detention basin, Figure 15. The below results illustrate that the water quality objectives can be achieved with the proposed treatment train, Figure 16.

Similar to the stormwater quantity analysis, Pre-development = 20% (representing forest conditions) and post-development = 95% (representing industrial development) have been adopted for Catchments 1-1, 1-2, 1-3, and 1-4 (land subject to LEP amendment). The upstream forest catchment remains at 20% imperviousness for both pre-development and post-development scenarios.

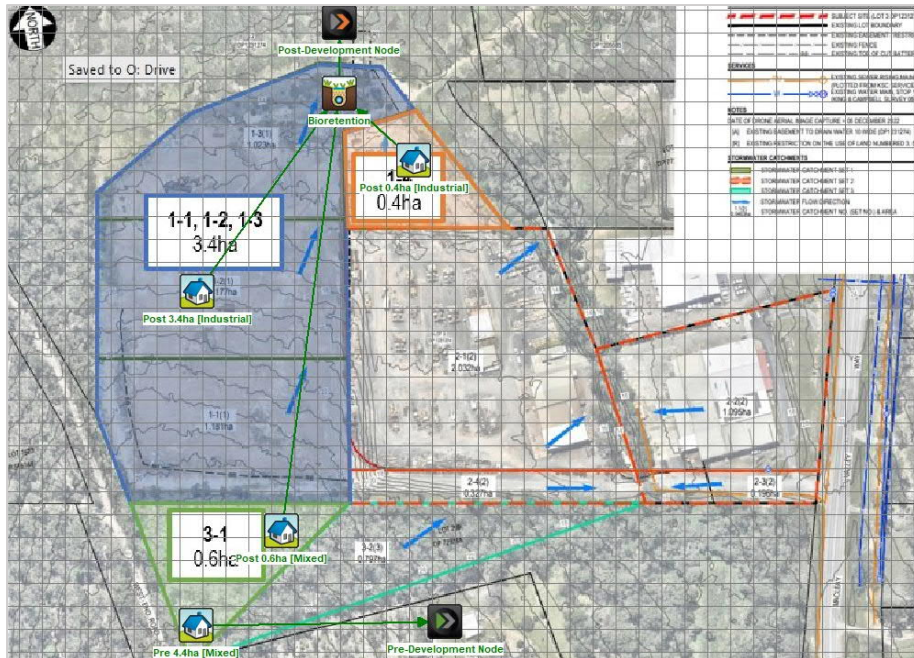


Figure 14 – MUSIC Model

Properties of Bioretention - Development Node

Location: **Bioretention** [Products >>](#)

**Inlet Properties**

Low Flow By-pass (cubic metres per sec): 0.000

High Flow By-pass (cubic metres per sec): 100.000

**Storage Properties**

Extended Detention Depth (metres): 0.40

Surface Area (square metres): 400.00

**Filter and Media Properties**

Filter Area (square metres): 150.00

Unlined Filter Media Perimeter (metres): 50.00

Saturated Hydraulic Conductivity (mm/hour): 100.00

Filter Depth (metres): 0.40

TN Content of Filter Media (mg/kg): 400

Orthophosphate Content of Filter Media (mg/kg): 35.0

**Infiltration Properties**

Exfiltration Rate (mm/hr): 3.60

**Lining Properties**

Is Base Lined? ☐ Yes ☒ No

**Vegetation Properties**

☒ Vegetated with Effective Nutrient Removal Plants

☐ Vegetated with Ineffective Nutrient Removal Plants

☐ Unvegetated

**Outlet Properties**

Overflow Weir Width (metres): 5.00

Underdrain Present? ☒ Yes ☐ No

Submerged Zone With Carbon Present? ☒ Yes ☐ No

Depth (metres): 0.30

[Fluxes...](#) [Notes...](#) [More](#)

[Cancel](#) [Back](#) [Finish](#)

Figure 15 – MUSIC Properties of Bioretention

	Sources		Residual Load		% Reduction	
	Pre	Post	Pre	Post	Pre	Post
Flow (ML/yr)	40.6	65.1	40.6	60.5	0	7.07
Total Suspended Solids (kg/yr)	4360	10700	4360	1300	0	87.9
Total Phosphorus (kg/yr)	8.53	18.9	8.53	8.4	0	55.6
Total Nitrogen (kg/yr)	89.8	145	89.8	76.9	0	47
Gross Pollutants (kg/yr)	573	1370	573	0	0	100

Figure 16 – MUSIC Treatment Train Effectiveness



## 5. SERVICING STRATEGY

### 5.1. Sewer

Kempsey Shire Council (KSC) is the responsible authority for the provision of sewerage infrastructure. Before You Dig results indicate that an existing sewer pressure main is located within the Macleay Valley Way road reserve. It is proposed that future development would extend the pressure sewer network within the development site (Appendix A).

### 5.2. Water

Kempsey Shire Council (KSC) is the responsible authority for the provision of water infrastructure. Existing water mains are present within the road reserve of Macleay Valley Way. It is proposed that future development would extend the water main network within the development site (Appendix A).

### 5.3. Electricity

Essential Energy is the responsible authority for provision of electrical supply in the area. Essential Energy Network Information Portal and Before You Dig results indicate there are existing high (11kV) and low voltage Essential Energy assets located within the Macleay Valley Way road reserve, and servicing existing operations on site. It is proposed that future development would extend the electrical network within the development site.

### 5.4. Telecommunications

NBN Co. website indicates that NBN is currently available in the area to service proposed future development. Before You Dig results identify that existing NBN assets are available within the Macleay Valley Way road reserve. It is proposed that future development would extend the communications network within the development site.

## 6. CONCLUSION

The report demonstrates how all stormwater impacts (quantity and quality) generated from the development, can be adequately mitigated through implementation of the Stormwater Management Plan, satisfying the stormwater objectives of Kempsey Shire Council and reflecting current industry best practice. This is achieved with:

- + 450m<sup>3</sup> stormwater detention basin, or similar, per Section 3.3
- + 150m<sup>2</sup> bioretention basin (within the detention basin), or similar, as per Section 4.

The report also highlights that pressure sewer, water, electricity and communications services are available for extension and connection to service the development site.

## 7. APPENDIX A – SERVICING STRATEGY PLAN







## 8. APPENDIX B – DRAINS AND MUSIC MODELLING DATA

# DRAINS DATA

## Nodes

• Pre-Development

- o ID: 1934682
- o Type: Node
- o Surface Elevation: 26
- o Max HGL: 26.0523
- o Coordinates: (X: 7552.039715, Y: -3434.056247)

• Post-Development

- o ID: 1756482
- o Type: Node
- o Surface Elevation: 26
- o Max HGL: 26.0523
- o Coordinates: (X: 8505.837959, Y: -3414.033765)

• Post-Development w OSD

- o ID: 1971528
- o Type: Node
- o Surface Elevation: 26
- o Max HGL: 26.0523
- o Coordinates: (X: 9299.456345, Y: -3419.494442)

• N1.2

- o ID: 1935119
- o Type: Node
- o Surface Elevation: 16
- o Max HGL: 16.1227
- o Coordinates: (X: 7548.399264, Y: -3712.550772)

• N1.3

- o ID: 1942972
- o Type: Node
- o Surface Elevation: 16
- o Max HGL: 16.034
- o Coordinates: (X: 7364.556473, Y: -3719.831675)

• N1.4

- o ID: 1755834
- o Type: Node
- o Surface Elevation: 14
- o Max HGL: 14.1562
- o Coordinates: (X: 7542.938587, Y: -3949.180108)

• N2.2

- o ID: 1960221
- o Type: Node
- o Surface Elevation: 16
- o Max HGL: 16.1291
- o Coordinates: (X: 8505.837959, Y: -3730.753029)

• N2.3

- o ID: 1960676
- o Type: Node
- o Surface Elevation: 16
- o Max HGL: 16.0365
- o Coordinates: (X: 8316.534491, Y: -3730.753029)

• N2.4

- o ID: 1962391
- o Type: Node
- o Surface Elevation: 14
- o Max HGL: 14.1649
- o Coordinates: (X: 8505.837959, Y: -3983.764395)

• N3

- o ID: 1756485
- o Type: Node
- o Surface Elevation: 12.29
- o Max HGL: 12.402
- o Coordinates: (X: 9303.096796, Y: -4224.034182)

• N3.2

- o ID: 1972791
- o Type: Node
- o Surface Elevation: 16
- o Max HGL: 16.1291
- o Coordinates: (X: 9297.636119, Y: -3592.415879)

• N3.3

- o ID: 1974102
- o Type: Node
- o Surface Elevation: 16
- o Max HGL: 16.0365
- o Coordinates: (X: 9124.714682, Y: -3597.876556)

• N3.4

- o ID: 1974498
- o Type: Node
- o Surface Elevation: 14
- o Max HGL: 14.1649
- o Coordinates: (X: 9297.636119, Y: -3805.382281)

• OSD

- o ID: 1756488
- o Type: Basin
- o Surface Elevation: 12
- o Max HGL: 13.0219
- o Coordinates: (X: 9301.276570, Y: -3956.461010)

• Discharge Post-dev

- o ID: 1962634
- o Type: Node
- o Surface Elevation: 13

- o Max HGL: -999
- o Coordinates: (X: 8497.343572, Y: -4411.517424)

• Discharge Pre-dev

- o ID: 1938050
- o Type: Node
- o Surface Elevation: 13
- o Max HGL: -999
- o Coordinates: (X: 7528.073411, Y: -4402.416296)

• Discharge w OSD

- o ID: 1757459
- o Type: Node
- o Surface Elevation: 12
- o Max HGL: -999
- o Coordinates: (X: 9301.276570, Y: -4400.899441)

---

## Overflow Routes

• OF1

- o ID: 1935875
- o Travel Time: 0.5
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 6.67
- o Length: 100 m
- o Max Flow: 0.399851
- o Max Velocity: 2.70078
- o Max Depth: 0.0557247
- o Max DxV: 0.140183
- o Upstream Coordinates: (X: 7552.039715, Y: -3434.056247)
- o Downstream Coordinates: (X: 7548.399264, Y: -3712.550772)

• OF1.1

- o ID: 1939196
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 0.268665
- o Max Velocity: 2.59075
- o Max Depth: 0.0409305
- o Max DxV: 0.106041
- o Upstream Coordinates: (X: 7364.556473, Y: -3719.831675)
- o Downstream Coordinates: (X: 7542.938587, Y: -3949.180108)



• **OF1.2**

- o ID: 1947060
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 2.80396
- o Max Velocity: 6.50465
- o Max Depth: 0.122792
- o Max DxV: 0.798718
- o Upstream Coordinates: (X: 7548.399264, Y: -3712.550772)
- o Downstream Coordinates: (X: 7542.938587, Y: -3949.180108)

• **OF1.3**

- o ID: 1942693
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 3.07803
- o Max Velocity: 5.44617
- o Max Depth: 0.156325
- o Max DxV: 0.851374
- o Upstream Coordinates: (X: 7542.938587, Y: -3949.180108)
- o Downstream Coordinates: (X: 7528.073411, Y: -4402.416296)

• **OF2**

- o ID: 1961876
- o Travel Time: 0.5
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 6.67
- o Length: 100 m
- o Max Flow: 0.399851
- o Max Velocity: 2.70078
- o Max Depth: 0.0557247
- o Max DxV: 0.140183
- o Upstream Coordinates: (X: 8505.837959, Y: -3414.033765)
- o Downstream Coordinates: (X: 8505.837959, Y: -3730.753029)

• **OF2.1**

- o ID: 1963485
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 0.303055
- o Max Velocity: 2.71579
- o Max Depth: 0.0429031
- o Max DxV: 0.116516
- o Upstream Coordinates: (X: 8316.534491, Y: -3730.753029)
- o Downstream Coordinates: (X: 8505.837959, Y: -3983.764395)

• **OF2.2**

- o ID: 1963215
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 3.08032
- o Max Velocity: 6.77388
- o Max Depth: 0.12871
- o Max DxV: 0.871862
- o Upstream Coordinates: (X: 8505.837959, Y: -3730.753029)
- o Downstream Coordinates: (X: 8505.837959, Y: -3983.764395)

• **OF2.3**

- o ID: 1963772
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 3.38494
- o Max Velocity: 5.6725
- o Max Depth: 0.164216
- o Max DxV: 0.931513
- o Upstream Coordinates: (X: 8505.837959, Y: -3983.764395)
- o Downstream Coordinates: (X: 8497.343572, Y: -4411.517424)

• **OF3**

- o ID: 1975251
- o Travel Time: 0.5
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3

- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 6.67
- o Length: 100 m
- o Max Flow: 0.399851
- o Max Velocity: 2.70078
- o Max Depth: 0.0557247
- o Max DxV: 0.140183
- o Upstream Coordinates: (X: 9299.456345, Y: -3419.494442)
- o Downstream Coordinates: (X: 9297.636119, Y: -3592.415879)

• **OF3.1**

- o ID: 1975653
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 0.303055
- o Max Velocity: 2.71579
- o Max Depth: 0.0429031
- o Max DxV: 0.116516
- o Upstream Coordinates: (X: 9124.714682, Y: -3597.876556)
- o Downstream Coordinates: (X: 9297.636119, Y: -3805.382281)

• **OF3.2**

- o ID: 1975553
- o Travel Time: 0.1
- o Cross Section: 4 m wide pathway
- o Safe Depth Major: 0.3
- o Safe Depth Minor: 0.15
- o Safe DxV: 0.4
- o Slope: 1.00
- o Length: 10 m
- o Max Flow: 3.08031
- o Max Velocity: 6.77385
- o Max Depth: 0.12871
- o Max DxV: 0.871859
- o Upstream Coordinates: (X: 9297.636119, Y: -3592.415879)
- o Downstream Coordinates: (X: 9297.636119, Y: -3805.382281)

---

**Catchments**

• **C1-1, 1-2, 1-3 (Pre-dev)**

- o ID: 1755782
- o Area: 3.6 ha
- o Paved Percentage: 20%
- o Grassed Percentage: 80%
- o Max Flow: 2.41573
- o Coordinates: (X: 7571.439691, Y: -3713.990799)

• C1-4 (Pre-dev)

- o ID: 1933643
- o Area: 0.4 ha
- o Paved Percentage: 20%
- o Grassed Percentage: 80%
- o Max Flow: 0.268415
- o Coordinates: (X: 7387.596899, Y: -3719.831675)

• C3 -1(Pre-dev)

- o ID: 1971283
- o Area: 0.6 ha
- o Paved Percentage: 20%
- o Grassed Percentage: 80%
- o Max Flow: 0.402622
- o Coordinates: (X: 9299.456345, Y: -3397.894042)

• C3- 1 (Pre-dev)

- o ID: 1756015
- o Area: 0.6 ha
- o Paved Percentage: 20%
- o Grassed Percentage: 80%
- o Max Flow: 0.402622
- o Coordinates: (X: 8502.957906, Y: -3393.873392)

• C3-1 (Pre-dev)

- o ID: 1933127
- o Area: 0.6 ha
- o Paved Percentage: 20%
- o Grassed Percentage: 80%
- o Max Flow: 0.402622
- o Coordinates: (X: 7553.479742, Y: -3412.455847)

C 1-1, 1-2, 1-3 (Post-dev)

- o ID: 1961239
- o Area: 3.6 ha
- o Paved Percentage: 95%
- o Grassed Percentage: 5%
- o Max Flow: 2.72048
- o Coordinates: (X: 8525.249518, Y: -3729.543407)

• C 1-4 (Post-dev)

- o ID: 1961545
- o Area: 0.4 ha
- o Paved Percentage: 95%
- o Grassed Percentage: 5%
- o Max Flow: 0.302275
- o Coordinates: (X: 8338.134891, Y: -3730.753029)

• C1 -1, 1-2, 1-3 (Post-dev)

- o ID: 1973062
- o Area: 3.6 ha
- o Paved Percentage: 95%
- o Grassed Percentage: 5%
- o Max Flow: 2.72048
- o Coordinates: (X: 9319.236519, Y: -3593.855906)

• C1 -4 (Post-dev)

- o ID: 1973625
- o Area: 0.4 ha
- o Paved Percentage: 95%
- o Grassed Percentage: 5%
- o Max Flow: 0.302275
- o Coordinates: (X: 9150.635162, Y: -3597.876556)

MUSIC DATA

Source nodes				
Location	Post 3.4ha	Pre 4.4ha	Post 0.4ha	Post 0.6ha
ID	4	5	6	7
Node Type	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode	UrbanSourceNode
Zoning Surface Type	Industrial	Mixed	Industrial	Mixed
Total Area (ha)	3.4	4.4	0.4	0.6
Area Impervious (ha)	3.22061194	0.901179104	0.378895522	0.12288806
Area Pervious (ha)	0.17938806	3.498820896	0.021104478	0.47711194
Field Capacity (mm)	70	70	70	70
Pervious Area Infiltration Capacity coefficient - a	180	180	180	180
Pervious Area Infiltration Capacity exponent - b	3	3	3	3
Impervious Area Rainfall Threshold (mm/day)	1	1	1	1
Pervious Area Soil Storage Capacity (mm)	88	88	88	88
Pervious Area Soil Initial Storage (% of Capacity)	25	25	25	25
Groundwater Initial Depth (mm)	10	10	10	10
Groundwater Daily Recharge Rate (%)	25	25	25	25
Groundwater Daily Baseflow Rate (%)	25	25	25	25
Groundwater Daily Deep Seepage Rate (%)	0	0	0	0
Stormflow Total Suspended Solids Mean (log mg/L)	2.15	1.95	2.15	1.95
Stormflow Total Suspended Solids Standard Deviation (log mg/L)	0.32	0.32	0.32	0.32
Stormflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Suspended Solids Serial Correlation	0	0	0	0
Stormflow Total Phosphorus Mean (log mg/L)	-0.6	-0.66	-0.6	-0.66
Stormflow Total Phosphorus Standard Deviation (log mg/L)	0.25	0.25	0.25	0.25
Stormflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Phosphorus Serial Correlation	0	0	0	0
Stormflow Total Nitrogen Mean (log mg/L)	0.3	0.3	0.3	0.3
Stormflow Total Nitrogen Standard Deviation (log mg/L)	0.19	0.19	0.19	0.19
Stormflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic
Stormflow Total Nitrogen Serial Correlation	0	0	0	0
Baseflow Total Suspended Solids Mean (log mg/L)	1.2	1.15	1.2	1.15
Baseflow Total Suspended Solids Standard Deviation (log mg/L)	0.17	0.17	0.17	0.17
Baseflow Total Suspended Solids Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Suspended Solids Serial Correlation	0	0	0	0
Baseflow Total Phosphorus Mean (log mg/L)	-0.85	-1.22	-0.85	-1.22
Baseflow Total Phosphorus Standard Deviation (log mg/L)	0.19	0.19	0.19	0.19
Baseflow Total Phosphorus Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Phosphorus Serial Correlation	0	0	0	0
Baseflow Total Nitrogen Mean (log mg/L)	0.11	-0.05	0.11	-0.05
Baseflow Total Nitrogen Standard Deviation (log mg/L)	0.12	0.12	0.12	0.12
Baseflow Total Nitrogen Estimation Method	Stochastic	Stochastic	Stochastic	Stochastic
Baseflow Total Nitrogen Serial Correlation	0	0	0	0
Flow based constituent generation - enabled	Off	Off	Off	Off
Flow based constituent generation - flow file				
Flow based constituent generation - base flow column				
Flow based constituent generation - pervious flow column				
Flow based constituent generation - impervious flow column				
Flow based constituent generation - unit				
OUT - Mean Annual Flow (ML/yr)	53.3	40.6	6.27	5.54
OUT - TSS Mean Annual Load (kg/yr)	8.97E+03	4.36E+03	1.14E+03	595

OUT - TP Mean Annual Load (kg/yr)	15.8	8.53	1.88	1.16
OUT - TN Mean Annual Load (kg/yr)	119	89.8	14.2	12.2
OUT - Gross Pollutant Mean Annual Load (kg/yr)	1.16E+03	573	136	78.1
Rain In (ML/yr)	59.5655	77.0846	7.00769	10.5116
ET Loss (ML/yr)	6.257	35.9354	0.736117	4.90029
Deep Seepage Loss (ML/yr)	0	0	0	0
Baseflow Out (ML/yr)	0.218606	4.52642	0.0257183	0.61724
Imp. Stormflow Out (ML/yr)	52.0054	14.1687	6.11829	1.93209
Perv. Stormflow Out (ML/yr)	1.05864	21.9201	0.124546	2.9891
Total Stormflow Out (ML/yr)	53.0641	36.0888	6.24283	4.92119
Total Outflow (ML/yr)	53.2827	40.6152	6.26855	5.53843
Change in Soil Storage (ML/yr)	0.0257923	0.53405	0.00303425	0.072825
TSS Baseflow Out (kg/yr)	3.71568	67.7766	0.44635	9.24227
TSS Total Stormflow Out (kg/yr)	8967.53	4294.52	1141.33	585.616
TSS Total Outflow (kg/yr)	8971.24	4362.3	1141.78	594.859
TP Baseflow Out (kg/yr)	0.0335978	0.311804	0.004188	0.0425188
TP Total Stormflow Out (kg/yr)	15.7914	8.22174	1.87135	1.12115
TP Total Outflow (kg/yr)	15.825	8.53354	1.87553	1.16366
TN Baseflow Out (kg/yr)	0.291088	4.24089	0.034691	0.578303
TN Total Stormflow Out (kg/yr)	118.333	85.5108	14.2059	11.6606
TN Total Outflow (kg/yr)	118.624	89.7517	14.2405	12.2389
GP Total Outflow (kg/yr)	1163.21	610.359	136.848	83.2307
No Imported Data Source nodes				
USTM treatment nodes				
Location	Bioretention			
ID	3			
Node Type	BioRetentionNodeV4			
Lo-flow bypass rate (cum/sec)	0			
Hi-flow bypass rate (cum/sec)	100			
Inlet pond volume				
Area (sqm)	400			
Initial Volume (m^3)				
Extended detention depth (m)	0.4			
Number of Rainwater tanks				
Permanent Pool Volume (cubic metres)				
Proportion vegetated				
Equivalent Pipe Diameter (mm)				
Overflow weir width (m)	5			
Notional Detention Time (hrs)				
Orifice Discharge Coefficient				
Weir Coefficient	1.7			
Number of CSTR Cells	3			
Total Suspended Solids - k (m/yr)	8000			
Total Suspended Solids - C* (mg/L)	20			
Total Suspended Solids - C** (mg/L)				
Total Phosphorus - k (m/yr)	6000			
Total Phosphorus - C* (mg/L)	0.13			
Total Phosphorus - C** (mg/L)				

Total Nitrogen - k (m/yr)	500			
Total Nitrogen - C* (mg/L)	1.4			
Total Nitrogen - C** (mg/L)				
Threshold Hydraulic Loading for C** (m/yr)				
Horizontal Flow Coefficient	3			
Reuse Enabled	Off			
Max drawdown height (m)				
Annual Demand Enabled	Off			
Annual Demand Value (ML/year)				
Annual Demand Distribution				
Annual Demand Monthly Distribution: Jan				
Annual Demand Monthly Distribution: Feb				
Annual Demand Monthly Distribution: Mar				
Annual Demand Monthly Distribution: Apr				
Annual Demand Monthly Distribution: May				
Annual Demand Monthly Distribution: Jun				
Annual Demand Monthly Distribution: Jul				
Annual Demand Monthly Distribution: Aug				
Annual Demand Monthly Distribution: Sep				
Annual Demand Monthly Distribution: Oct				
Annual Demand Monthly Distribution: Nov				
Annual Demand Monthly Distribution: Dec				
Daily Demand Enabled	Off			
Daily Demand Value (ML/day)				
Custom Demand Enabled	Off			
Custom Demand Time Series File				
Custom Demand Time Series Units				
Filter area (sqm)	150			
Filter perimeter (m)	50			
Filter depth (m)	0.4			
Filter Median Particle Diameter (mm)				
Saturated Hydraulic Conductivity (mm/hr)	100			
Infiltration Media Porosity	0.35			
Length (m)				
Bed slope				
Base Width (m)				
Top width (m)				
Vegetation height (m)				
Vegetation Type	Vegetated with Effective Nutrient Removal Plants			
Total Nitrogen Content in Filter (mg/kg)	400			
Orthophosphate Content in Filter (mg/kg)	35			
Is Base Lined?	No			
Is Underdrain Present?	Yes			
Is Submerged Zone Present?	Yes			
Submerged Zone Depth (m)	0.3			
B for Media Soil Texture	13			
Proportion of upstream impervious area treated				
Exfiltration Rate (mm/hr)	3.6			
Evaporative Loss as % of PET	100			
Depth in metres below the drain pipe				



TSS A Coefficient				
TSS B Coefficient				
TP A Coefficient				
TP B Coefficient				
TN A Coefficient				
TN B Coefficient				
Sfc	0.61			
S*	0.37			
Sw	0.11			
Sh	0.05			
E <sub>max</sub> (m/day)	0.008			
E <sub>w</sub> (m/day)	0.001			
IN - Mean Annual Flow (ML/yr)	65.1			
IN - TSS Mean Annual Load (kg/yr)	1.07E+04			
IN - TP Mean Annual Load (kg/yr)	18.9			
IN - TN Mean Annual Load (kg/yr)	145			
IN - Gross Pollutant Mean Annual Load (kg/yr)	1.37E+03			
OUT - Mean Annual Flow (ML/yr)	60.5			
OUT - TSS Mean Annual Load (kg/yr)	1.30E+03			
OUT - TP Mean Annual Load (kg/yr)	8.4			
OUT - TN Mean Annual Load (kg/yr)	76.9			
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0			
Flow In (ML/yr)	65.0896			
ET Loss (ML/yr)	0.404719			
Infiltration Loss (ML/yr)	4.15718			
Low Flow Bypass Out (ML/yr)	0			
High Flow Bypass Out (ML/yr)	0			
Orifice / Filter Out (ML/yr)	33.6384			
Weir Out (ML/yr)	26.8872			
Transfer Function Out (ML/yr)	0			
Reuse Supplied (ML/yr)	0			
Reuse Requested (ML/yr)	0			
% Reuse Demand Met	0			
% Load Reduction	7.01187			
TSS Flow In (kg/yr)	10707.9			
TSS ET Loss (kg/yr)	0			
TSS Infiltration Loss (kg/yr)	47.5535			
TSS Low Flow Bypass Out (kg/yr)	0			
TSS High Flow Bypass Out (kg/yr)	0			
TSS Orifice / Filter Out (kg/yr)	66.3419			
TSS Weir Out (kg/yr)	1237.26			
TSS Transfer Function Out (kg/yr)	0			
TSS Reuse Supplied (kg/yr)	0			
TSS Reuse Requested (kg/yr)	0			
TSS % Reuse Demand Met	0			
TSS % Load Reduction	87.8257			
TP Flow In (kg/yr)	18.8642			
TP ET Loss (kg/yr)	0			
TP Infiltration Loss (kg/yr)	0.512513			
TP Low Flow Bypass Out (kg/yr)	0			

TP High Flow Bypass Out (kg/yr)	0			
TP Orifice / Filter Out (kg/yr)	3.81084			
TP Weir Out (kg/yr)	4.59221			
TP Transfer Function Out (kg/yr)	0			
TP Reuse Supplied (kg/yr)	0			
TP Reuse Requested (kg/yr)	0			
TP % Reuse Demand Met	0			
TP % Load Reduction	55.455			
TN Flow In (kg/yr)	145.104			
TN ET Loss (kg/yr)	0			
TN Infiltration Loss (kg/yr)	4.08404			
TN Low Flow Bypass Out (kg/yr)	0			
TN High Flow Bypass Out (kg/yr)	0			
TN Orifice / Filter Out (kg/yr)	20.1831			
TN Weir Out (kg/yr)	56.6868			
TN Transfer Function Out (kg/yr)	0			
TN Reuse Supplied (kg/yr)	0			
TN Reuse Requested (kg/yr)	0			
TN % Reuse Demand Met	0			
TN % Load Reduction	47.0241			
GP Flow In (kg/yr)	1372.8			
GP ET Loss (kg/yr)	0			
GP Infiltration Loss (kg/yr)	0			
GP Low Flow Bypass Out (kg/yr)	0			
GP High Flow Bypass Out (kg/yr)	0			
GP Orifice / Filter Out (kg/yr)	0			
GP Weir Out (kg/yr)	0			
GP Transfer Function Out (kg/yr)	0			
GP Reuse Supplied (kg/yr)	0			
GP Reuse Requested (kg/yr)	0			
GP % Reuse Demand Met	0			
GP % Load Reduction	100			
PET Scaling Factor	2.1			
No Generic treatment nodes				
Other nodes				
Location	Post-Development Node	Pre-Development Node		
ID	1	2		
Node Type	PostDevelopmentNode	PreDevelopmentNode		
IN - Mean Annual Flow (ML/yr)	60.5	40.6		
IN - TSS Mean Annual Load (kg/yr)	1.30E+03	4.36E+03		
IN - TP Mean Annual Load (kg/yr)	8.4	8.53		
IN - TN Mean Annual Load (kg/yr)	76.9	89.8		
IN - Gross Pollutant Mean Annual Load (kg/yr)	0	573		
OUT - Mean Annual Flow (ML/yr)	60.5	40.6		
OUT - TSS Mean Annual Load (kg/yr)	1.30E+03	4.36E+03		
OUT - TP Mean Annual Load (kg/yr)	8.4	8.53		
OUT - TN Mean Annual Load (kg/yr)	76.9	89.8		
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0	573		

% Load Reduction	7.01	0			
TSS % Load Reduction	87.8	0			
TN % Load Reduction	47	0			
TP % Load Reduction	55.5	0			
GP % Load Reduction	100	0			
Links					
Location	Drainage Link	Drainage Link	Drainage Link	Drainage Link	Drainage Link
Source node ID	3	4	5	6	7
Target node ID	1	3	2	3	3
Muskingum-Cunge Routing	Not Routed	Not Routed	Not Routed	Not Routed	Not Routed
Muskingum K					
Muskingum theta					
IN - Mean Annual Flow (ML/yr)	60.5	53.3	40.6	6.27	5.54
IN - TSS Mean Annual Load (kg/yr)	1.30E+03	8.97E+03	4.36E+03	1.14E+03	595
IN - TP Mean Annual Load (kg/yr)	8.4	15.8	8.53	1.88	1.16
IN - TN Mean Annual Load (kg/yr)	76.9	119	89.8	14.2	12.2
IN - Gross Pollutant Mean Annual Load (kg/yr)	0	1.16E+03	573	136	78.1
OUT - Mean Annual Flow (ML/yr)	60.5	53.3	40.6	6.27	5.54
OUT - TSS Mean Annual Load (kg/yr)	1.30E+03	8.97E+03	4.36E+03	1.14E+03	595
OUT - TP Mean Annual Load (kg/yr)	8.4	15.8	8.53	1.88	1.16
OUT - TN Mean Annual Load (kg/yr)	76.9	119	89.8	14.2	12.2
OUT - Gross Pollutant Mean Annual Load (kg/yr)	0	1.16E+03	573	136	78.1
Catchment Details					
Catchment Name	6928-Pre and Post				
Timestep	Day				
Start Date	1/01/1972				
End Date	31/12/1975				
Rainfall Station	Coastal_MUSIC				
ET Station	Coastal_MUSIC				
Mean Annual Rainfall (mm)	1752				
Mean Annual ET (mm)	1484				