



PLANS AND DOCUMENTS  
referred to in the PDA  
DEVELOPMENT APPROVAL

Approval no: DEV2016/768

Date: 4 March 2021



# Mirvac

## Everleigh Stormwater Masterplan

Report

2 December 2020

M43000\_023-REP-701-4

Job no. and Project Name: M43000\_023 Everleigh Stormwater Masterplan  
Doc Path File: \\online.com\files\Management\Projects\M43000\_Mirvac\M43000\_023 Everleigh Masterplan Update\07  
Deliv\Docs\Report\Revs\M43000\_023-REP-701-3-Everleigh Stormwater Masterplan.docx

| Rev | Date       | Description      | Author                       | Reviewer     | Project Mgr. | Approver     |
|-----|------------|------------------|------------------------------|--------------|--------------|--------------|
| 0   | 4/09/2020  | Draft for Review | Kelsey Mundt/ John<br>Nguyen | Daniel Niven | David Sexton | Mark Page    |
| 1   | 15/10/2020 | For Approval     | Kelsey Mundt/ John<br>Nguyen | David Sexton | David Sexton | Daniel Niven |
| 2   | 16/10/2020 | For Approval     | Kelsey Mundt/ John<br>Nguyen | David Sexton | David Sexton | Daniel Niven |
| 3   | 2/12/2020  | For Approval     | Kelsey Mundt/ John<br>Nguyen | David Sexton | David Sexton | Daniel Niven |

Signatures



#### DISCLAIMER

This Report has been prepared on behalf of and for the exclusive use of Mirvac and is subject to and issued in accordance with Mirvac instruction to Engeny Water Management (Engeny). The content of this Report was based on previous information and studies supplied by Mirvac.

Engeny accepts no liability or responsibility whatsoever for it in respect of any use of or reliance upon this Report by any third party. Copying this Report without the permission of Mirvac or Engeny is not permitted.

# Contents

|          |                                         |           |
|----------|-----------------------------------------|-----------|
| <b>1</b> | <b>INTRODUCTION</b>                     | <b>3</b>  |
| <b>2</b> | <b>SITE DETAILS</b>                     | <b>4</b>  |
| 2.1      | SITE LOCATION                           | 4         |
| 2.2      | SITE ENCUMBRANCES                       | 4         |
| 2.3      | TOPOGRAPHY AND DRAINAGE                 | 4         |
| 2.4      | LAWFUL POINTS OF DISCHARGE              | 4         |
| 2.5      | PROPOSED DEVELOPMENT                    | 6         |
| <b>3</b> | <b>STORMWATER QUANTITY MANAGEMENT</b>   | <b>7</b>  |
| 3.1      | SUMMARY OF STRATEGY                     | 7         |
| 3.2      | MODELLING APPROACH                      | 7         |
| 3.3      | SUMMARY OF STORMWATER DETENTION         | 7         |
| <b>4</b> | <b>STORMWATER QUALITY MANAGEMENT</b>    | <b>12</b> |
| 4.1      | SUMMARY OF STRATEGY                     | 12        |
| 4.1.1    | Treatment Types                         | 12        |
| 4.2      | MODELLING APPROACH                      | 13        |
| 4.3      | SUMMARY OF STORMWATER QUALITY TREATMENT | 14        |
| <b>5</b> | <b>SUMMARY</b>                          | <b>17</b> |
| <b>6</b> | <b>QUALIFICATIONS</b>                   | <b>18</b> |
| <b>7</b> | <b>REFERENCES</b>                       | <b>19</b> |

## Appendices

|             |                               |    |
|-------------|-------------------------------|----|
| Appendix A: | Development Layout            | 20 |
| Appendix B: | Design Standards              | 22 |
| Appendix C: | Stormwater Quantity Modelling | 25 |
| Appendix D: | XPRAFTS Catchment Parameters  | 5  |
| Appendix E: | ARR 2019 Data Hub Output      | 11 |

|                                              |    |
|----------------------------------------------|----|
| Appendix F: Stormwater Quality Modelling     | 13 |
| Appendix G: Media – Data Sheet               | 7  |
| Appendix H: Stormwater Harvesting Conditions | 9  |

---

#### List of Tables

|                                                      |    |
|------------------------------------------------------|----|
| Table 3.1: Detention Basin Requirements              | 7  |
| Table 3.2: Peak Flow Reporting Summary               | 8  |
| Table 4.1: Adopted Water Quality Objectives          | 14 |
| Table 4.2: Proposed Water Quality Treatment Measures | 14 |

---

#### List of Figures

|                                                                        |    |
|------------------------------------------------------------------------|----|
| Figure 2.1: Site Locality                                              | 5  |
| Figure 2.2: Proposed Development Layout                                | 6  |
| Figure 3.1: Detention Locations and Contributing Catchments            | 11 |
| Figure 4.1: Existing Eroded Creek Line within the Site                 | 13 |
| Figure 4.2: Stormwater Treatment Locations and Contributing Catchments | 16 |

---



# 1 INTRODUCTION

This document acts as the Stormwater Masterplan (Masterplan) for Mirvac's Everleigh development. The development comprises of an approximate 3,450 lot residential subdivision located at Teviot Road, Greenbank (the Site). Everleigh sits within the Logan City Council Local Government Area (LGA), however the Site falls within a declared Priority Development Area (PDA), with the assessing authority being Economic Development Queensland (EDQ).

This Masterplan comprises of the following:

- Stormwater quantity management – quantification of changes in catchment hydrology as a result of the development and the required stormwater detention infrastructure in order to meet mitigation targets.
- Stormwater quality management – modelling and specification of a stormwater quality treatment train to demonstrate compliance with relevant guidelines.

The Masterplan has been prepared with reference to the following key guidelines and planning documents:

- Logan City Council Planning Scheme (LCC, 2015).
- Queensland Urban Drainage Manual (QUDM) (IPWEAQ, 2017).
- Australian Rainfall and Runoff (ARR) (Ball et. al., 2019).
- MUSIC Modelling Guidelines (Water By Design, 2018).
- Framework for the Integration of Flooding and Stormwater Management into Open Space (Water By Design, 2011).
- State Planning Policy (DILGP, 2017).

As staging of the development progresses, individual Stormwater Management Plans (SMP) for each Reconfiguration of Lot (ROL) will be produced. The management strategy in these SMPs will remain consistent with this Masterplan, however, minor changes to the infrastructure based on detailed design will be reflected in the SMPs.

## 2 SITE DETAILS

### 2.1 SITE LOCATION

The Site is located off Greenbank Road and Teviot Road, Greenbank. The Site originally comprises Lot 434 on RP845844, Lot 9 on S312355 and Lot 205 on RP 854844, is approximately 481 hectares in size and was used as farmland (predominately grazing). The total yield is anticipated to be in the order of 3,450 lots. The location of the Site is presented in Figure 2.1.

### 2.2 SITE ENCUMBRANCES

The Site is currently encumbered by the following:

- Four primary drainage lines (Tributaries of Norris Creek) that traverse the Site generally in a West- East direction.
- Two existing farm dams that have an impact on attenuation of pre-developed flows (proposed for removal).
- Easements over two services on the northern border of the Site (power and water).
- Environmental constraints, with applicable conservation reserve.

### 2.3 TOPOGRAPHY AND DRAINAGE

The Site is located in the Logan River catchment and the current site topography and drainage characteristics are described as follows:

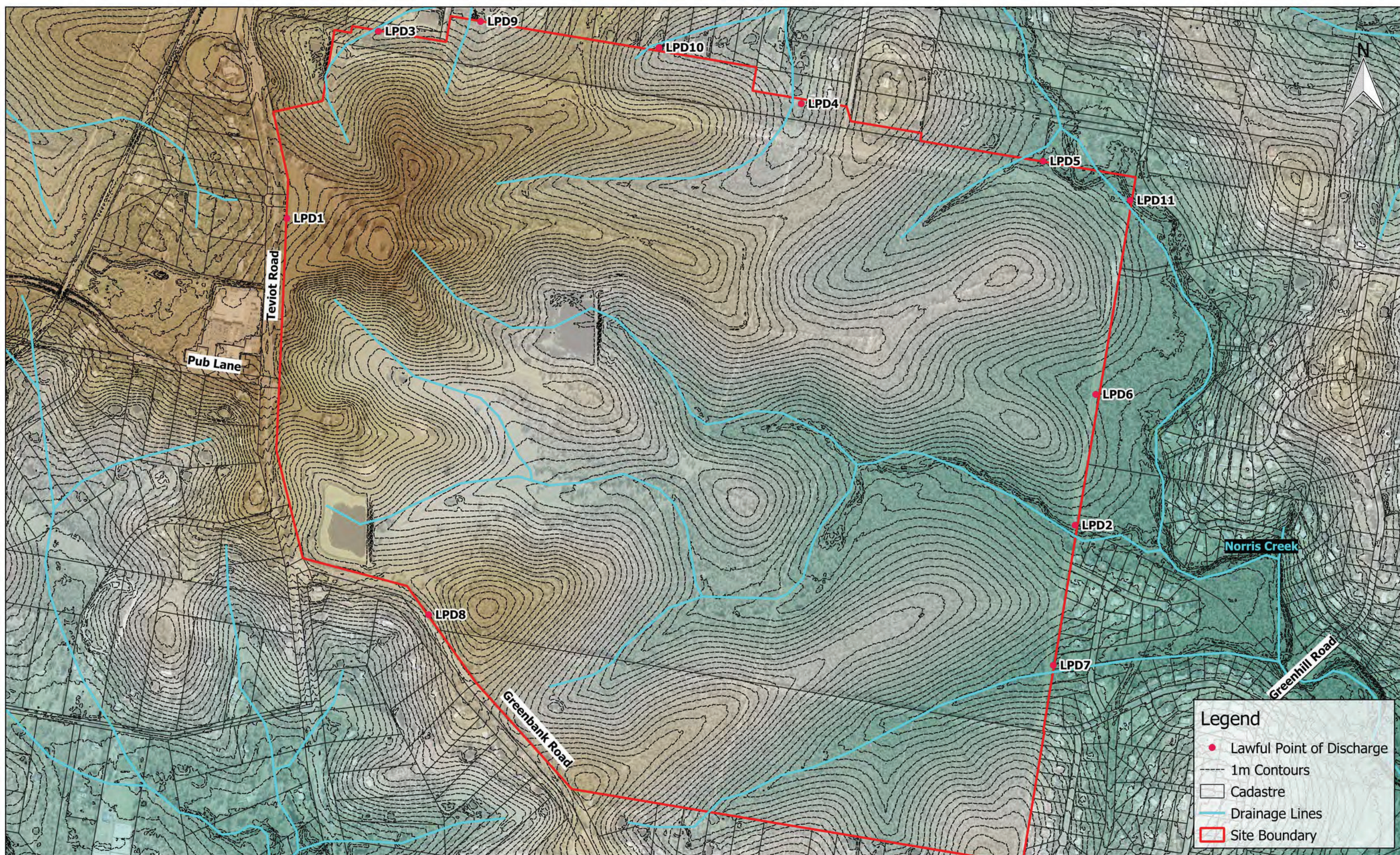
- Elevations on the Site range from 25 to 78 m AHD.
- Minimal upstream catchment, the majority of the upstream catchment comprises the Site.
- Drainage lines are well defined and provide the Lawful Point of Discharge (LPD) for Site runoff at the development boundary. The predominant drainage lines flows from west to east across the Site before discharging into the Logan River through Norris Creek. An additional drainage line is located south of the major drainage line and also flows towards the east. Three minor drainage lines flow across the northern boundary.

Site topography and main drainage lines are shown in Figure 2.1.

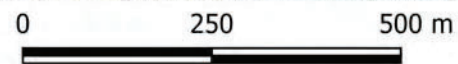
### 2.4 LAWFUL POINTS OF DISCHARGE

When land is developed, the roof and stormwater runoff from that land and any external catchment (draining through the development site) must be discharged to a defined lawful point of discharge (LPD). The LPDs to be retained following development of the Site have been identified in accordance with the relevant guidelines (refer Appendix B) and are also shown on Figure 2.1.





Level 7, 500 Queen St Brisbane QLD 4000  
PO Box 10183 Brisbane QLD 4000  
www.engeny.com.au  
P: 03 3221 7174  
F: 03 3236 2399



Scale in metres ( 1:10000@ A3)  
Map Projection: Tranverse Mercator  
Horizontal Datum: Geocentric Datum of Australia  
Vertical Datum: Australia Height Datum  
Grid: Map Grid of Australia, Zone 56

Everleigh Masterplan Update

Figure 2.1  
Site Locality

Job Number:  
M43000\_023  
Revision: 0  
Drawn: KM  
Date: 22 /10 /2020



## 2.5 PROPOSED DEVELOPMENT

The proposed development site is approximately 481 hectares. The predominant post-development land use will be approximately 3,450 residential lots. There will be two main residential land use types:

- Residential – Standard Lots at 15 dwellings per hectare.
- Residential – Interface Lots at 2.4 dwellings per hectare.

In addition, the development will also contain a neighbourhood centre, community facility, school and linear/neighbourhood and recreational parks. A portion of the Site will remain undeveloped as it is identified as forming part of Logan City Council's Conservation Parkland.

Figure 2.2 presents the key details of the proposed layout, with the full Masterplan layout included in Appendix A.



**Figure 2.2: Proposed Development Layout**

# 3 STORMWATER QUANTITY MANAGEMENT

## 3.1 SUMMARY OF STRATEGY

A stormwater quantity management strategy has been developed to ensure non-worsening at all site LPDs, in accordance with the relevant design standards for the Site (refer Appendix B). The strategy involves the strategic placement of stormwater detention on key drainage flow paths. By utilising timing of run-off from various catchments, the full development footprint of the Site has not been required to be detained. The following sections outline the key modelling details and a summary of the proposed stormwater detention infrastructure.

## 3.2 MODELLING APPROACH

The stormwater quantity management strategy has been supported through the hydrologic software XPRAFTS. The assessment considered the following scenario:

- Existing scenario (the Site in its condition prior to any development works).
- Post-development scenario (the Site with ultimate proposed land-use), and,
- Mitigated post-development scenario (the Site with ultimate proposed land-use including mitigation basins).

An assessment of peak flows was completed reviewing each of the LPDs and the downstream Greenhill Road where the site sub-catchments ultimately combine. The various stormwater detention basins required to mitigate post-development flows were sized to ensure no adverse peak flood flows occur downstream.

The complete details of the hydrologic modelling are provided in Appendix C.

## 3.3 SUMMARY OF STORMWATER DETENTION

The resultant proposed detention 1:100 AEP basin volumes and footprints, proposed outlet configuration and the respective LPD identification number is provided in Table 3.1, with the existing scenario, post-development scenario and post-development mitigated scenario peak flows provided in Table 3.2.

Peak flow reporting is provided below for LPDs 1-8, where either an increase to the impervious fraction or an increase to the contributing catchment is expected within the contributing catchments. At LPDs 9-11, no increases to impervious fraction or catchment area are proposed due to the retainment of pre-development conditions, with flows equal or less than those in the existing scenario, and hence peak flow reporting has not been provided. Due to the alignment of the property boundaries to the topography, sheet flow is also observed at some boundary locations outside of the proposed LPDs. As this discharge is not from a defined flow path, and no change to impervious fraction or catchment area is proposed post-development at these locations, these localities have not been defined as formal LPDs, nor is peak flow reporting provided for these localities.

The location of the detention basins and the contributing catchments is shown on Figure 3.1.

**Table 3.1: Detention Basin Requirements**

| Catchment ID | Basin ID | 1% AEP Stored Volume (m <sup>3</sup> ) | 1% AEP Approximate Footprint (m <sup>2</sup> ) | Proposed Outlet Configuration                                 | LPD ID |
|--------------|----------|----------------------------------------|------------------------------------------------|---------------------------------------------------------------|--------|
| 2            | D2       | 86,700                                 | 32,000                                         | 3/1200x1200 RCBCs at invert<br>5/1500x600 RCBCs at 1.9m depth | 2      |



| Catchment ID | Basin ID | 1% AEP Stored Volume (m <sup>3</sup> ) | 1% AEP Approximate Footprint (m <sup>2</sup> ) | Proposed Outlet Configuration                                                   | LPD ID |
|--------------|----------|----------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------|--------|
| 3            | D3       | 8,500                                  | 9,500                                          | 4/300 RCPs at invert<br>6/300 RCPs at 0.55m depth<br>5m spillway at 1.45m depth | 3      |
| 4            | D4       | 23,233                                 | 42,000                                         | 5/600x600 RCBCs at invert<br>8/1200x300 RCBCs at 0.67m depth                    | 4      |
| 5 (Bypassed) | -        | -                                      | -                                              | -                                                                               | 5      |
| 6 (Bypassed) | -        | -                                      | -                                              | -                                                                               | 2      |
| 7 (Bypassed) | -        | -                                      | -                                              | -                                                                               | 6      |
| 8            | D8       | 10,000                                 | 10,000                                         | 1/225 RCP at Invert<br>20m spillway at 1.5m depth                               | 2      |
| 9 (Bypassed) | -        | -                                      | -                                              | -                                                                               | 7      |
| 10           | D10      | 7,100                                  | 6,400                                          | 4/675 RCPs at invert<br>10m spillway at 1.5m depth                              | 7      |

**Table 3.2: Peak Flow Reporting Summary**

| LPD 1     | Existing Scenario Peak Flow (m <sup>3</sup> /s) | Post-Development Scenario Peak Flow (m <sup>3</sup> /s) | Post-Development Mitigated Scenario Peak Flow (m <sup>3</sup> /s) | Reduction in Peak Flow (%) |
|-----------|-------------------------------------------------|---------------------------------------------------------|-------------------------------------------------------------------|----------------------------|
| 1:100 AEP | 1.95                                            | 0.69                                                    | N/A*                                                              | -64%                       |
| 1:50 AEP  | 1.67                                            | 0.60                                                    | N/A*                                                              | -64%                       |
| 1:20 AEP  | 1.08                                            | 0.52                                                    | N/A*                                                              | -52%                       |
| 1:10 AEP  | 0.84                                            | 0.42                                                    | N/A*                                                              | -50%                       |
| 1:5 AEP   | 0.62                                            | 0.36                                                    | N/A*                                                              | -42%                       |
| 1:2 AEP   | 0.38                                            | 0.28                                                    | N/A*                                                              | -25%                       |
| LPD 2     | Existing Scenario Peak Flow (m <sup>3</sup> /s) | Post-Development Scenario Peak Flow (m <sup>3</sup> /s) | Post-Development Mitigated Scenario Peak Flow (m <sup>3</sup> /s) | Reduction in Peak Flow (%) |
| 1:100 AEP | 40.97                                           | 60.93                                                   | 39.52                                                             | -4%                        |
| 1:50 AEP  | 33.77                                           | 52.87                                                   | 32.69                                                             | -3%                        |
| 1:20 AEP  | 25.93                                           | 42.94                                                   | 24.42                                                             | -6%                        |
| 1:10 AEP  | 19.95                                           | 35.60                                                   | 19.91                                                             | 0%                         |

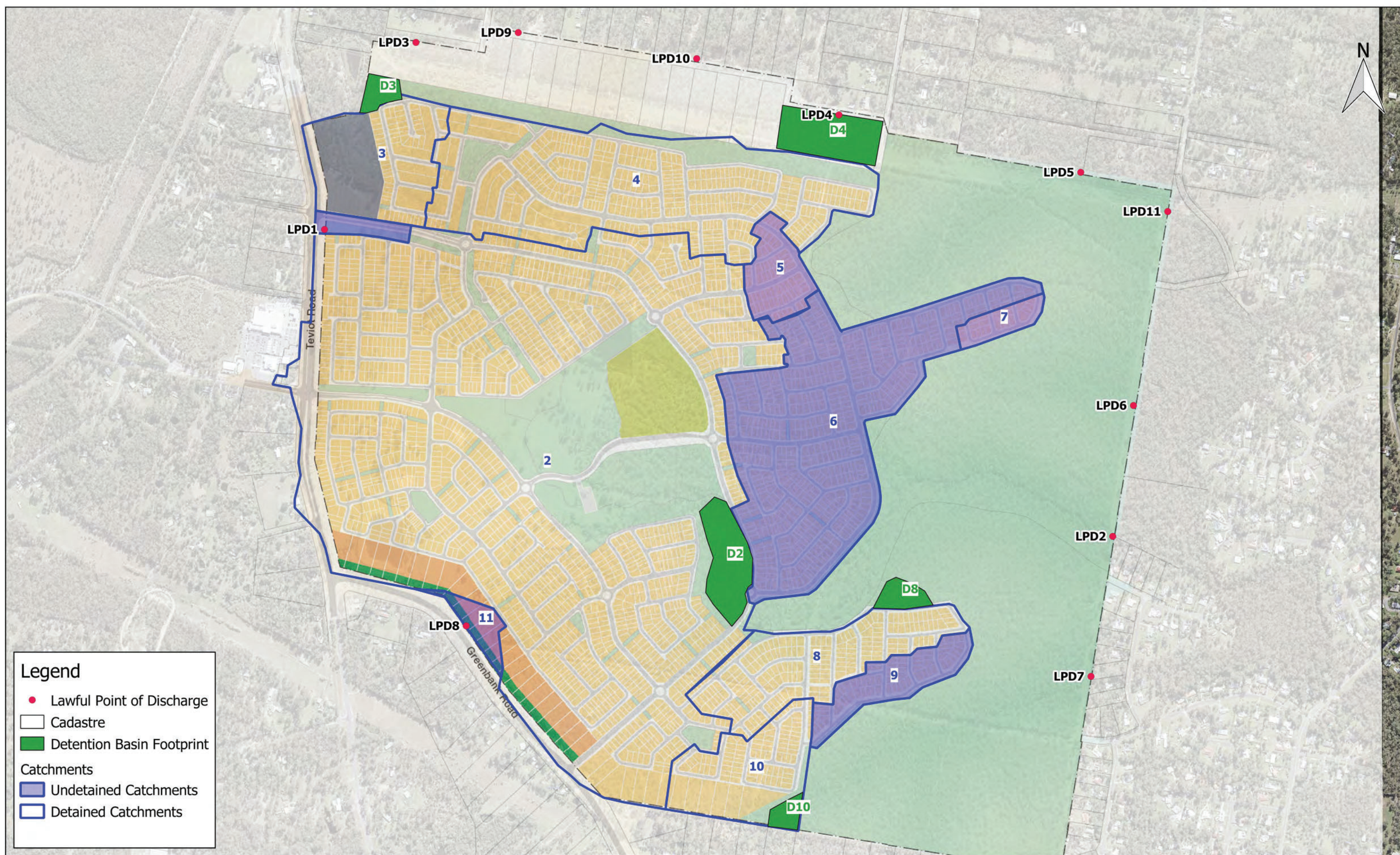
|              |                                           |                                                   |                                                             |                                   |
|--------------|-------------------------------------------|---------------------------------------------------|-------------------------------------------------------------|-----------------------------------|
| 1:5 AEP      | 15.79                                     | 28.63                                             | 15.07                                                       | -5%                               |
| 1:2 AEP      | 9.40                                      | 20.77                                             | 9.36                                                        | 0%                                |
| <b>LPD 3</b> | <b>Existing Scenario Peak Flow (m³/s)</b> | <b>Post-Development Scenario Peak Flow (m³/s)</b> | <b>Post-Development Mitigated Scenario Peak Flow (m³/s)</b> | <b>Reduction in Peak Flow (%)</b> |
| 1:100 AEP    | 2.38                                      | 7.53                                              | 2.31                                                        | -3%                               |
| 1:50 AEP     | 2.03                                      | 6.96                                              | 1.60                                                        | -21%                              |
| 1:20 AEP     | 1.56                                      | 5.80                                              | 1.30                                                        | -16%                              |
| 1:10 AEP     | 1.17                                      | 5.04                                              | 1.16                                                        | -1%                               |
| 1:5 AEP      | 0.90                                      | 4.27                                              | 0.87                                                        | -3%                               |
| 1:2 AEP      | 0.52                                      | 3.33                                              | 0.47                                                        | -10%                              |
| <b>LPD 4</b> | <b>Existing Scenario Peak Flow (m³/s)</b> | <b>Post-Development Scenario Peak Flow (m³/s)</b> | <b>Post-Development Mitigated Scenario Peak Flow (m³/s)</b> | <b>Reduction in Peak Flow (%)</b> |
| 1:100 AEP    | 8.13                                      | 18.62                                             | 7.58                                                        | -7%                               |
| 1:50 AEP     | 6.52                                      | 16.66                                             | 6.27                                                        | -4%                               |
| 1:20 AEP     | 4.56                                      | 13.89                                             | 4.47                                                        | -2%                               |
| 1:10 AEP     | 3.63                                      | 12.93                                             | 3.39                                                        | -7%                               |
| 1:5 AEP      | 2.61                                      | 10.59                                             | 2.44                                                        | -6%                               |
| 1:2 AEP      | 1.63                                      | 8.13                                              | 1.59                                                        | -3%                               |
| <b>LPD 5</b> | <b>Existing Scenario Peak Flow (m³/s)</b> | <b>Post-Development Scenario Peak Flow (m³/s)</b> | <b>Post-Development Mitigated Scenario Peak Flow (m³/s)</b> | <b>Reduction in Peak Flow (%)</b> |
| 1:100 AEP    | 7.66                                      | 7.01                                              | N/A*                                                        | -8%                               |
| 1:50 AEP     | 6.36                                      | 5.80                                              | N/A*                                                        | -9%                               |
| 1:20 AEP     | 4.42                                      | 4.33                                              | N/A*                                                        | -2%                               |
| 1:10 AEP     | 3.47                                      | 3.42                                              | N/A*                                                        | -1%                               |
| 1:5 AEP      | 2.61                                      | 2.40                                              | N/A*                                                        | -8%                               |
| 1:2 AEP      | 1.59                                      | 1.54                                              | N/A*                                                        | -3%                               |
| <b>LPD 6</b> | <b>Existing Scenario Peak Flow (m³/s)</b> | <b>Post-Development Scenario Peak Flow (m³/s)</b> | <b>Post-Development Mitigated Scenario Peak Flow (m³/s)</b> | <b>Reduction in Peak Flow (%)</b> |
| 1:100 AEP    | 4.09                                      | 3.84                                              | N/A*                                                        | -6%                               |
| 1:50 AEP     | 3.34                                      | 3.24                                              | N/A*                                                        | -3%                               |
| 1:20 AEP     | 2.32                                      | 2.30                                              | N/A*                                                        | -1%                               |
| 1:10 AEP     | 1.84                                      | 1.83                                              | N/A*                                                        | 0%                                |



|                       |                                                      |                                                              |                                                                        |                                   |
|-----------------------|------------------------------------------------------|--------------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------|
| 1:5 AEP               | 1.29                                                 | 1.28                                                         | N/A*                                                                   | -1%                               |
| 1:2 AEP               | 0.81                                                 | 0.78                                                         | N/A*                                                                   | -4%                               |
| <b>LPD 7</b>          | <b>Existing Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Post-Development Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Post-Development Mitigated Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Reduction in Peak Flow (%)</b> |
| 1:100 AEP             | 18.54                                                | 19.19                                                        | 17.06                                                                  | -8%                               |
| 1:50 AEP              | 15.27                                                | 16.08                                                        | 14.44                                                                  | -5%                               |
| 1:20 AEP              | 11.69                                                | 12.39                                                        | 10.97                                                                  | -6%                               |
| 1:10 AEP              | 9.48                                                 | 10.06                                                        | 8.78                                                                   | -7%                               |
| 1:5 AEP               | 6.89                                                 | 7.63                                                         | 6.77                                                                   | -2%                               |
| 1:2 AEP               | 4.20                                                 | 4.60                                                         | 3.93                                                                   | -6%                               |
| <b>LPD 8</b>          | <b>Existing Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Post-Development Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Post-Development Mitigated Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Reduction in Peak Flow (%)</b> |
| 1:100 AEP             | 1.08                                                 | 0.71                                                         | N/A*                                                                   | -34%                              |
| 1:50 AEP              | 0.97                                                 | 0.62                                                         | N/A*                                                                   | -36%                              |
| 1:20 AEP              | 0.75                                                 | 0.50                                                         | N/A*                                                                   | -33%                              |
| 1:10 AEP              | 0.60                                                 | 0.39                                                         | N/A*                                                                   | -36%                              |
| 1:5 AEP               | 0.43                                                 | 0.28                                                         | N/A*                                                                   | -34%                              |
| 1:2 AEP               | 0.25                                                 | 0.17                                                         | N/A*                                                                   | -30%                              |
| <b>Greenhill Road</b> | <b>Existing Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Post-Development Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Post-Development Mitigated Scenario Peak Flow (m<sup>3</sup>/s)</b> | <b>Reduction in Peak Flow (%)</b> |
| 1:100 AEP             | 134.60                                               | 147.17                                                       | 130.75                                                                 | -3%                               |
| 1:50 AEP              | 108.92                                               | 123.02                                                       | 105.51                                                                 | -3%                               |
| 1:20 AEP              | 86.78                                                | 93.36                                                        | 82.01                                                                  | -5%                               |
| 1:10 AEP              | 69.30                                                | 74.27                                                        | 64.74                                                                  | -7%                               |
| 1:5 AEP               | 50.50                                                | 59.01                                                        | 48.21                                                                  | -5%                               |
| 1:2 AEP               | 33.51                                                | 36.85                                                        | 32.04                                                                  | -4%                               |

\*Catchment reporting to LPD is reduced following development, resulting in reduction in peak flows and no mitigation required.





**Legend**

- Lawful Point of Discharge
- Cadastre
- Detention Basin Footprint

**Catchments**

- Undetained Catchments
- Detained Catchments



# 4 STORMWATER QUALITY MANAGEMENT

## 4.1 SUMMARY OF STRATEGY

In accordance with the design standards for the Site as provided in Appendix B: and with the State Planning Policy (SPP) 2017, a stormwater quality management strategy has been developed to ensure that the Water Quality Objectives have been met for the site. The following sections outline the types of treatment measures and the modelling approach adopted to meet the SPP stormwater quality objectives

### 4.1.1 Treatment Types

The stormwater quality strategy incorporates a number of different WSUD assets including bioretention systems, a wetland, stormwater harvesting systems and waterway enhancement works. A description of the infrastructure is below:

#### Bioretention Basin

Bioretention located within detention basins will be incorporated below the detention storage and therefore the water quality extended detention depth is not included within the detention basin storage curve. Basin inflows will be directed into a coarse sediment basin that will protect the filter media from sediment loads. During larger flow events, bioretention systems will be protected via a high flow bypass or backwater over the filter media where bioretention systems are located in detention basins. Inflows will be managed with adequate scour protection and located far enough away from the bioretention filter media to not pose an erosion risk. The orientation of each system and scour protection requirements will be addressed further in detailed design stage.

#### Wetland and Water Harvesting

The master plan strategy also proposes the inclusion of a wetland, to be located at the southern end of the new central park. The wetland is integrated with a stormwater harvesting system which enables harvesting and reuse of stormwater for irrigation of sports fields within the sports and recreation park. The wetland and associated infrastructure will consist of an inlet pond (sediment basin), wetland, harvesting pond and a pump/irrigation system.

The wetland is proposed to be combined with Detention Basin D2 which is to be located in the same area. Once again the 300mm extended detention depth required for water quality requirements within the wetland has not been included in the detention basin storage curve.

The harvesting pond will be located at the far end of the wetland to ensure stored stormwater has undergone the maximum amount of treatment through the wetland. The harvesting pond will be separated from the wetland to ensure that water used for harvesting purposes does not draw down on water within the wetland therefore impacting on the drought resilience of the wetland. This will be achieved through an outlet structure that will only allow flows from the wetland into the harvesting pond above the wetlands normal water surface level. The harvesting pond batters will be densely planted to minimise access and any visual amenity issues caused by the frequent fluctuation in water level.

Council has previously confirmed it has no concerns with stormwater harvesting proposal providing a number of conditions are met, refer Appendix H:

#### Waterway Enhancement

Revegetation and stabilization of riparian zones is proposed as an alternative treatment measure to bioretention systems where flows discharge to drainage lines within the Environmental area. It is proposed to revegetate 4 m<sup>2</sup> of riparian habitat for every 1 m<sup>2</sup> of bioretention filter media required to meet the SPP treatment objectives for the catchment according to the MUSIC model for the development.

As part of the revegetation it is proposed to undertake all the earthworks required for successful vegetation establishment along the relevant sections of waterway. Detailed plans for the riparian revegetation are to be included as part of the stormwater management plans for the relevant development stages.

The success of the riparian revegetation will be assessed based on a 60% plant survival rate assessed 1 year following installation of plants. A monitoring plan to assess these conditions is to be developed, as part of the future Stormwater Management Plans.

We believe this innovative approach to water quality treatment will offer the following additional benefits to council:

- Increase in waterway stability.
- Reduction in maintenance activities due to sedimentation in downstream drains and channels.
- Reduced regular maintenance as this work will replace four WSUD assets all of which would require ongoing maintenance activities.
- Improved natural habitat.
- Improvements to water quality associated with filtration of water through vegetation, shading of the waterway and reduced sediment loads associated with instream erosion.



**Figure 4.1: Existing Eroded Creek Line within the Site**

## 4.2 MODELLING APPROACH

The stormwater quality management strategy has been modelled in accordance with the MUSIC modelling guidelines. An assessment of the post-development (the Site with the ultimate proposed land-use) was undertaken with the inclusion of the proposed treatment trains to meeting the SWQ objectives in Table 4.1. The details of the proposed stormwater quality treatment sizes are proposed in Figure 4.2.



**Table 4.1: Adopted Water Quality Objectives**

| Pollutant              | Reduction Objectives (%) | Modelled Reduction (%) |
|------------------------|--------------------------|------------------------|
| Total Suspended Solids | 80                       | 80.5                   |
| Total Phosphorus       | 60                       | 71.0                   |
| Total Nitrogen         | 45                       | 45.0                   |
| Gross Pollutants > 5mm | 90                       | 98.8                   |

### 4.3 SUMMARY OF STORMWATER QUALITY TREATMENT

There has been previous discussion with Council with regards to the stormwater harvesting system (W2 & HP2) from the ROL6 precinct, which has been supported and endorsed for construction by the key stakeholders. Reference to this endorsement is provided within Appendix H.

In addition, it should be noted that treatment measures SB1 and B1 have already been constructed to manage stormwater quantity as part of the earlier stages of the development. Detailed stormwater quality approach and parameters are outlined in Appendix F.

The water quality catchments and proposed treatment locations are represented in Figure 4.2.

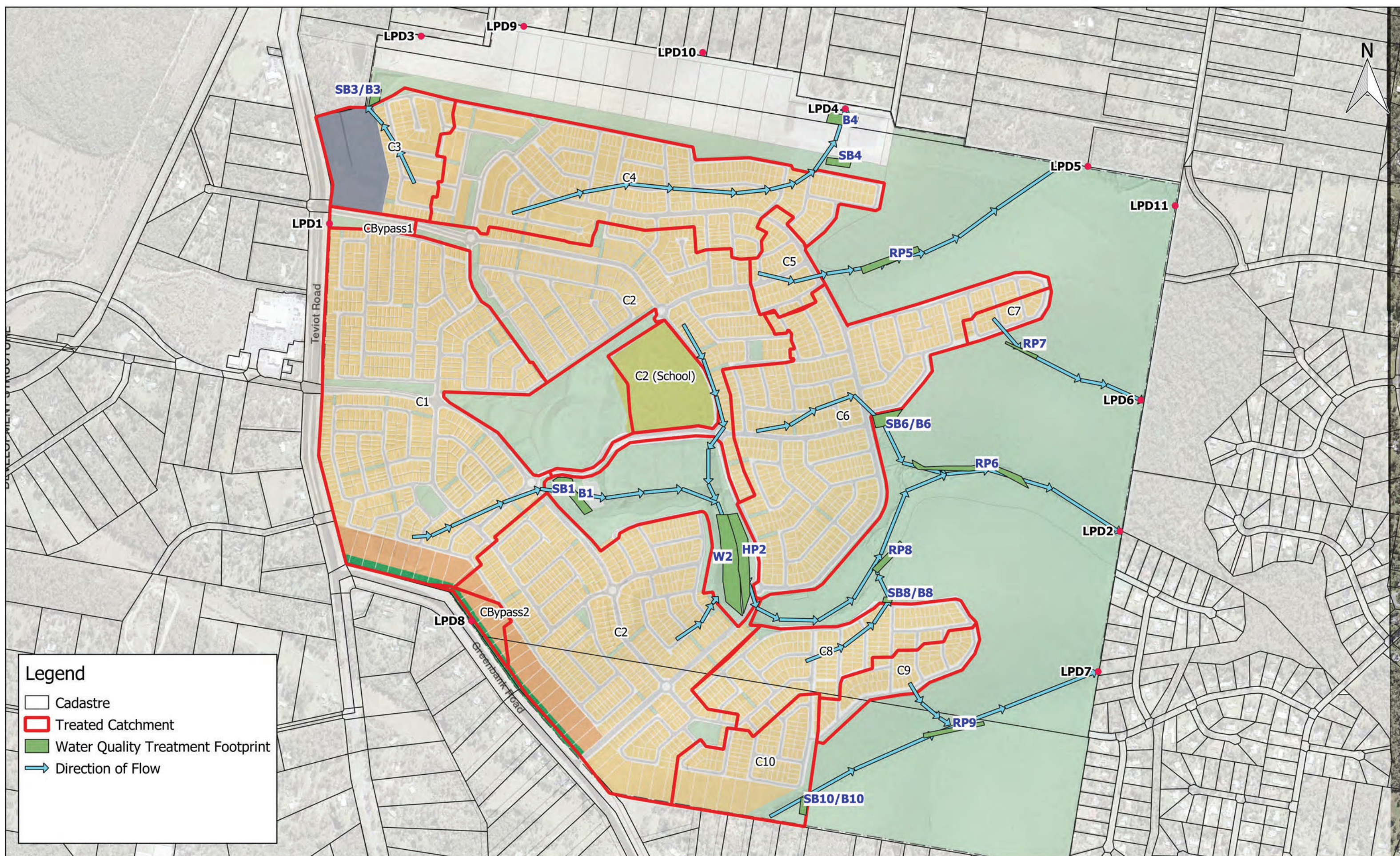
**Table 4.2: Proposed Water Quality Treatment Measures**

| Treatment ID | Catchment | Treatment Type                   | Filter Media Area (m <sup>2</sup> ) |
|--------------|-----------|----------------------------------|-------------------------------------|
| SB1          | 1         | Sediment Basin (Constructed)     | 1,500                               |
| B1           | 1         | Bioretention Basin (Constructed) | 2,200                               |
| W2           | 2         | Wetland                          | 14,000                              |
| HP2          | 2         | Harvesting Pond                  | 8,000                               |
| SB3          | 3         | Sediment Basin                   | 350                                 |
| B3           | 3         | Bioretention Basin               | 950                                 |
| SB4          | 4         | Sediment Basin                   | 1,400                               |
| B4           | 4         | Bioretention Basin               | 2,800                               |
| RP5          | 5         | Riparian Vegetation              | 1,040                               |
| SB6          | 6         | Sediment Basin                   | 500                                 |
| B6           | 6         | Bioretention Basin               | 950                                 |
| RP6          | 6         | Riparian Vegetation              | 3,800                               |
| RP7          | 7         | Riparian Vegetation              | 130                                 |
| SB8          | 8         | Sediment Basin                   | 480                                 |
| B8           | 8         | Bioretention Basin               | 300                                 |
| RP8          | 8         | Riparian Vegetation              | 1,200                               |
| RP9          | 9         | Riparian Vegetation              | 340                                 |

| Treatment ID | Catchment | Treatment Type     | Filter Media Area (m <sup>2</sup> ) |
|--------------|-----------|--------------------|-------------------------------------|
| SB10         | 10        | Sediment Basin     | 330                                 |
| B10          | 10        | Bioretention Basin | 650                                 |

Catchments with bioretention systems and catchment areas above 5 Ha have been modelled to include a sediment basin. The size of the sediment basin was sized based on a 30 m<sup>2</sup> per hectare of catchment, which is consistent with the ratio adopted for the approved and constructed sediment basin SB1.







## 5 SUMMARY

The stormwater masterplan for the proposed MIRVAC Everleigh development has been developed to achieve the required stormwater management objectives as outlined in the State Planning Policy (SPP) 2017. The key objectives of the stormwater masterplan included:

- Stormwater quality modelling to develop a stormwater quality treatment train to demonstrate compliance with SPP water quality objectives.
- Hydrologic assessment to quantify the Site's potential impact on peak flow discharge, and to size appropriate mitigation measures to achieve "no worsening" at suitable reporting locations.

Key stormwater quality management design outcomes for the Site are as follows:

- Six bioretention basins are proposed to be incorporated within the development.
- One Wetland and an associated harvesting pond are proposed to be included at the southern end of the new Central Park. It is proposed to channel outflows from the wetland into the harvesting pond, where they will be captured for use as irrigation water for the neighbouring sports park.
- Four catchments have been identified as suitable for the application of riparian revegetation rather than conventional water quality treatment through bioretention. In these areas it is proposed to revegetate 4 m<sup>2</sup> of the existing riparian waterway for every 1 m<sup>2</sup> of bioretention filter media required to meet the SPP water quality objectives in the music model.
- The details of the riparian revegetation are to be developed, as part of the stormwater management plans for the relevant development stages.

Key stormwater quantity management design outcomes for the Site as follows:

- A total of five detention basins are required to mitigate increased runoff from the development for the ultimate development scenario.

The Master Plan has achieved the stormwater management objectives through the use of detention basins, bioretention systems, wetland with stormwater harvesting pond, and riparian revegetation. The proposed treatment train will not only mitigate additional pollutant loads as results of the development, but will also significantly improve the existing stormwater water quality. This masterplan is intended to set a stormwater management benchmark for future developments of this type.



## 6 QUALIFICATIONS

- a) In preparing this document, including all relevant calculation and modelling, Engeny Water Management (Engeny) has exercised the degree of skill, care and diligence normally exercised by members of the engineering profession and has acted in accordance with accepted practices of engineering principles.
- b) Engeny has used reasonable endeavours to inform itself of the parameters and requirements of the project and has taken reasonable steps to ensure that the works and document is as accurate and comprehensive as possible given the information upon which it has been based including information that may have been provided or obtained by any third party or external sources which has not been independently verified.
- c) Engeny reserves the right to review and amend any aspect of the works performed including any opinions and recommendations from the works included or referred to in the works if:
  - i) Additional sources of information not presently available (for whatever reason) are provided or become known to Engeny; or
  - ii) Engeny considers it prudent to revise any aspect of the works in light of any information which becomes known to it after the date of submission.
- d) Engeny does not give any warranty nor accept any liability in relation to the completeness or accuracy of the works, which may be inherently reliant upon the completeness and accuracy of the input data and the agreed scope of works. All limitations of liability shall apply for the benefit of the employees, agents and representatives of Engeny to the same extent that they apply for the benefit of Engeny.
- e) This document is for the use of the party to whom it is addressed and for no other persons. No responsibility is accepted to any third party for the whole or part of the contents of this Body.
- f) If any claim or demand is made by any person against Engeny on the basis of detriment sustained or alleged to have been sustained as a result of reliance upon the Body or information therein, Engeny will rely upon this provision as a defence to any such claim or demand.
- g) This Body does not provide legal advice.

## 7 REFERENCES

Australian Government Bureau of Meteorology ([www.bom.gov.au](http://www.bom.gov.au)).

Ball et. al. (2019). *Australian Rainfall and Runoff: A Guide to Flood Estimation*, © Commonwealth of Australia

Brisbane City Council (2003). *Natural Channel Design*. November 2003.

Department of Infrastructure, Local Government and Planning (DILGP) (2017), *State Planning Policy (SPP)*. © State of Queensland July 2017

Department of State Development, Manufacturing, Infrastructure and Planning (DSDMIO) (2019), *State Development Assessment Provisions*. © State of Queensland July 2019. Version 2.5.

Department of Transport and Main Roads (DTMR) (2019). *Road Drainage Manual*.

Healthy Land and Water (2014). *Bioretention Technical Design Guidelines*. October 2014. Version 1.1

Healthy Land and Water (2018). *MUSIC Modelling Guidelines*. November 2018.

Healthy Waterways (2011). *Framework for the Integration of Flood and Stormwater Management into Open Space*. August 2011. Version 1.1

Institute of Public Works Engineering Australasia Queensland (IPWEAQ) (2017). *Queensland Urban Drainage Design Manual*. 4<sup>th</sup> Edition

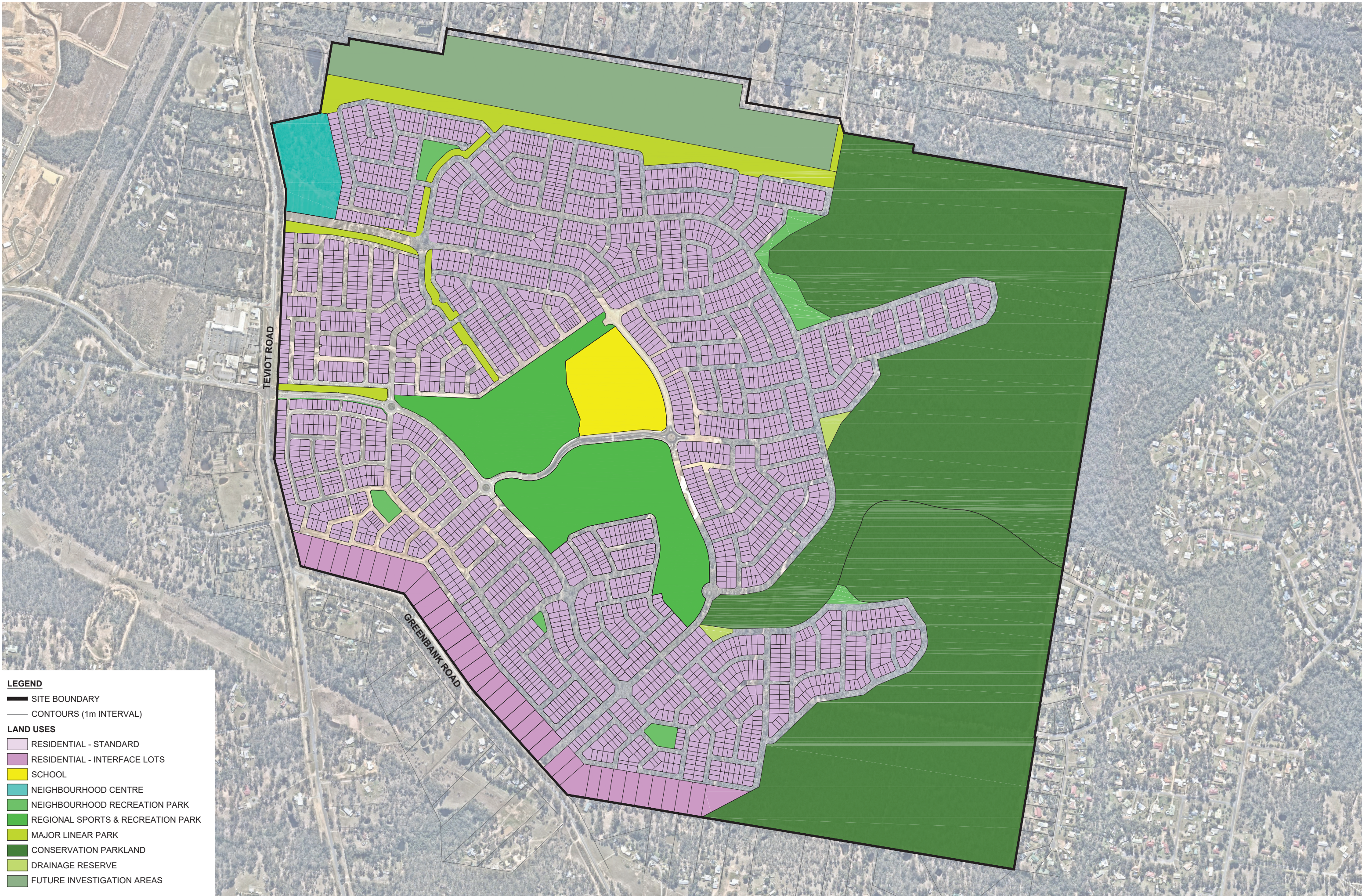
Logan City Council (2015). *Logan City Council Planning Scheme*.

State of Queensland (2018). *Environmental Protection (Water) Policy 2009*.



# Appendix A: Development Layout





**LEGEND**

— SITE BOUNDARY  
— CONTOURS (1m INTERVAL)

**LAND USES**

- RESIDENTIAL - STANDARD
- RESIDENTIAL - INTERFACE LOTS
- SCHOOL
- NEIGHBOURHOOD CENTRE
- NEIGHBOURHOOD RECREATION PARK
- REGIONAL SPORTS & RECREATION PARK
- MAJOR LINEAR PARK
- CONSERVATION PARKLAND
- DRAINAGE RESERVE
- FUTURE INVESTIGATION AREAS



# Appendix B:

## Design Standards



**Table B.1: Design Outcomes**

| Element                                           | Design Outcome                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Lawful Point of Discharge                         | <p>The point of discharge for outlet works is considered lawful where discharge is to waterways, drainage channels, or drainage features within:</p> <ul style="list-style-type: none"> <li>• The balance land of the subject development site.</li> <li>• Land to be dedicated / transferred to Council, or otherwise to be under the control of Council.</li> <li>• Reconfigured allotments within the subject development site where access to the discharge infrastructure is secured by an easement (if relevant), or,</li> <li>• Private allotments outside the subject development site where access to the discharge infrastructure is secured by an easement (if relevant).</li> </ul> <p>The point of discharge from the development site is considered lawful where discharge is to existing waterways, drainage channels, or drainage features at the site boundary.</p>                          |
| Non-Worsening                                     | <p>Non-worsening is defined as:</p> <ul style="list-style-type: none"> <li>• No increase in peak discharge from the development boundary for the 1:2, 1:5, 1:10, 1:20, 1:50 &amp; 1:100 AEP flood events.</li> <li>• No increase in flood levels external to the development boundary for the 1:2, 1:5, 1:10, 1:20, 1:50 &amp; 1:100 AEP flood events.</li> <li>• No change to timing of peak flow without appropriate runoff routing modelling for the 1:2, 1:5, 1:10, 1:20, 1:50 &amp; 1:100 AEP flood events.</li> <li>• No increase in frequency and duration of discharge for the minor storm (i.e. 1:1 AEP flood event)</li> <li>• No reduction to capacity of external drainage system.</li> </ul> <p>When assessing stormwater quantity, the point of measurement is defined as the point of discharge from the development site rather than individual points of discharge from balance parcels.</p> |
| Owner's Consent                                   | <p>Downstream property owner's consent is not required if the requirements for Lawful Point of Discharge and non-worsening are met (where non-worsening is measured at the boundary of the development site and at Greenhill Road).</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Minimum Habitable Floor Level                     | <p>The minimum habitable floor level for buildings (not gazebos or structures open on 3 or more sides) is to be the 1:100 AEP + 500 mm.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| Flood Immunity - Essential Service Infrastructure | <p>Essential service infrastructure likely to fail when inundated will be set above the 1:100 AEP flood level.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Flood Immunity - Roads                            | <ul style="list-style-type: none"> <li>• Depth x velocity products in accordance with QUDM.</li> <li>• Maximum depth over roads of 300 mm in 1:100 AEP event.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| Quantity Modelling Event Assumptions              | <p>Masterplan and individual stormwater management plans will be assessed against 1:2, 1:5, 1:10, 1:20, 1:50 &amp; 1:100 AEP flood events for the critical storm duration.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| Infrastructure design                             | <ul style="list-style-type: none"> <li>• Stormwater assets in parkland or other public land must be designed to not look like a hydraulic structure but rather it must have special character. This will involve using variable slopes, retaining upstream gullies, camouflaging inlets and outlet structures and similar (a rectangular or geometrically shaped basin is generally undesirable).</li> <li>• Safe egress and adequate signage are to be considered in accordance with a risk based approach.</li> <li>• Overland flow paths are to be designed to convey the 1:100 AEP flood event.</li> <li>• Stormwater detention basins / bioretention basins and the like are to be sited on land which is to be dedicated / transferred to Council, or otherwise under the control of Council.</li> </ul>                                                                                                |
| Stormwater detention                              | <ul style="list-style-type: none"> <li>• Stormwater detention may be required to manage stormwater discharge by limiting post development peak flows to the pre-development flow rates for all design storm events.</li> <li>• Stormwater detention may be achieved using road embankments or online storage in areas outside of the conservation area.</li> <li>• Stormwater detention system are to be free draining.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| Water Quality Modelling                           | <ul style="list-style-type: none"> <li>• Water quality modelling to be undertaken in accordance with the Water by Design MUSIC modelling guidelines.</li> <li>• Waterway rehabilitation and stabilisation is acceptable as an offset to traditional WSUD measures.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |



| Element                                                                                                                                                                                                                                            | Design Outcome                                                                                                                                                                                                                                                                                                                                                                  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                    | <ul style="list-style-type: none"> <li>SPP water quality objectives adopted where traditional WSUD measures are proposed.</li> </ul>                                                                                                                                                                                                                                            |
| Design                                                                                                                                                                                                                                             | <ul style="list-style-type: none"> <li>Stormwater management systems used within waterway buffers must be vegetated stormwater management systems (earth and vegetation) which provide stormwater management and ecological function.</li> <li>Design of channel works as part of development maximises the use of natural channel design principles where possible.</li> </ul> |
| <p>Notes:</p> <ul style="list-style-type: none"> <li>Development outcomes are acceptable where in accordance with the design outcomes above, or part thereof.</li> <li>Alternate design outcomes may be proposed and deemed acceptable.</li> </ul> |                                                                                                                                                                                                                                                                                                                                                                                 |

## Table B.2: Design Standards/Resources

### Reference

|                                                                                                           |
|-----------------------------------------------------------------------------------------------------------|
| Queensland Urban Drainage Manual (QUDM) 2017                                                              |
| Logan City Council Planning Scheme 2015                                                                   |
| Queensland Environmental Protection (Water) Policy 2009                                                   |
| Queensland State Planning Policy (SPP) 2017                                                               |
| Queensland State Development Assessment Provisions 2019                                                   |
| Water by Design: Bioretention Technical Design Guidelines 2014                                            |
| Water by Design: Music Modelling Guidelines 2018                                                          |
| Water by Design: Framework for the Integration of Flooding and Stormwater Management into Open Space 2011 |
| Australian Rainfall and Runoff (ARR) 2019                                                                 |
| Brisbane City Council Natural Channel Design Guideline 2003                                               |
| Queensland Road Drainage Manual 2019                                                                      |

### Notes:

- The Design Standards / Resources above are considered acceptable Standards / Resources.
- Development outcomes in accordance with the Design Standards / Resources, or part thereof, are considered acceptable outcomes.
- Alternate Standards / Resources may be proposed and deemed acceptable.

# Appendix C: Stormwater Quantity Modelling



## Introduction

The hydrologic assessment for the Site has been undertaken utilising XPRAFTS hydrologic modelling software. An assessment of the existing scenario (the Site in its condition prior to any development works) and post-development (the Site with ultimate proposed land-use) peak flows was completed, and the various stormwater detention basins required to mitigate post-development flows were also sized. The following sections outline the hydrologic modelling.

## Existing Scenario XPRAFTS Model Development

### Catchment Parameters

A XPRAFTS split-catchment approach model was developed to reflect existing scenario site conditions. Existing scenario catchment delineation and land use can be viewed in Figure C.1.

The impervious and pervious portions of the catchment were modelled as separate catchments with 100% and 0% fraction impervious values, respectively. Land use areas for the catchment were delineated using aerial imagery and cadastral boundary data. Fraction impervious values for the catchments were adopted from the delineated land use types summarised in Table C.1. These impervious fractions have been adopted in accordance with Table 4.5.1 of QUDM (IPWAEQ, 2017).

The full XPRAFTS catchment parameters can be found in Appendix D.

**Table C.1: Existing Scenario Fraction Impervious per Land Use**

| Land Use          | Fraction Impervious |
|-------------------|---------------------|
| Rural             | 0%                  |
| Road              | 90%                 |
| Rural Residential | 10%                 |
| Open Area         | 0%                  |
| Industrial        | 90%                 |

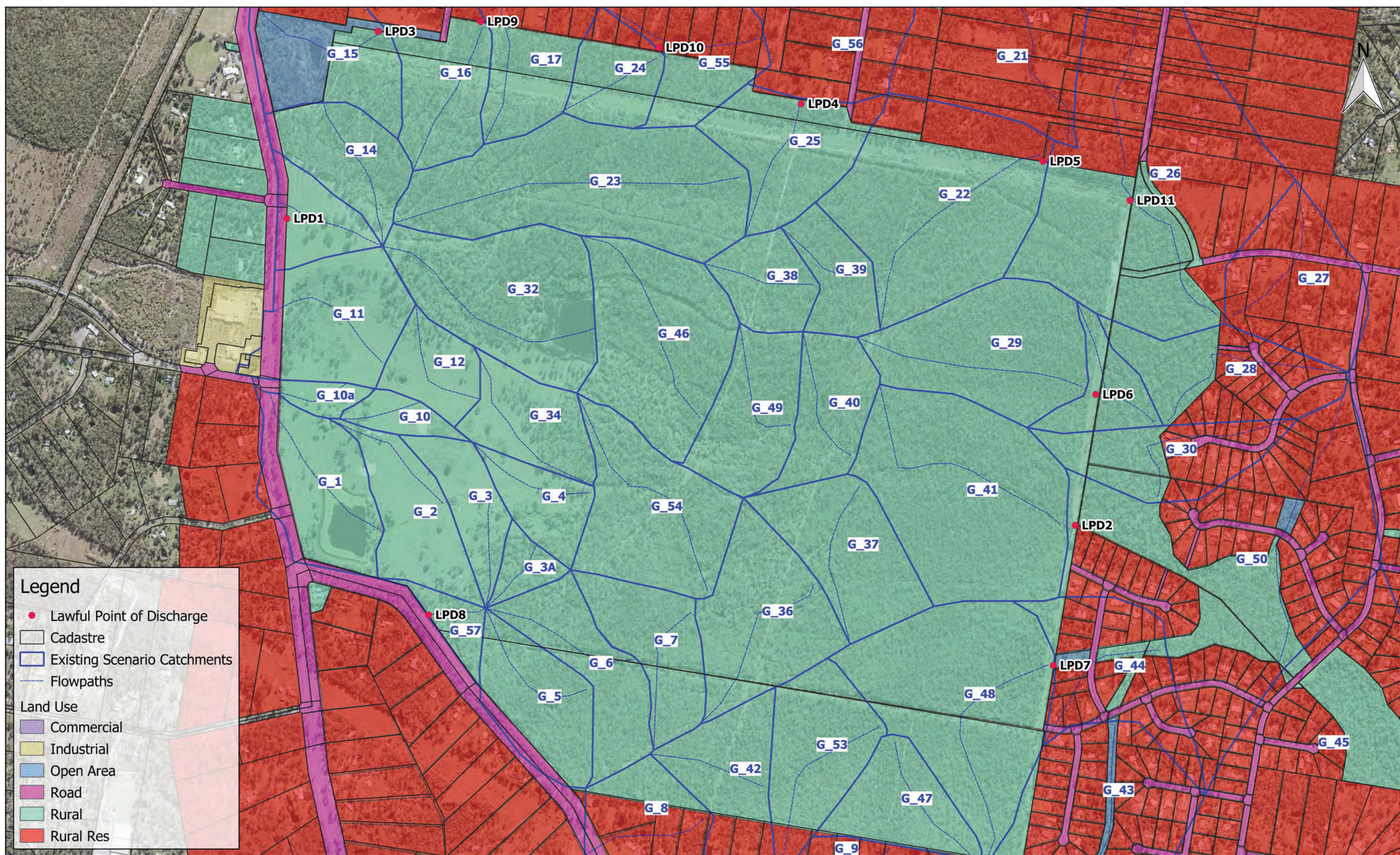
The PERN values were applied globally for pervious and impervious portions of catchment and are summarised in Table .

**Table C.2: PERN Values for Existing Scenario**

| Catchment Type | Manning's "n" Value |
|----------------|---------------------|
| Pervious       | 0.06                |
| Impervious     | 0.025               |

A hydrograph lag approach to link-lag was utilised, calculated using appropriate average stream velocity values as indicated by Table 4.6.6 in QUDM.







### Rainfall and Losses

Design rainfall depths and intensities were generated using the ARR 2019 data hub tool (<https://data.arr-software.org/>), utilising the centroid of the main flow path catchment as the reference point (-27.741, 152.999). The data hub output for the Site is provided in Appendix E.

The recommended losses for application in the XPRAFTS model were:

- Initial loss: 25.0 mm.
- Continuing loss: 1.1 mm/hr.

Median pre-burst has also been applied in accordance with ARR19 for each storm utilising XPRAFTS Automatic Storm Generator Utility.

### Estimation of Farm Dam Discharge

A localised TUFLOW hydraulic model was built to produce discharge rating curves for the overtopping behaviour for the existing farm dams on the Site. Localised flow was applied to each dam, with the head level in the dam versus the flow downstream of the spillway recorded to produce the discharge rating curve. The rating curves are provided in Table C.3. The discharge rating curves were then applied to storage nodes in the XPRAFTS model representing each dam.

**Table C.3: Farm Dam Discharge Rating Curves**

| Northern Farm Dam             |                               | Southern Farm Dam             |                               |
|-------------------------------|-------------------------------|-------------------------------|-------------------------------|
| Water Level Elevation (m AHD) | Discharge (m <sup>3</sup> /s) | Water Level Elevation (m AHD) | Discharge (m <sup>3</sup> /s) |
| 46.20                         | 0.00                          | 53.00                         | 0.00                          |
| 46.47                         | 0.24                          | 53.08                         | 0.97                          |
| 46.51                         | 0.50                          | 53.10                         | 1.49                          |
| 46.55                         | 0.82                          | 53.11                         | 1.81                          |
| 46.57                         | 1.35                          | 53.12                         | 2.27                          |
| 46.60                         | 2.05                          | 53.14                         | 2.90                          |
| 46.62                         | 2.67                          | 53.15                         | 3.46                          |

### Rational Method Validation

The existing development scenario XPRAFTS hydrological model was validated utilising the Rational Method at three LPDs on Table C.5. Based on the outcomes from the validation, the XPRAFTS model is considered fit for purpose to complete the runoff estimation for the proposed site.

**Table C.4: Rational Method Validation Parameters**

| Parameter                   | LPD2  | LPD4 | LPD7 |
|-----------------------------|-------|------|------|
| Catchment Area (ha)         | 254.1 | 44.6 | 91.4 |
| C10 Value                   | 0.52  | 0.52 | 0.52 |
| Time of Concentration (min) | 69.6  | 69.5 | 47.2 |



**Table C.5: Rational Method Validation Summary**

| Flood Event | LPD2                                |                             |                                      | LPD4                                |                             |                                      | LPD7                                |                             |                                      |
|-------------|-------------------------------------|-----------------------------|--------------------------------------|-------------------------------------|-----------------------------|--------------------------------------|-------------------------------------|-----------------------------|--------------------------------------|
|             | Rational Method (m <sup>3</sup> /s) | XPRAFTS (m <sup>3</sup> /s) | Difference (XPRAFTS-Rational Method) | Rational Method (m <sup>3</sup> /s) | XPRAFTS (m <sup>3</sup> /s) | Difference (XPRAFTS-Rational Method) | Rational Method (m <sup>3</sup> /s) | XPRAFTS (m <sup>3</sup> /s) | Difference (XPRAFTS-Rational Method) |
| 1:100 AEP   | 37.03                               | 40.97                       | 10.6%                                | 6.51                                | 8.13                        | 24.8%                                | 16.84                               | 18.54                       | 10.1%                                |
| 1:50 AEP    | 31.54                               | 33.77                       | 7.1%                                 | 5.54                                | 6.52                        | 17.5%                                | 14.41                               | 15.27                       | 5.97%                                |
| 1:20 AEP    | 24.16                               | 25.93                       | 7.3%                                 | 4.25                                | 4.56                        | 7.2%                                 | 11.11                               | 11.69                       | 5.2%                                 |
| 1:10 AEP    | 19.74                               | 19.95                       | 1.1%                                 | 3.47                                | 3.63                        | 4.7%                                 | 9.11                                | 9.48                        | 4.0%                                 |
| 1:5 AEP     | 15.97                               | 15.79                       | -1.2%                                | 2.81                                | 2.61                        | -7.2%                                | 7.40                                | 6.89                        | -6.8%                                |
| 1:2 AEP     | 11.11                               | 9.40                        | -15.3%                               | 1.95                                | 1.63                        | -16.5%                               | 5.15                                | 4.20                        | -18.6%                               |

### Post-Development Scenario XPRAFTS Model Development

The post-development scenario XPRAFTS model was developed to reflect the proposed development density and land use, utilising the proposed masterplan for the Site. Similar to the existing scenario model, a split-catchment approach was adopted. The rainfall intensities and losses for the developed scenario are consistent with the existing scenario.

### Catchment Parameters

Post-development scenario catchment delineation and land use can be viewed in Figure C.2. Fraction impervious values for the catchments were adopted from the delineated land use types summarised in Table C.6. These impervious fractions have been adopted in accordance with Table 4.5.1 of QUDM (IPWAEQ, 2017).

The full XPRAFTS catchment parameters can be found in Appendix D.

**Table C.6: Developed Scenario Fraction Impervious per Land Use**

| Land Use                     | Fraction Impervious |
|------------------------------|---------------------|
| Residential – Standard Lots  | 0.7                 |
| Roads                        | 0.9                 |
| Rural Residential            | 0.1                 |
| Residential - Interface Lots | 0.15                |
| Recreation Park              | 0.1                 |
| Neighbourhood Centre         | 0.9                 |
| Open Area                    | 0                   |
| Linear Park                  | 0.02                |
| Rural                        | 0                   |
| Neighbourhood Park           | 0.02                |
| School                       | 0.7                 |

| Land Use               | Fraction Impervious |
|------------------------|---------------------|
| Residential - Eco Lots | 0.08                |
| Industrial             | 0.9                 |

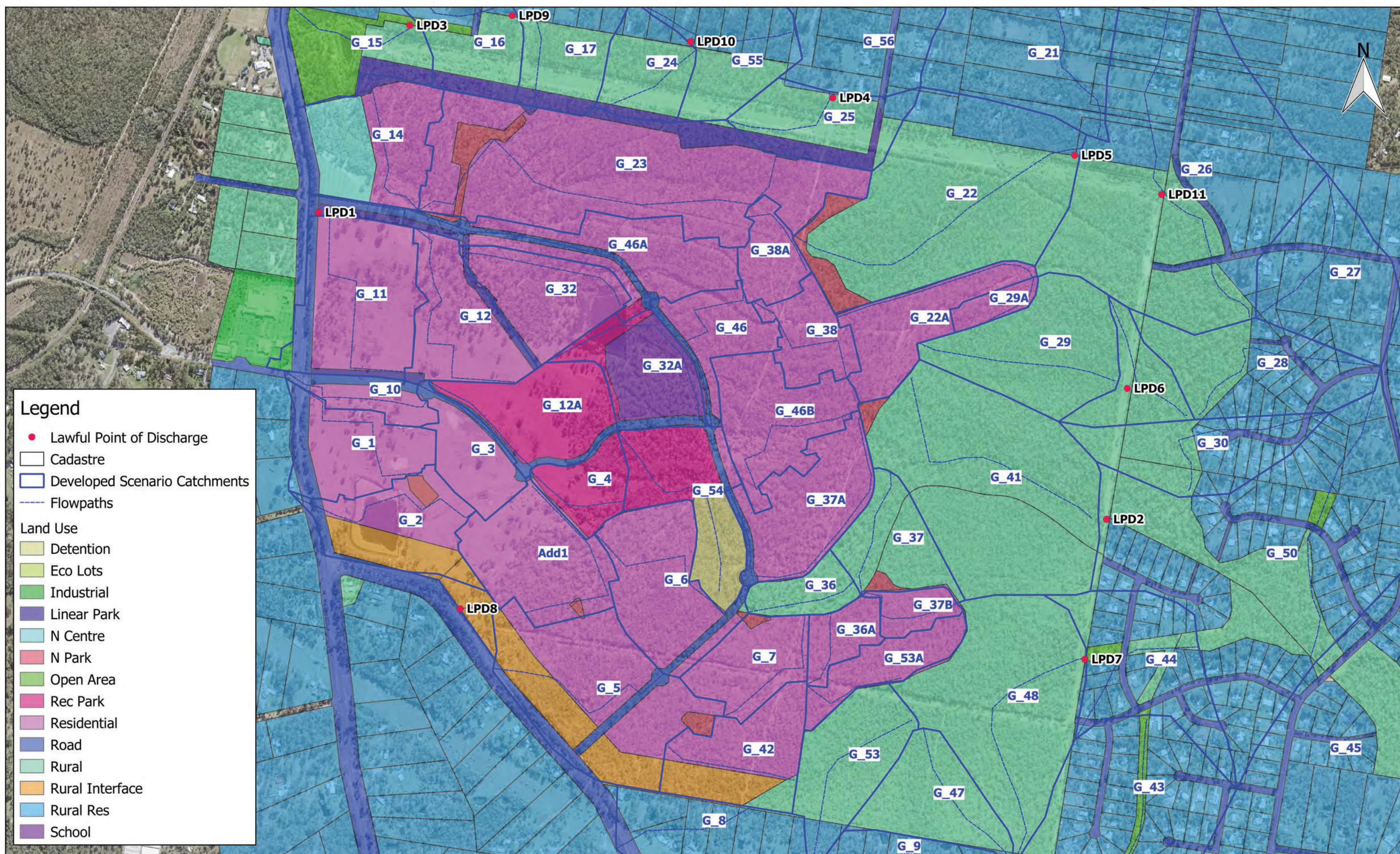
The PERN values are expected to vary across portions of the Site in the post-development scenarios. The adopted roughness values are summarised in Table C.7.

**Table C.7: PERN Values for Developed Scenario**

| Catchment Type                                   | Manning's "n" Value |
|--------------------------------------------------|---------------------|
| Pervious – within residential standard lots area | 0.04                |
| Pervious – within open space                     | 0.05                |
| Pervious – for all other areas                   | 0.06                |
| Impervious                                       | 0.025               |

For natural stream paths on site a hydrograph lag approach to link-lag was utilised equal to that in the existing scenario, calculated using appropriate average stream velocity values as indicated by Table 4.6.6 in QUDM. Where the flow paths are expected to be urbanised in the post-development scenario, pipe flow calculations were utilised to estimate the expected hydrograph lag.







## Detention Sizing

An analysis was undertaken on the expected change to peak flow rates at the Site LPDs for the 1:2 AEP to the 1:100 AEP flood event. Where increases in peak flow are expected, detention basins have been sized to mitigate post-development scenario peak flows down to existing scenario peak flows. The following assumptions are relevant to the detention sizing undertaken for the Site:

- Where concept design has progressed on detention basins, real storage curves extracted from the post-development design tin have been included in XPRAFTS. For basins that have not progressed to design, a simplified linear storage curve has been included in RAFTS.
- Outlet configurations have been specified as required to mitigate peak flows from each basin to the required existing scenario flow and consist of combinations of low flow culverts at invert, high flow culverts and weirs.
- Detention has not been provided for the entirety of the developable area, where catchments are able to discharge direct to existing flow paths without mitigation, or are located on flow paths where favourable timing ensures that upstream detention is sufficient to provide mitigation of peak flows.

**Table C.8: Detention Reporting – D2 and D8 at LPD2**

| Flood Event | Existing Peak Discharge (m <sup>3</sup> /s) | Developed Peak Discharge (m <sup>3</sup> /s) | Developed Mitigated Peak Discharge (m <sup>3</sup> /s) | Difference |
|-------------|---------------------------------------------|----------------------------------------------|--------------------------------------------------------|------------|
| 1:100 AEP   | 40.97                                       | 60.93                                        | 39.52                                                  | -4%        |
| 1:50 AEP    | 33.77                                       | 52.87                                        | 32.69                                                  | -3%        |
| 1:20 AEP    | 25.93                                       | 42.94                                        | 24.42                                                  | -6%        |
| 1:10 AEP    | 19.95                                       | 35.60                                        | 19.91                                                  | 0%         |
| 1:5 AEP     | 15.79                                       | 28.63                                        | 15.07                                                  | -5%        |
| 1:2 AEP     | 9.40                                        | 20.77                                        | 9.36                                                   | 0%         |

**Table C.9: Detention Reporting – D3 at LPD 3**

| Flood Event | Existing Peak Discharge (m <sup>3</sup> /s) | Developed Peak Discharge (m <sup>3</sup> /s) | Developed Mitigated Peak Discharge (m <sup>3</sup> /s) | Difference |
|-------------|---------------------------------------------|----------------------------------------------|--------------------------------------------------------|------------|
| 1:100 AEP   | 2.38                                        | 7.53                                         | 2.31                                                   | -3%        |
| 1:50 AEP    | 2.03                                        | 6.96                                         | 1.60                                                   | -21%       |
| 1:20 AEP    | 1.56                                        | 5.80                                         | 1.30                                                   | -16%       |
| 1:10 AEP    | 1.17                                        | 5.04                                         | 1.16                                                   | -1%        |
| 1:5 AEP     | 0.90                                        | 4.27                                         | 0.87                                                   | -3%        |
| 1:2 AEP     | 0.52                                        | 3.33                                         | 0.47                                                   | -10%       |



**Table C.10: Detention Reporting – D4 at LPD4**

| Flood Event | Existing Peak Discharge (m <sup>3</sup> /s) | Developed Peak Discharge (m <sup>3</sup> /s) | Developed Mitigated Peak Discharge (m <sup>3</sup> /s) | Difference |
|-------------|---------------------------------------------|----------------------------------------------|--------------------------------------------------------|------------|
| 1:100 AEP   | 8.13                                        | 18.62                                        | 7.58                                                   | -7%        |
| 1:50 AEP    | 6.52                                        | 16.66                                        | 6.27                                                   | -4%        |
| 1:20 AEP    | 4.56                                        | 13.89                                        | 4.47                                                   | -2%        |
| 1:10 AEP    | 3.63                                        | 12.93                                        | 3.39                                                   | -7%        |
| 1:5 AEP     | 2.61                                        | 10.59                                        | 2.44                                                   | -6%        |
| 1:2 AEP     | 1.63                                        | 8.13                                         | 1.59                                                   | -3%        |

**Table C.11: Detention Reporting – D10 at LPD7**

| Flood Event | Existing Peak Discharge (m <sup>3</sup> /s) | Developed Peak Discharge (m <sup>3</sup> /s) | Developed Mitigated Peak Discharge (m <sup>3</sup> /s) | Difference |
|-------------|---------------------------------------------|----------------------------------------------|--------------------------------------------------------|------------|
| 1:100 AEP   | 18.54                                       | 19.19                                        | 17.06                                                  | -8%        |
| 1:50 AEP    | 15.27                                       | 16.08                                        | 14.44                                                  | -5%        |
| 1:20 AEP    | 11.69                                       | 12.39                                        | 10.97                                                  | -6%        |
| 1:10 AEP    | 9.48                                        | 10.06                                        | 8.78                                                   | -7%        |
| 1:5 AEP     | 6.89                                        | 7.63                                         | 6.77                                                   | -2%        |
| 1:2 AEP     | 4.20                                        | 4.60                                         | 3.93                                                   | -6%        |

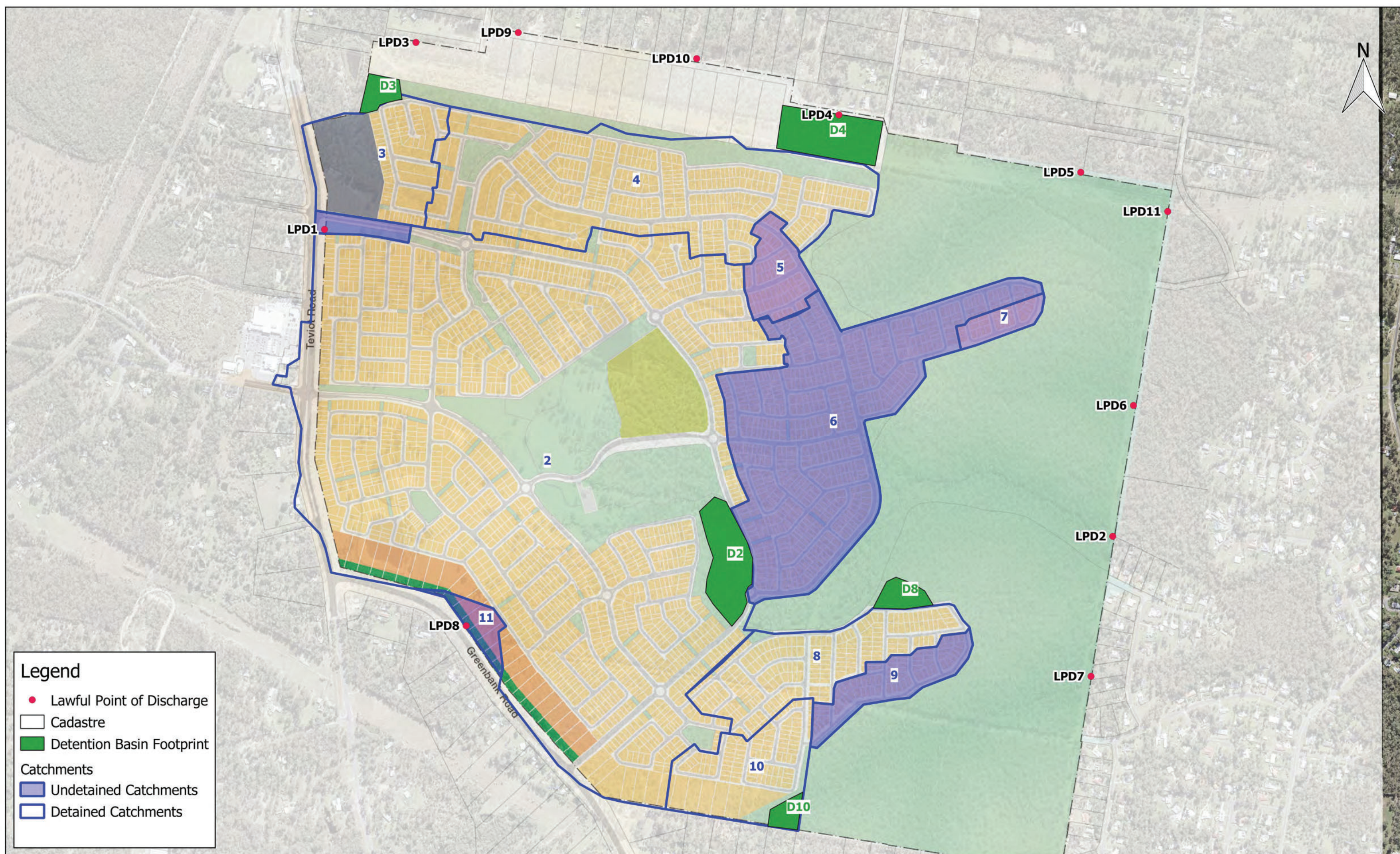
**Table C.12: Detention Basin Requirements**

| Catchment ID | Basin ID | 1% AEP Stored Volume (m <sup>3</sup> ) | 1% AEP Approximate Footprint (m <sup>2</sup> ) | Proposed Outlet Configuration                                                   | LPD ID |
|--------------|----------|----------------------------------------|------------------------------------------------|---------------------------------------------------------------------------------|--------|
| 2            | D2       | 86,700                                 | 32,000                                         | 3/1200x1200 RCBCs at invert<br>5/1500x600 RCBCs at 1.9m depth                   | 2      |
| 3            | D3       | 8,500                                  | 9,500                                          | 4/300 RCPs at invert<br>6/300 RCPs at 0.55m depth<br>5m spillway at 1.45m depth | 3      |
| 4            | D4       | 23,233                                 | 42,000                                         | 5/600x600 RCBCs at invert<br>8/1200x300 RCBCs at 0.67m depth                    | 4      |
| 5 (Bypassed) | -        | -                                      | -                                              | -                                                                               | 5      |
| 6 (Bypassed) | -        | -                                      | -                                              | -                                                                               | 2      |
| 7 (Bypassed) | -        | -                                      | -                                              | -                                                                               | 6      |



| Catchment ID | Basin ID | 1% AEP Stored Volume (m <sup>3</sup> ) | 1% AEP Approximate Footprint (m <sup>2</sup> ) | Proposed Outlet Configuration                      | LPD ID |
|--------------|----------|----------------------------------------|------------------------------------------------|----------------------------------------------------|--------|
| 8            | D8       | 10,000                                 | 10,000                                         | 1/225 RCP at Invert<br>20m spillway at 1.5m depth  | 2      |
| 9 (Bypassed) | -        | -                                      | -                                              | -                                                  | 7      |
| 10           | D10      | 7,100                                  | 6,400                                          | 4/675 RCPs at invert<br>10m spillway at 1.5m depth | 7      |







# Appendix D:

## XPRAFTS

### Catchment Parameters



**Table D.1: Existing Scenario XPRAFTS Parameters**

| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_1_B1       | 1                    | 11.53           | 0.06           | 0                         | 3.47               |
|              | 2                    | 2.53            | 0.025          | 100                       | 3.47               |
| G_2          | 1                    | 10.59           | 0.06           | 0                         | 5.48               |
|              | 2                    | 0.001           | 0.025          | 100                       | 5.48               |
| G_3          | 1                    | 6.75            | 0.06           | 0                         | 6                  |
|              | 2                    | 0.001           | 0.025          | 100                       | 6                  |
| G_4          | 1                    | 6.26            | 0.06           | 0                         | 1.6                |
|              | 2                    | 0.001           | 0.025          | 100                       | 1.6                |
| G_5          | 1                    | 10.41           | 0.06           | 0                         | 4.71               |
|              | 2                    | 1.13            | 0.025          | 100                       | 4.71               |
| G_6          | 1                    | 11.37           | 0.06           | 0                         | 5.48               |
|              | 2                    | 0.001           | 0.025          | 100                       | 5.48               |
| G_7          | 1                    | 10.68           | 0.06           | 0                         | 3.26               |
|              | 2                    | 0.001           | 0.025          | 100                       | 3.26               |
| G_8          | 1                    | 10.54           | 0.06           | 0                         | 3.44               |
|              | 2                    | 1.52            | 0.025          | 100                       | 3.44               |
| G_9          | 1                    | 12.61           | 0.06           | 0                         | 3.88               |
|              | 2                    | 1.43            | 0.025          | 100                       | 3.88               |
| G_10         | 1                    | 3.09            | 0.06           | 0                         | 6.05               |
|              | 2                    | 0.001           | 0.025          | 100                       | 6.05               |
| G_11         | 1                    | 13.22           | 0.06           | 0                         | 4.44               |
|              | 2                    | 1.78            | 0.025          | 100                       | 4.44               |
| G_12         | 1                    | 6.47            | 0.06           | 0                         | 3.84               |
|              | 2                    | 0.001           | 0.025          | 100                       | 3.84               |
| G_13         | 1                    | 5.33            | 0.06           | 0                         | 3.57               |
|              | 2                    | 0.91            | 0.025          | 100                       | 3.57               |
| G_14         | 1                    | 9.76            | 0.06           | 0                         | 3.95               |
|              | 2                    | 0.31            | 0.025          | 100                       | 3.95               |



| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_15         | 1                    | 13.66           | 0.06           | 0                         | 3.05               |
|              | 2                    | 1.15            | 0.025          | 100                       | 3.05               |
| G_16         | 1                    | 8.38            | 0.06           | 0                         | 5.02               |
|              | 2                    | 0.33            | 0.025          | 100                       | 5.02               |
| G_17         | 1                    | 17.19           | 0.06           | 0                         | 2.34               |
|              | 2                    | 1.1             | 0.025          | 100                       | 2.34               |
| G_18         | 1                    | 22.43           | 0.06           | 0                         | 2.08               |
|              | 2                    | 3.92            | 0.025          | 100                       | 2.08               |
| G_19         | 1                    | 13              | 0.06           | 0                         | 3.02               |
|              | 2                    | 2.03            | 0.025          | 100                       | 3.02               |
| G_20         | 1                    | 42.17           | 0.06           | 0                         | 1.92               |
|              | 2                    | 6.14            | 0.025          | 100                       | 1.92               |
| G_21         | 1                    | 46.61           | 0.06           | 0                         | 1.08               |
|              | 2                    | 5.13            | 0.025          | 100                       | 1.08               |
| G_22         | 1                    | 30              | 0.06           | 0                         | 1.37               |
|              | 2                    | 0.57            | 0.025          | 100                       | 1.37               |
| G_23         | 1                    | 30.91           | 0.06           | 0                         | 1.98               |
|              | 2                    | 0.001           | 0.025          | 100                       | 1.98               |
| G_24         | 1                    | 7.16            | 0.06           | 0                         | 5.08               |
|              | 2                    | 0.13            | 0.025          | 100                       | 5.08               |
| G_25         | 1                    | 13.58           | 0.06           | 0                         | 1.8                |
|              | 2                    | 0.19            | 0.025          | 100                       | 1.8                |
| G_26         | 1                    | 50.11           | 0.06           | 0                         | 1.33               |
|              | 2                    | 4.38            | 0.025          | 100                       | 1.33               |
| G_27         | 1                    | 12.87           | 0.06           | 0                         | 4.6                |
|              | 2                    | 2.57            | 0.025          | 100                       | 4.6                |
| G_28         | 1                    | 13.04           | 0.06           | 0                         | 2.99               |
|              | 2                    | 1.75            | 0.025          | 100                       | 2.99               |
| G_29         | 1                    | 19.8            | 0.06           | 0                         | 2.29               |
|              | 2                    | 0.001           | 0.025          | 100                       | 2.29               |

| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_30         | 1                    | 10.74           | 0.06           | 0                         | 2.47               |
|              | 2                    | 1.244314        | 0.025          | 100                       | 2.47               |
| G_31         | 1                    | 5.99            | 0.06           | 0                         | 2.73               |
|              | 2                    | 0.001           | 0.025          | 100                       | 2.73               |
| G_32_B2      | 1                    | 21.4            | 0.06           | 0                         | 4.24               |
|              | 2                    | 0.001           | 0.025          | 100                       | 4.24               |
| G_34         | 1                    | 9.16            | 0.06           | 0                         | 1.78               |
|              | 2                    | 0.001           | 0.025          | 100                       | 1.78               |
| G_36         | 1                    | 16.76           | 0.06           | 0                         | 2.69               |
|              | 2                    | 0.001           | 0.025          | 100                       | 2.69               |
| G_37         | 1                    | 14.18           | 0.06           | 0                         | 1.72               |
|              | 2                    | 0.001           | 0.025          | 100                       | 1.72               |
| G_38         | 1                    | 7.11            | 0.06           | 0                         | 4.45               |
|              | 2                    | 0.001           | 0.025          | 100                       | 4.45               |
| G_39         | 1                    | 6.74            | 0.06           | 0                         | 2.86               |
|              | 2                    | 0.001           | 0.025          | 100                       | 2.86               |
| G_40         | 1                    | 9.36            | 0.06           | 0                         | 3.53               |
|              | 2                    | 0.001           | 0.025          | 100                       | 3.53               |
| G_41         | 1                    | 31.04           | 0.06           | 0                         | 1.4                |
|              | 2                    | 0.001           | 0.025          | 100                       | 1.4                |
| G_42         | 1                    | 12.69           | 0.06           | 0                         | 5.32               |
|              | 2                    | 0.44            | 0.025          | 100                       | 5.32               |
| G_43         | 1                    | 29.18           | 0.06           | 0                         | 2.18               |
|              | 2                    | 4.8             | 0.025          | 100                       | 2.18               |
| G_44         | 1                    | 12.66           | 0.06           | 0                         | 1.9                |
|              | 2                    | 2.68            | 0.025          | 100                       | 1.9                |
| G_45         | 1                    | 69.13           | 0.06           | 0                         | 2.34               |
|              | 2                    | 10.77           | 0.025          | 100                       | 2.34               |
| G_46         | 1                    | 21.76           | 0.06           | 0                         | 2.92               |
|              | 2                    | 0.001           | 0.025          | 100                       | 2.92               |



| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_47         | 1                    | 9.75            | 0.06           | 0                         | 3.86               |
|              | 2                    | 0.03            | 0.025          | 100                       | 3.86               |
| G_48         | 1                    | 29.08           | 0.06           | 0                         | 2.42               |
|              | 2                    | 0.04            | 0.025          | 100                       | 2.42               |
| G_49         | 1                    | 11.69           | 0.06           | 0                         | 4.8                |
|              | 2                    | 0.001           | 0.025          | 100                       | 4.8                |
| G_50         | 1                    | 46.2            | 0.06           | 0                         | 2.69               |
|              | 2                    | 6.54            | 0.025          | 100                       | 2.69               |
| G_51         | 1                    | 29.99           | 0.06           | 0                         | 2.04               |
|              | 2                    | 5.49            | 0.025          | 100                       | 2.04               |
| G_52         | 1                    | 22.84           | 0.06           | 0                         | 1.61               |
|              | 2                    | 5.45            | 0.025          | 100                       | 1.61               |
| G_53         | 1                    | 13.26           | 0.06           | 0                         | 5.32               |
|              | 2                    | 0.12            | 0.025          | 100                       | 5.32               |
| G_54         | 1                    | 18.01           | 0.06           | 0                         | 1.35               |
|              | 2                    | 0.001           | 0.025          | 100                       | 1.35               |
| G_55         | 1                    | 13.01           | 0.06           | 0                         | 2.87               |
|              | 2                    | 1.02            | 0.025          | 100                       | 2.87               |
| G_56         | 1                    | 23.86           | 0.06           | 0                         | 2.16               |
|              | 2                    | 1.53            | 0.025          | 100                       | 2.16               |
| G10_a        | 1                    | 2.19            | 0.06           | 0                         | 6.86               |
|              | 2                    | 0.27            | 0.025          | 100                       | 6.86               |
| G_3A         | 1                    | 2.86            | 0.025          | 0                         | 6                  |
|              | 2                    | 0.001           | 0.025          | 100                       | 6                  |
| G_16A        | 1                    | 14.66           | 0.06           | 0                         | 4.33               |
|              | 2                    | 0.02            | 0.025          | 100                       | 4.33               |
| G_57         | 1                    | 3.1             | 0.05           | 0                         | 6.5                |
|              | 2                    | 0.01            | 0.025          | 100                       | 6.5                |

**Table D.2: Post-Development Scenario XPRAFTS Parameters**

| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_1          | 1                    | 2.78            | 0.04           | 0                         | 3.03               |
|              | 2                    | 7.17            | 0.025          | 100                       | 3.03               |
| G_2          | 1                    | 5.76            | 0.04           | 0                         | 5.23               |
|              | 2                    | 5.14            | 0.025          | 100                       | 5.23               |
| G_3          | 1                    | 1.75            | 0.04           | 0                         | 3.65               |
|              | 2                    | 4.56            | 0.025          | 100                       | 3.65               |
| G_4          | 1                    | 4.38            | 0.05           | 0                         | 1.66               |
|              | 2                    | 0.75            | 0.025          | 100                       | 1.66               |
| G_5          | 1                    | 10.08           | 0.04           | 0                         | 2.11               |
|              | 2                    | 11.95           | 0.025          | 100                       | 2.11               |
| G_7          | 1                    | 2.44            | 0.04           | 0                         | 3.62               |
|              | 2                    | 5.21            | 0.025          | 100                       | 3.62               |
| G_8          | 1                    | 11.83           | 0.06           | 0                         | 3.44               |
|              | 2                    | 1.98            | 0.025          | 100                       | 3.44               |
| G_9          | 1                    | 12.59           | 0.06           | 0                         | 3.88               |
|              | 2                    | 1.43            | 0.025          | 100                       | 3.88               |
| G_10         | 1                    | 1.02            | 0.04           | 0                         | 3.7                |
|              | 2                    | 3.08            | 0.025          | 100                       | 3.7                |
| G_11         | 1                    | 4.42            | 0.04           | 0                         | 1.73               |
|              | 2                    | 11.94           | 0.025          | 100                       | 1.73               |
| G_12         | 1                    | 3.83            | 0.04           | 0                         | 3.27               |
|              | 2                    | 6.88            | 0.025          | 100                       | 3.27               |



| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_13         | 1                    | 0.71            | 0.04           | 0                         | 3.47               |
|              | 2                    | 0.83            | 0.025          | 100                       | 3.47               |
| G_14         | 1                    | 3.08            | 0.03           | 0                         | 4.02               |
|              | 2                    | 9.89            | 0.025          | 100                       | 4.02               |
| G_15         | 1                    | 11.98           | 0.05           | 0                         | 3.05               |
|              | 2                    | 0.76            | 0.025          | 100                       | 3.05               |
| G_16         | 1                    | 12.09           | 0.05           | 0                         | 2.71               |
|              | 2                    | 0.50            | 0.025          | 100                       | 2.71               |
| G_17         | 1                    | 23.97           | 0.06           | 0                         | 2.34               |
|              | 2                    | 1.53            | 0.025          | 100                       | 2.34               |
| G_18         | 1                    | 22.4            | 0.06           | 0                         | 2.08               |
|              | 2                    | 3.92            | 0.025          | 100                       | 2.08               |
| G_19         | 1                    | 12.98           | 0.06           | 0                         | 3.02               |
|              | 2                    | 2.02            | 0.025          | 100                       | 3.02               |
| G_20         | 1                    | 42.11           | 0.06           | 0                         | 1.92               |
|              | 2                    | 6.13            | 0.025          | 100                       | 1.92               |
| G_21         | 1                    | 46.53           | 0.06           | 0                         | 1.08               |
|              | 2                    | 5.12            | 0.025          | 100                       | 1.08               |
| G_22A        | 1                    | 2.71            | 0.04           | 0                         | 0.2                |
|              | 2                    | 6.32            | 0.025          | 100                       | 0.2                |
| G_24         | 1                    | 7.29            | 0.05           | 0                         | 4.36               |
|              | 2                    | 0.00            | 0.025          | 100                       | 4.36               |
| G_25         | 1                    | 9.89            | 0.05           | 0                         | 1.98               |

| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_26         | 2                    | 0.00            | 0.025          | 100                       | 1.98               |
|              | 1                    | 49.06           | 0.06           | 0                         | 1.33               |
| G_27         | 2                    | 5.45            | 0.025          | 100                       | 1.33               |
|              | 1                    | 12.85           | 0.06           | 0                         | 4.6                |
| G_28         | 2                    | 2.56            | 0.025          | 100                       | 4.6                |
|              | 1                    | 12.91           | 0.06           | 0                         | 2.99               |
| G_29         | 2                    | 1.85            | 0.025          | 100                       | 2.99               |
|              | 1                    | 15.28           | 0.06           | 0                         | 2.29               |
| G_30         | 2                    | 0.02            | 0.025          | 100                       | 2.29               |
|              | 1                    | 10.62           | 0.06           | 0                         | 2.47               |
| G_31         | 2                    | 1.34            | 0.025          | 100                       | 2.47               |
|              | 1                    | 5.98            | 0.06           | 0                         | 2.73               |
| G_32         | 2                    | 0.01            | 0.025          | 100                       | 2.73               |
|              | 1                    | 3.28            | 0.04           | 0                         | 4.36               |
| G_32A        | 2                    | 6.77            | 0.025          | 100                       | 4.36               |
|              | 1                    | 3.87            | 0.05           | 0                         | 1.52               |
| G_36         | 2                    | 5.51            | 0.025          | 100                       | 1.52               |
|              | 1                    | 3.88            | 0.06           | 0                         | 1.13               |
| G_37         | 2                    | 0.06            | 0.025          | 100                       | 1.13               |
|              | 1                    | 7.89            | 0.06           | 0                         | 1.95               |
| G_38         | 2                    | 0.12            | 0.025          | 100                       | 1.95               |
|              | 1                    | 1.76            | 0.04           | 0                         | 2.36               |
|              | 2                    | 4.2             | 0.025          | 100                       | 2.36               |



| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_41         | 1                    | 33.59           | 0.06           | 0                         | 2.46               |
|              | 2                    | 0.03            | 0.025          | 100                       | 2.46               |
| G_42         | 1                    | 5.59            | 0.04           | 0                         | 5                  |
|              | 2                    | 5.28            | 0.025          | 100                       | 5                  |
| G_43         | 1                    | 29.13           | 0.06           | 0                         | 2.18               |
|              | 2                    | 4.79            | 0.025          | 100                       | 2.18               |
| G_44         | 1                    | 12.64           | 0.06           | 0                         | 1.9                |
|              | 2                    | 2.68            | 0.025          | 100                       | 1.9                |
| G_45         | 1                    | 69              | 0.06           | 0                         | 2.34               |
|              | 2                    | 10.78           | 0.025          | 100                       | 2.34               |
| G_46         | 1                    | 1.84            | 0.04           | 0                         | 1.66               |
|              | 2                    | 4.81            | 0.025          | 100                       | 1.66               |
| G_47         | 1                    | 9.74            | 0.06           | 0                         | 3.86               |
|              | 2                    | 0.03            | 0.025          | 100                       | 3.86               |
| G_48         | 1                    | 25.06           | 0.06           | 0                         | 2.42               |
|              | 2                    | 0.17            | 0.025          | 100                       | 2.42               |
| G_46B        | 1                    | 3.38            | 0.04           | 0                         | 1.56               |
|              | 2                    | 7.89            | 0.025          | 100                       | 1.56               |
| G_50         | 1                    | 46.02           | 0.06           | 0                         | 2.69               |
|              | 2                    | 6.64            | 0.025          | 100                       | 2.69               |
| G_51         | 1                    | 29.94           | 0.06           | 0                         | 2.04               |
|              | 2                    | 5.48            | 0.025          | 100                       | 2.04               |
| G_52         | 1                    | 22.8            | 0.06           | 0                         | 1.61               |

| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_53         | 2                    | 5.47            | 0.025          | 100                       | 1.61               |
|              | 1                    | 10.9            | 0.06           | 0                         | 5.32               |
| G_55         | 2                    | 0.19            | 0.025          | 100                       | 5.32               |
|              | 1                    | 13.86           | 0.06           | 0                         | 2.87               |
| G_56         | 2                    | 0.14            | 0.025          | 100                       | 2.87               |
|              | 1                    | 23.83           | 0.06           | 0                         | 2.16               |
| G_54         | 2                    | 3.51            | 0.025          | 100                       | 2.16               |
|              | 1                    | 5.55            | 0.05           | 0                         | 1.56               |
| G_12A        | 2                    | 5.87            | 0.025          | 100                       | 1.56               |
|              | 1                    | 8.93            | 0.05           | 0                         | 2.3                |
| G_6          | 2                    | 1.82            | 0.025          | 100                       | 2.3                |
|              | 1                    | 3.9             | 0.04           | 0                         | 1.89               |
| G_29A        | 2                    | 9.3             | 0.025          | 100                       | 1.89               |
|              | 1                    | 0.62            | 0.04           | 0                         | 0.86               |
| Add1         | 2                    | 1.43            | 0.025          | 100                       | 0.86               |
|              | 1                    | 3.87            | 0.04           | 0                         | 2.18               |
| G_46A        | 2                    | 8.7             | 0.025          | 100                       | 2.18               |
|              | 1                    | 4.09            | 0.04           | 0                         | 3.58               |
| G_37A        | 2                    | 9.15            | 0.025          | 100                       | 3.58               |
|              | 1                    | 3.34            | 0.04           | 0                         | 0.52               |
| G_23         | 2                    | 8.54            | 0.025          | 100                       | 0.52               |
|              | 1                    | 12.72           | 0.04           | 0                         | 2.02               |
|              | 2                    | 24.69           | 0.025          | 100                       | 2.02               |



| Catchment ID | Sub-catchment Number | Total Area [ha] | Catchment PERN | Percentage Impervious [%] | Vectored Slope [%] |
|--------------|----------------------|-----------------|----------------|---------------------------|--------------------|
| G_53A        | 1                    | 1.69            | 0.04           | 0                         | 1.38               |
|              | 2                    | 3.94            | 0.025          | 100                       | 1.38               |
| G_36A        | 1                    | 1.13            | 0.04           | 0                         | 3.4                |
|              | 2                    | 2.59            | 0.025          | 100                       | 3.4                |
| G_37B        | 1                    | 0.83            | 0.04           | 0                         | 2.02               |
|              | 2                    | 1.93            | 0.025          | 100                       | 2.02               |
| G_22         | 1                    | 34.18           | 0.06           | 0                         | 2                  |
|              | 2                    | 0.61            | 0.025          | 100                       | 2                  |
| G_38A        | 1                    | 1.37            | 0.04           | 0                         | 1.37               |
|              | 2                    | 3.18            | 0.025          | 100                       | 1.37               |
| G_57         | 1                    | 0.28            | 0.05           | 0                         | 6.5                |
|              | 2                    | 1.57            | 0.025          | 100                       | 6.5                |

# Appendix E:

## ARR 2019 Data Hub Output

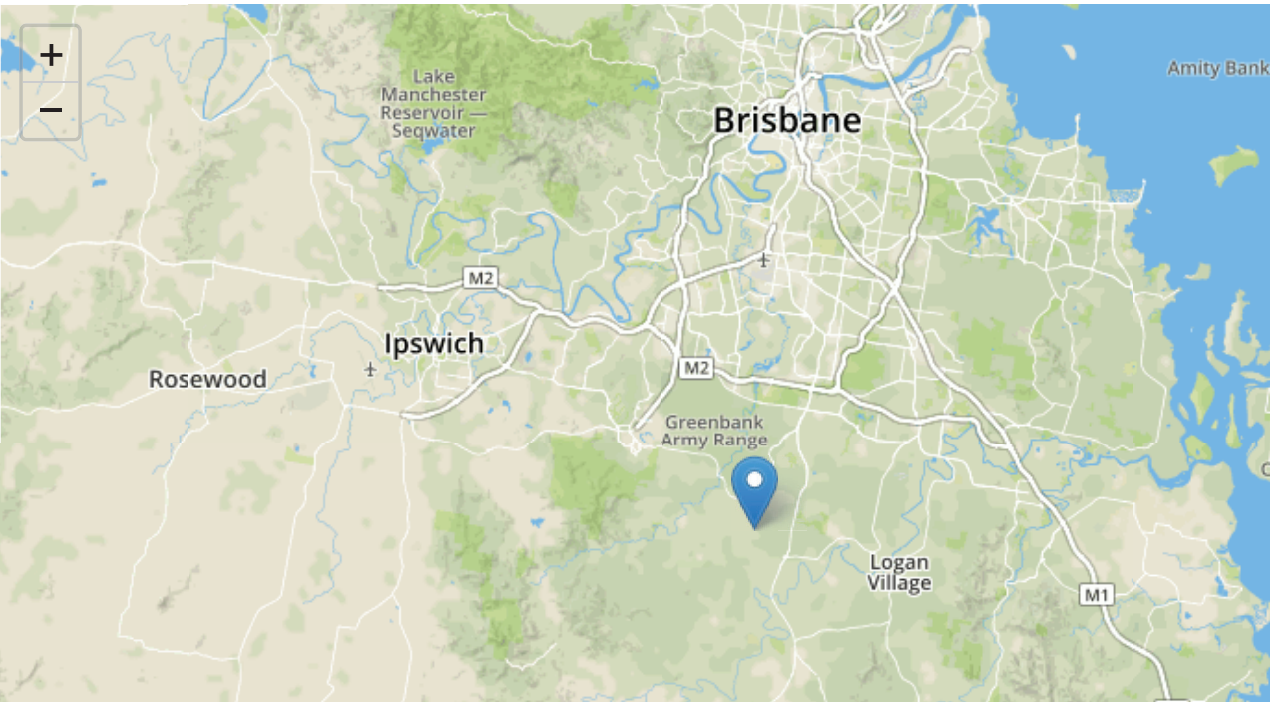


ATTENTION: This site was updated recently, changing some of the functionality. Please see the changelog (./changelog) for further information

# Australian Rainfall & Runoff Data Hub - Results

## Input Data

|                                   |         |
|-----------------------------------|---------|
| Longitude                         | 152.999 |
| Latitude                          | -27.741 |
| Selected Regions (clear)          |         |
| River Region                      | show    |
| ARF Parameters                    | show    |
| Storm Losses                      | show    |
| Temporal Patterns                 | show    |
| Areal Temporal Patterns           | show    |
| BOM IFDs                          | show    |
| Median Preburst Depths and Ratios | show    |
| 10% Preburst Depths               | show    |
| 25% Preburst Depths               | show    |
| 75% Preburst Depths               | show    |
| 90% Preburst Depths               | show    |
| Interim Climate Change Factors    | show    |





## Data

### River Region

|                     |                     |
|---------------------|---------------------|
| <b>Division</b>     | North East Coast    |
| <b>River Number</b> | 45                  |
| <b>River Name</b>   | Logan-Albert Rivers |

### Layer Info

|                      |                      |
|----------------------|----------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM |
| <b>Version</b>       | 2016_v1              |

### ARF Parameters

$$ARF = Min \left\{ 1, \left[ 1 - a \left( Area^b - \log_{10} Duration \right) Duration^{-d} + e Area^f Duration^g (0.3 + \log_{10} AEP) + h 10^{i Area \frac{Duration}{1440}} (0.3 + \log_{10} AEP) \right] \right\}$$

| Zone             | a     | b     | c     | d    | e       | f    | g     | h     | i       |
|------------------|-------|-------|-------|------|---------|------|-------|-------|---------|
| East Coast North | 0.327 | 0.241 | 0.448 | 0.36 | 0.00096 | 0.48 | -0.21 | 0.012 | -0.0013 |

### Short Duration ARF

$$ARF = Min \left[ 1, 1 - 0.287 \left( Area^{0.265} - 0.439 \log_{10} (Duration) \right) \cdot Duration^{-0.36} + 2.26 \times 10^{-3} \times Area^{0.226} \cdot Duration^{0.125} (0.3 + \log_{10} (AEP)) + 0.0141 \times Area^{0.213} \times 10^{-0.021 \frac{(Duration-180)^2}{1440}} (0.3 + \log_{10} (AEP)) \right]$$

### Layer Info

|                      |                      |
|----------------------|----------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM |
| <b>Version</b>       | 2016_v1              |



## Storm Losses

Note: Burst Loss = Storm Loss - Preburst

Note: These losses are only for rural use and are **NOT FOR DIRECT USE** in urban areas

|                                       |         |
|---------------------------------------|---------|
| <b>ID</b>                             | 29205.0 |
| <b>Storm Initial Losses (mm)</b>      | 25.0    |
| <b>Storm Continuing Losses (mm/h)</b> | 1.1     |

## Layer Info

|                      |                      |
|----------------------|----------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM |
| <b>Version</b>       | 2016_v1              |

## Temporal Patterns | Download (.zip) (static/temporal\_patterns/TP/ECnorth.zip)

|              |                  |
|--------------|------------------|
| <b>code</b>  | ECnorth          |
| <b>Label</b> | East Coast North |

## Layer Info

|                      |                      |
|----------------------|----------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM |
| <b>Version</b>       | 2016_v2              |

## Areal Temporal Patterns | Download (.zip) (./static/temporal\_patterns/Areal/Areal\_ECnorth.zip)

|                  |                  |
|------------------|------------------|
| <b>code</b>      | ECnorth          |
| <b>arealabel</b> | East Coast North |

## Layer Info

|                      |                      |
|----------------------|----------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM |
| <b>Version</b>       | 2016_v2              |

## BOM IFDs

Click here ([http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate\\_type=dd&latitude=-27.741&longitude=152.999&sdmin=true&sdhr=true&sdday=true&user\\_label=](http://www.bom.gov.au/water/designRainfalls/revised-ifd/?year=2016&coordinate_type=dd&latitude=-27.741&longitude=152.999&sdmin=true&sdhr=true&sdday=true&user_label=)) to obtain the IFD depths for catchment centroid from the BoM website

## Layer Info

|                      |                      |
|----------------------|----------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM |
|----------------------|----------------------|

## Median Preburst Depths and Ratios

Values are of the format depth (ratio) with depth in mm

| min (h)\AEP(%) | 50             | 20             | 10              | 5               | 2               | 1               |
|----------------|----------------|----------------|-----------------|-----------------|-----------------|-----------------|
| 60 (1.0)       | 0.3<br>(0.009) | 2.9<br>(0.059) | 4.6<br>(0.079)  | 6.2<br>(0.092)  | 7.1<br>(0.088)  | 7.8<br>(0.086)  |
| 90 (1.5)       | 0.1<br>(0.002) | 2.0<br>(0.036) | 3.2<br>(0.049)  | 4.5<br>(0.058)  | 11.9<br>(0.129) | 17.4<br>(0.167) |
| 120 (2.0)      | 0.0<br>(0.000) | 3.6<br>(0.061) | 6.1<br>(0.084)  | 8.4<br>(0.099)  | 15.5<br>(0.153) | 20.8<br>(0.182) |
| 180 (3.0)      | 0.4<br>(0.009) | 5.1<br>(0.076) | 8.2<br>(0.102)  | 11.2<br>(0.118) | 22.7<br>(0.198) | 31.4<br>(0.240) |
| 360 (6.0)      | 0.1<br>(0.002) | 7.8<br>(0.093) | 12.8<br>(0.127) | 17.7<br>(0.148) | 30.6<br>(0.211) | 40.3<br>(0.243) |
| 720 (12.0)     | 1.8<br>(0.023) | 9.1<br>(0.084) | 14.0<br>(0.106) | 18.7<br>(0.120) | 31.4<br>(0.166) | 40.9<br>(0.189) |
| 1080 (18.0)    | 0.5<br>(0.005) | 8.5<br>(0.066) | 13.9<br>(0.089) | 19.0<br>(0.103) | 28.3<br>(0.126) | 35.2<br>(0.136) |
| 1440 (24.0)    | 0.7<br>(0.007) | 5.7<br>(0.039) | 9.0<br>(0.051)  | 12.2<br>(0.058) | 22.9<br>(0.090) | 31.0<br>(0.106) |
| 2160 (36.0)    | 0.2<br>(0.002) | 2.8<br>(0.016) | 4.6<br>(0.022)  | 6.3<br>(0.025)  | 12.7<br>(0.042) | 17.5<br>(0.050) |
| 2880 (48.0)    | 0.0<br>(0.000) | 1.6<br>(0.008) | 2.7<br>(0.011)  | 3.7<br>(0.013)  | 12.0<br>(0.035) | 18.2<br>(0.046) |
| 4320 (72.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000)  | 0.0<br>(0.000)  | 1.8<br>(0.004)  | 3.1<br>(0.007)  |

## Layer Info

|                      |                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM                                                                                                 |
| <b>Version</b>       | 2018_v1                                                                                                              |
| <b>Note</b>          | Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged. |



## 10% Preburst Depths

Values are of the format depth (ratio) with depth in mm

| min (h)\AEP(%) | 50             | 20             | 10             | 5              | 2              | 1              |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 60 (1.0)       | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 90 (1.5)       | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 120 (2.0)      | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 180 (3.0)      | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 360 (6.0)      | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 720 (12.0)     | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 1080 (18.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 1440 (24.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 2160 (36.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 2880 (48.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 4320 (72.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |

## Layer Info

|                      |                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM                                                                                                 |
| <b>Version</b>       | 2018_v1                                                                                                              |
| <b>Note</b>          | Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged. |

## 25% Preburst Depths

Values are of the format depth (ratio) with depth in mm

| min (h)\AEP(%) | 50             | 20             | 10             | 5              | 2              | 1              |
|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 60 (1.0)       | 0.0<br>(0.000) | 0.2<br>(0.003) | 0.3<br>(0.005) | 0.4<br>(0.006) | 0.4<br>(0.004) | 0.3<br>(0.004) |
| 90 (1.5)       | 0.0<br>(0.000) | 0.1<br>(0.001) | 0.1<br>(0.001) | 0.1<br>(0.002) | 0.7<br>(0.008) | 1.1<br>(0.011) |
| 120 (2.0)      | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.6<br>(0.006) | 1.0<br>(0.009) |
| 180 (3.0)      | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 1.1<br>(0.009) | 1.9<br>(0.014) |
| 360 (6.0)      | 0.0<br>(0.000) | 0.1<br>(0.001) | 0.2<br>(0.002) | 0.3<br>(0.002) | 2.7<br>(0.018) | 4.5<br>(0.027) |
| 720 (12.0)     | 0.0<br>(0.000) | 0.9<br>(0.009) | 1.6<br>(0.012) | 2.2<br>(0.014) | 4.4<br>(0.023) | 6.1<br>(0.028) |
| 1080 (18.0)    | 0.0<br>(0.000) | 0.3<br>(0.002) | 0.4<br>(0.003) | 0.6<br>(0.003) | 4.4<br>(0.019) | 7.2<br>(0.028) |
| 1440 (24.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.1<br>(0.000) | 0.1<br>(0.001) | 1.8<br>(0.007) | 3.1<br>(0.011) |
| 2160 (36.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.1<br>(0.000) | 0.2<br>(0.000) |
| 2880 (48.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |
| 4320 (72.0)    | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) | 0.0<br>(0.000) |

## Layer Info

|                      |                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM                                                                                                 |
| <b>Version</b>       | 2018_v1                                                                                                              |
| <b>Note</b>          | Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged. |



## 75% Preburst Depths

Values are of the format depth (ratio) with depth in mm

| min (h)\AEP(%) | 50              | 20              | 10              | 5               | 2                | 1                |
|----------------|-----------------|-----------------|-----------------|-----------------|------------------|------------------|
| 60 (1.0)       | 9.4<br>(0.270)  | 22.0<br>(0.452) | 30.4<br>(0.520) | 38.4<br>(0.565) | 34.0<br>(0.420)  | 30.7<br>(0.337)  |
| 90 (1.5)       | 2.9<br>(0.075)  | 17.5<br>(0.318) | 27.1<br>(0.411) | 36.3<br>(0.471) | 67.5<br>(0.731)  | 90.9<br>(0.871)  |
| 120 (2.0)      | 8.1<br>(0.190)  | 24.1<br>(0.404) | 34.7<br>(0.484) | 44.9<br>(0.534) | 85.6<br>(0.847)  | 116.2<br>(1.014) |
| 180 (3.0)      | 11.9<br>(0.250) | 38.5<br>(0.575) | 56.1<br>(0.695) | 73.0<br>(0.769) | 102.0<br>(0.889) | 123.7<br>(0.947) |
| 360 (6.0)      | 20.2<br>(0.338) | 38.4<br>(0.458) | 50.5<br>(0.498) | 62.0<br>(0.519) | 100.0<br>(0.690) | 128.5<br>(0.775) |
| 720 (12.0)     | 24.8<br>(0.321) | 42.4<br>(0.389) | 54.0<br>(0.409) | 65.2<br>(0.419) | 86.9<br>(0.459)  | 103.2<br>(0.476) |
| 1080 (18.0)    | 18.5<br>(0.204) | 37.7<br>(0.293) | 50.5<br>(0.323) | 62.7<br>(0.339) | 82.8<br>(0.368)  | 97.9<br>(0.380)  |
| 1440 (24.0)    | 18.7<br>(0.184) | 34.5<br>(0.237) | 44.9<br>(0.254) | 54.8<br>(0.262) | 73.6<br>(0.288)  | 87.6<br>(0.299)  |
| 2160 (36.0)    | 13.7<br>(0.116) | 22.1<br>(0.129) | 27.6<br>(0.131) | 32.9<br>(0.132) | 47.4<br>(0.155)  | 58.2<br>(0.166)  |
| 2880 (48.0)    | 3.3<br>(0.025)  | 12.3<br>(0.064) | 18.2<br>(0.078) | 23.9<br>(0.085) | 49.6<br>(0.144)  | 68.8<br>(0.174)  |
| 4320 (72.0)    | 0.4<br>(0.003)  | 5.6<br>(0.026)  | 9.1<br>(0.034)  | 12.5<br>(0.039) | 30.5<br>(0.077)  | 44.0<br>(0.096)  |

## Layer Info

|                      |                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM                                                                                                 |
| <b>Version</b>       | 2018_v1                                                                                                              |
| <b>Note</b>          | Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged. |

## 90% Preburst Depths

Values are of the format depth (ratio) with depth in mm

| min (h)\AEP(%) | 50              | 20               | 10               | 5                | 2                | 1                |
|----------------|-----------------|------------------|------------------|------------------|------------------|------------------|
| 60 (1.0)       | 25.0<br>(0.716) | 69.8<br>(1.431)  | 99.5<br>(1.703)  | 128.0<br>(1.882) | 115.7<br>(1.430) | 106.5<br>(1.172) |
| 90 (1.5)       | 14.5<br>(0.369) | 53.5<br>(0.974)  | 79.3<br>(1.203)  | 104.1<br>(1.350) | 176.9<br>(1.915) | 231.4<br>(2.217) |
| 120 (2.0)      | 29.1<br>(0.685) | 67.5<br>(1.133)  | 92.9<br>(1.295)  | 117.2<br>(1.394) | 180.0<br>(1.781) | 227.0<br>(1.981) |
| 180 (3.0)      | 65.3<br>(1.369) | 107.1<br>(1.599) | 134.8<br>(1.668) | 161.3<br>(1.698) | 222.1<br>(1.936) | 267.7<br>(2.049) |
| 360 (6.0)      | 56.9<br>(0.954) | 85.8<br>(1.024)  | 104.9<br>(1.035) | 123.2<br>(1.032) | 192.1<br>(1.326) | 243.8<br>(1.471) |
| 720 (12.0)     | 52.8<br>(0.684) | 92.6<br>(0.851)  | 119.0<br>(0.902) | 144.3<br>(0.927) | 182.9<br>(0.965) | 211.7<br>(0.976) |
| 1080 (18.0)    | 52.7<br>(0.581) | 79.8<br>(0.620)  | 97.8<br>(0.625)  | 115.0<br>(0.622) | 157.9<br>(0.702) | 190.1<br>(0.737) |
| 1440 (24.0)    | 52.4<br>(0.516) | 81.1<br>(0.559)  | 100.1<br>(0.566) | 118.4<br>(0.565) | 149.8<br>(0.587) | 173.3<br>(0.592) |
| 2160 (36.0)    | 38.3<br>(0.323) | 57.7<br>(0.336)  | 70.4<br>(0.336)  | 82.7<br>(0.332)  | 124.0<br>(0.407) | 155.0<br>(0.443) |
| 2880 (48.0)    | 33.0<br>(0.251) | 58.3<br>(0.305)  | 75.0<br>(0.320)  | 91.1<br>(0.325)  | 113.8<br>(0.331) | 130.8<br>(0.331) |
| 4320 (72.0)    | 19.9<br>(0.134) | 42.0<br>(0.193)  | 56.7<br>(0.211)  | 70.8<br>(0.219)  | 79.4<br>(0.199)  | 85.8<br>(0.187)  |

## Layer Info

|                      |                                                                                                                      |
|----------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Time Accessed</b> | 28 July 2020 08:56AM                                                                                                 |
| <b>Version</b>       | 2018_v1                                                                                                              |
| <b>Note</b>          | Preburst interpolation methods for catchment wide preburst has been slightly altered. Point values remain unchanged. |



Interim Climate Change Factors

|      | RCP 4.5      | RCP6          | RCP 8.5       |
|------|--------------|---------------|---------------|
| 2030 | 0.869 (4.3%) | 0.783 (3.9%)  | 0.983 (4.9%)  |
| 2040 | 1.057 (5.3%) | 1.014 (5.1%)  | 1.349 (6.8%)  |
| 2050 | 1.272 (6.4%) | 1.236 (6.2%)  | 1.773 (9.0%)  |
| 2060 | 1.488 (7.5%) | 1.458 (7.4%)  | 2.237 (11.5%) |
| 2070 | 1.676 (8.5%) | 1.691 (8.6%)  | 2.722 (14.2%) |
| 2080 | 1.810 (9.2%) | 1.944 (9.9%)  | 3.209 (16.9%) |
| 2090 | 1.862 (9.5%) | 2.227 (11.5%) | 3.679 (19.7%) |

Layer Info

|               |                                                                                                                                                          |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Time Accessed | 28 July 2020 08:56AM                                                                                                                                     |
| Version       | 2019_v1                                                                                                                                                  |
| Note          | ARR recommends the use of RCP4.5 and RCP 8.5 values. These have been updated to the values that can be found on the climate change in Australia website. |

Download TXT (downloads/1ba7f115-59bf-43c7-842c-897d6f53c24b.txt)

Download JSON (downloads/78d327a7-43dd-4761-a2b3-f66652604902.json)

Generating PDF... (downloads/3c9f71db-07ea-4980-a0cd-2141669d4a4b.pdf)

# Appendix F: Stormwater Quality Modelling



## Introduction

### Water Quality Design Objectives

A conceptual stormwater quality treatment strategy has been developed in accordance with the State Planning policy (SPP) 2014. Based on the provisions of the SPP, the load based pollutant reduction targets have been used to demonstrate compliance with objectives. Load based targets identified in the SPP were adopted for discharge targets as outlined in Table F.1.

**Table F.1: Water Quality Objectives**

| Pollutant                    | Load Reduction % |
|------------------------------|------------------|
| Total Suspended Solids (TSS) | 80               |
| Total Phosphorus (TP)        | 60               |
| Total Nitrogen (TN)          | 45               |
| Gross Pollutants (GP)        | 90               |

## MUSIC Modelling

### Climate Data

Climate data for the catchment was sourced from the Bureau of Meteorology (BoM). Rainfall data was obtained from Greenbank Thompson Rd (40659) for the 10 years between 1980 and 1989 at six (6) minute intervals as specified by MUSIC Modelling Guidelines for South East Queensland (Water By Design, 2018).

### Catchment Properties

The catchment areas for the water quality are based on the proposed development layout and is presented in Figure F.2. A lumped catchment approach was considered appropriate and adopted for the assessment of the urban residential catchments. Due to the vast areas of open green space within the sports and Recreation Park, this area has been excluded from the water quality model.

Rainfall-runoff and pollutant export parameters were adopted from the recommended values identified in Tables 3.8 and Table 3.9 Music Modelling Guidelines for South East Queensland (Water by Design, 2018).

Table F.2 provides a summary of the MUSIC Modelling parameters adopted with the various land uses throughout the study area. Fraction impervious was adopted based on the recommended values provided by MUSIC Modelling Guidelines for South East Queensland (Water by Design, 2018).

**Table F.2: MUSIC Model Catchment Parameters**

| Catchment ID          | MUSIC Land Use | Area (ha) | Impervious Fraction (%)                                                    |
|-----------------------|----------------|-----------|----------------------------------------------------------------------------|
| C1                    | Residential    | 52.67     | 55% (Based on Table 3.7, Water by Design MUSIC Modelling guidelines, 2018) |
| C2 (including School) | Residential    | 85.49     |                                                                            |
| C3                    | Residential    | 11.78     |                                                                            |
| C4                    | Residential    | 34.99     |                                                                            |
| C5                    | Residential    | 4.55      |                                                                            |
| C6                    | Residential    | 38.11     |                                                                            |
| C7                    | Residential    | 2.05      |                                                                            |

| Catchment ID | MUSIC Land Use | Area (ha) | Impervious Fraction (%) |
|--------------|----------------|-----------|-------------------------|
| C8           | Residential    | 14.20     |                         |
| C9           | Residential    | 5.61      |                         |
| C10          | Residential    | 10.87     |                         |
| Bypass 1     | Residential    | 1.33      |                         |
| Bypass 2     | Residential    | 1.85      |                         |





Legend

Cadastre

Treated Catchment

Level 2, 500 Queen St Brisbane QLD 4000  
PO Box 10183 Brisbane QLD 4000  
www.engeny.com.au  
P: 03 3221 7174  
F: 03 3236 2399



0 250 500 m

Scale in metres ( 1:10000@ A3)

Map Projection: Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia  
Vertical Datum: Australia Height Datum  
Grid: Map Grid of Australia, Zone 56

Everleigh Masterplan Update

Figure F1  
Water Quality Catchments

Job Number:  
M43000\_023  
Revision: 0  
Drawn: JN  
Date: 23 /10 /2020



### Treatment Sizing

Treatment system parameters have been adopted based on the WSUD Technical Design Guidelines for South East Queensland and the Water by Design MUSIC Modelling Guidelines for South East Queensland. The parameters used for the proposed bioretention basin and wetland are provided in Table F.3 and Table F.4, respectively. The proposed treatment device sizes are included in Section 4.3 and the layout of the MUSIC model is included as Figure F.2.

A Concept Layout Plan depicting the locations of the proposed water quality treatment devices for the developed scenario is included in Figure F.3.

**Table F.3: Modelled Bioretention Parameters**

| Parameter                                           | Value        |
|-----------------------------------------------------|--------------|
| Extended Detention Depth                            | 300 mm       |
| Filter Depth                                        | 500 mm       |
| Batter Slope to Natural Surface                     | 1 in 4 (V:H) |
| Orthophosphate Content of Filter Media <sup>1</sup> | 3 mg/kg      |

1 – The orthophosphate content of filter media based on River Sands Pty Ltd product data sheet for Bioretention Filter Media. (Refer to Appendix G)

**Table F.4: Modelled Wetland Parameters**

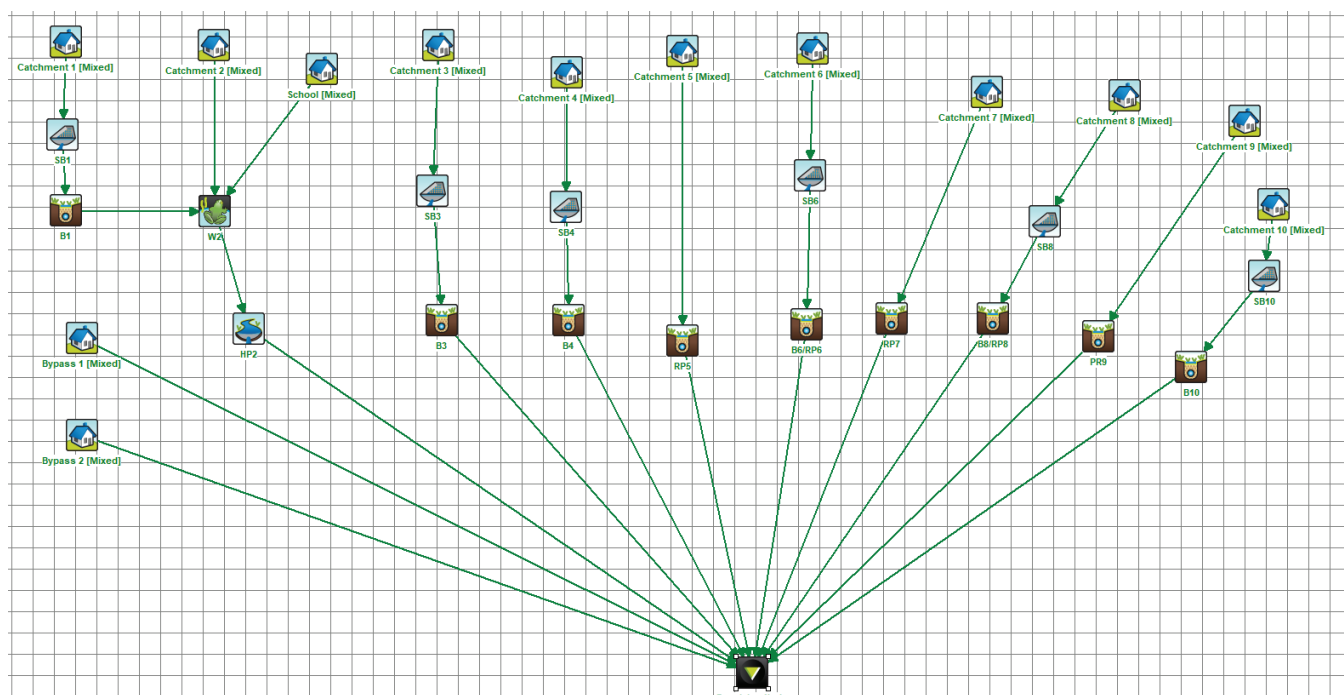
| Parameter                | Value                 |
|--------------------------|-----------------------|
| Extended Detention Depth | 400 mm                |
| Permanent Pool Volume    | 5,200 m <sup>3</sup>  |
| Wetland Surface Area     | 14,000 m <sup>2</sup> |
| Notional Detention Time  | 12 hours              |

**Table F.5: Modelled Harvesting Pond Parameters**

| Parameter                       | Value                 |
|---------------------------------|-----------------------|
| Extended Detention Depth        | 200 mm                |
| Permanent Pool Volume           | 12,000 m <sup>3</sup> |
| Harvesting Pond Area            | 8,000 m <sup>2</sup>  |
| Water Harvesting Rate           | 63,240 kL/year        |
| Water Harvesting Distribution   | PET                   |
| % of Demand met from Harvesting | 70%                   |

1 – Harvesting rate based on 12,000 L per hectare per year, which is derived from a recent sports field irrigation project in Ipswich over 5.27 Ha of sports fields





**Figure F.2: MUSIC Model Layout**

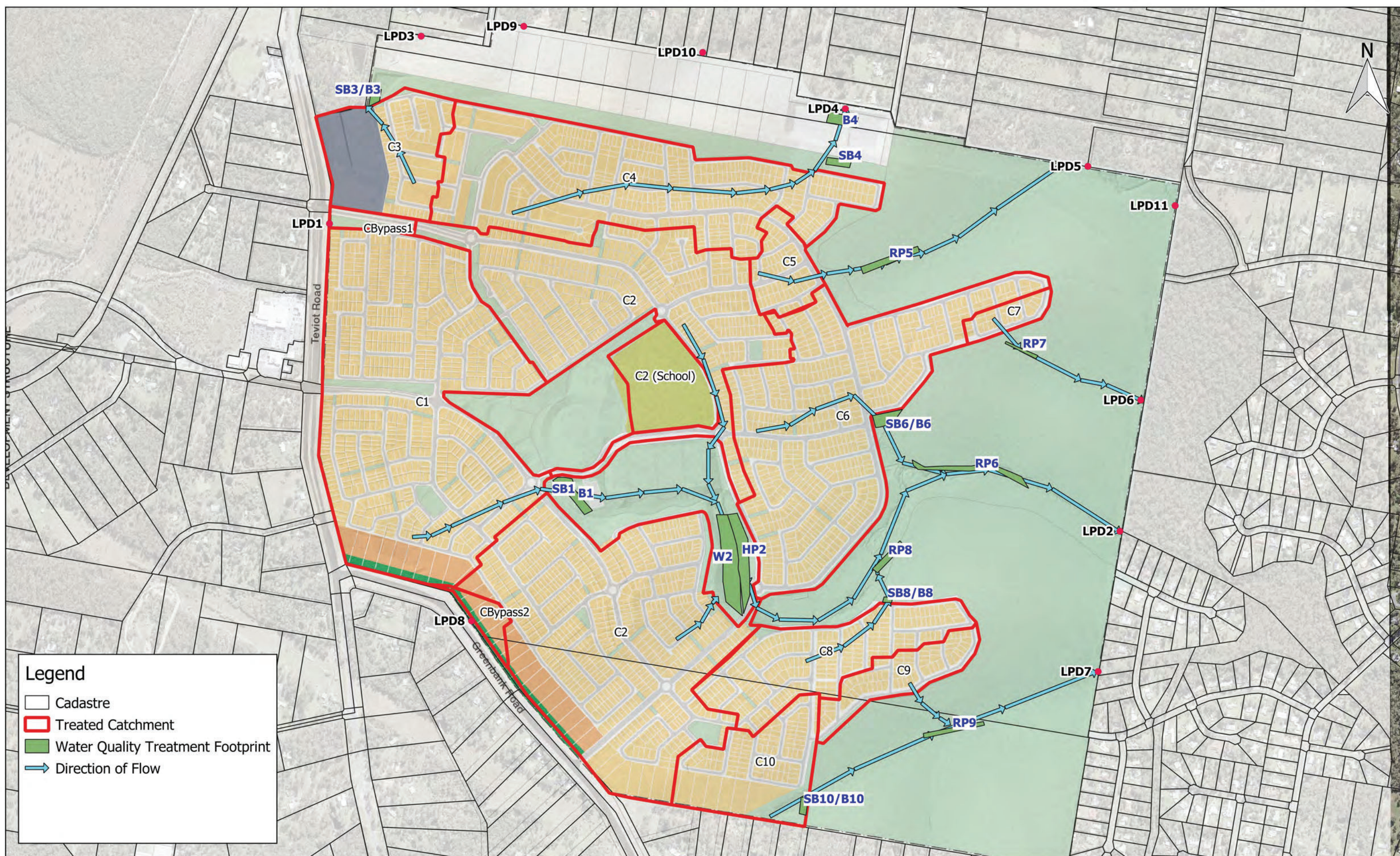
### Water Quality Model Results

The results of the MUSIC modelling indicate that the load based reduction targets have been achieved with the proposed treatment train. The results of the MUSIC model are presented in Table F.6.

**Table F.6: Music Model Results**

| Pollutant | Load Based Reduction Target (%) | Modelled Reduction (%) |
|-----------|---------------------------------|------------------------|
| TSS       | 80                              | 80.5                   |
| TP        | 60                              | 71.0                   |
| TN        | 45                              | 45.0                   |
| GP        | 90                              | 98.8                   |







# Appendix G:

## Media – Data Sheet

## PRODUCT DATA SHEET

*This is a typical analysis of material produced and does not constitute as a Product Certification for material supply*

### Product:

### River Sands Cert BioMedia (V1)

### BioRetention Filter Media

Manufactured to Meet:

- The Facility for Advance Water Biofiltration Guidelines (V 3.01 June 2009)
- The Healthy Waterways / Water By Design Specifications (V1, October 2012)

### Main Applications:

BioRetention Filter Media for BioRetention Systems to be used with BioRetention Transition Layer and Drainage Layer to assist in removing pollutants and supporting vegetation.

### Indicative Grade Analysis:

Sieve Standards: ASTM C136, AS1141.11.1

Sampling Methods: ASTM D75, AS1141.3.1

### Note:

*Indicative grading only. Grading analysis will vary over time due to changes in raw feed.*

### Technical Properties:

| Analysis                                        | FAWB Specification   | Result          |
|-------------------------------------------------|----------------------|-----------------|
| Organic Matter (%)                              | >3-10 (Ideally 5-10) | 6.8 %           |
| Saturated Hydraulic Conductivity (Ksat) (mm/hr) | 100-600mm            | 150 – 300 mm/hr |
| Electrical Conductivity (1:5) (dS/m)            | <1.2                 | 0.30 dS/m       |
| pH (1:5) in H2O (pH units)                      | 5.5-7.5              | 6.2             |
| Total Nitrogen (mg/kg)                          | < 1000 mg/kg         | 600.0 mg / kg   |
| Phosphate as PO4 (mg/kg)                        | <80 mg / kg          | 3.0 mg / kg     |

### Grading Properties:

*The below attached Particle Size Distribution (PSD) is a recommended range and is of secondary importance compared with saturated hydraulic conductivity.*

| Size (mm)                     | FAWB Indicative PSD | Result |
|-------------------------------|---------------------|--------|
| <0.05                         | 2-6%                | 3.3%   |
| 0.05-0.15                     | 5-30%               | 8.7%   |
| 0.15-0.25                     | 10-30%              | 32.1%  |
| 0.25-1.0                      | 40-60%              | 55.5%  |
| 1.0-2.0                       | 7-10%               | 0.3%   |
| 2.0-3.35                      | <3.0%               | 0.1%   |
| >3.35                         |                     | 0.1%   |
| D85 ( Filter Media Layer)     | AS 1141.11.1        | 0.8mm  |
| 5 x D85 (Filter Media Layer ) | AS 1141.11.1        | 4.0mm  |
| Fines <0.002mm                | < 2 %               | ✓      |

*To meet 'bridging criteria' the smallest 15% of the sand particles in the transition layer should bridge with the largest 15% of the filter media layer. As per section 4.3.2. Transition Layer ( Where using alternate materials please check bridging criteria before use.)*

|                                                            |                                                                                                      |   |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---|
| D15 ( Transition Layer ) <= 5 x D85 ( Filter Media Layer ) | 0.26-0.41mm ( D15 River Sands BioTrans 1mm & BioTrans )<br><= 4.0mm ( 5 x D85 River Sands BioMedia ) | ✓ |
|------------------------------------------------------------|------------------------------------------------------------------------------------------------------|---|

River Sands operates and maintains a Quality Certified system in accordance with AS/NZS ISO 9001:2008.

The Quality system is third party certified by BSI/NCSI.

River Sands also maintains a registered NATA laboratory.

Registration # 6898

Registration # 10470

Testing results achieved at time of manufacture 28.06.13:3AHS,13/26751

## Better Products, Outstanding Results



### SERVICE CENTRES

|                |                    |                  |
|----------------|--------------------|------------------|
| Geebung        | Phone 07 3865 6888 | Fax 07 3865 8777 |
| Gold Coast     | Phone 07 5597 0423 | Fax 07 5597 0424 |
| Sunshine Coast | Phone 07 5438 8900 | Fax 07 5438 8899 |
| Sydney         | Phone 02 9677 1056 | Fax 02 9677 1352 |
| Melbourne      | Phone 03 9311 9225 | Fax 03 9311 9445 |



# Appendix H:

## Stormwater Harvesting Conditions

**Project:** MIRVAC EVERLEIGH  
**Location:** GREATER FLAGSTONE PDA  
**Subject:** LOGAN CITY COUNCIL CONDITIONS – STORMWATER HARVESTING

#### Background

- Mirvac intends to include stormwater harvesting within its Everleigh community in Greenbank.
- Mirvac and Logan City Council (Council) have met to discuss the proposal
- Council has confirmed it has no concerns with the stormwater harvesting proposal providing a number of conditions are met (refer left hand column below)

#### Purpose

Mirvac has reviewed Council's conditions and either agrees or agrees in principle with same. Notwithstanding, Mirvac wishes to clarify several aspects of the conditions to ensure that both Council and Mirvac understand expectations going forward. The right-hand column below provides Mirvac's response to Council's conditions and requests Council feedback for some aspects.

#### Council Conditions & Mirvac Response

##### **Council Advice**

Council has no objection to the stormwater harvesting concept proposed for Everleigh provided that the following conditions are met:

1. that the scheme only irrigate sporting fields, noting Council does not irrigate any recreational parks and does not want to be responsible for providing recycled stormwater to education facilities;
2. that an appropriate backup option be maintained should the scheme fail, ensuring sports fields can continue to be irrigated from the potable water supply;

##### **Mirvac Response**

Agreed.

Agreed.



3. that the scheme uses an appropriately coloured pipe (noting lilac is proposed) to ensure differentiation from the reticulated potable water supply;
4. that the alignment of the pipeline for the stormwater reticulation be on a different alignment to the potable water supply (1.4 m) and sewer alignments (2.3 m) so that the stormwater reticulation is clearly separate from the potable water supply reticulation – the alignment should maintain a 0.7 metre separation to the potable water supply reticulation;
5. that Council has a preference for UV treatment of stormwater as opposed to chemical treatment, recognising typically lower costs and more practical operational requirements;
6. that the recycled stormwater quality will meet the Australian standards and requirements of the Council asset custodian for use on sporting fields;

Agreed.

Agree in principal.

While every reasonable effort will be made to comply, the final arrangement will be subject to the number and size of the other services. Mirvac commits to consulting with Council to discuss and resolve alternate alignments if the specified alignments cannot be achieved.

Please confirm Council is accepting of potential alternate alignments on this basis.

Agreed in principal.

We understand that neither UV or chemical treatment are mandatory where acceptable water quality outcomes can be achieved without same. The Mirvac proposal will seek to avoid the need for UV or chemical treatment by meeting acceptable water quality outcomes through the treatment train in the stormwater masterplan (i.e. bioretention systems, vegetated swales and wetland). Should acceptable water quality outcomes not be achieved through the stormwater treatment train, Mirvac acknowledges that UV treatment is Council's preferred option.

Please confirm Council is accepting that UV or chemical treatment is not required where acceptable water quality outcomes can be achieved through the stormwater treatment train.

Agree in principal.

We are not aware of a specific Australian Standard applicable to recycled water quality. The *Australian Guidelines for Water Recycling: Managing*

*Health and Environmental Risks (Natural Resources Management Ministerial Council, the Environment Protection and Heritage Council, and the National Health and Medical Research Council, 2009)* seeks to incorporate the relevant parts of several Australian and international standards. We propose to adopt the risk-based assessment outlined in the guideline above. This provides a practical way for both Mirvac and Council to manage potential public health and environmental risks associated with the reuse of urban stormwater.

Please confirm this approach is acceptable to Council.

7. that the ultimate Council asset custodian, nominated as Sport and Leisure Facilities; be involved in all elements of the detailed design for the scheme and for each subsequent stage of delivery;

Agree in Principal.

Note that the it would be practical to agree gates or hold points for Sport and Leisure Facilities input (e.g. concept design, 70% design development, 100%/approval, prestart, on-maintenance, off-maintenance).

Please confirm this approach is acceptable to Council

8. that the transfer of all scheme assets be subject to Economic Development Queensland's on maintenance / off maintenance processes but with the opportunity for the Council asset custodian to be involved in those processes and that the on-maintenance period be a period of 36 months to allow the developer to demonstrate the successful operation of the scheme over a number of weather seasons and to confirm operational costs; and
9. that there be agreement between the developer and the Council asset custodian regarding asset handover.

Agreed.

Agreed.





[engeny.com.au](http://engeny.com.au)

P: 07 3221 7174

Lvl 2, 500 Queen Street, Brisbane QLD 4000 | PO Box 10183 Brisbane QLD 4000