PLANS AND DOCUMENTS
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ENGENY

# URBEX
## Southern Thornlands

### Site Based Stormwater Management Plan – Early Release Stages

BNE01174_0005-REP-001-2

22 JUNE 2026

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| Rev | Date | Description | Author | Reviewer | Project Mgr. | Approver |
|---|---|---|---|---|---|---|
| 0 | 10/12/2025 | Client Issue | Ramya Srinivasan | Kelsey Mundt | Kelsey Mundt<br>RPEQ 32142 | Daniel Niven |
| 1 | 10/12/2025 | Client Issue | Ramya Srinivasan | Kelsey Mundt | Kelsey Mundt<br>RPEQ 32142 | Daniel Niven |
| 2 | 22/06/2026 | Client Issue | Ramya Srinivasan | Kelsey Mundt<br>p.p. Daniel Niven | Kelsey Mundt<br>p.p. Daniel Niven | Daniel Niven<br>RPEQ 12581 |
| **Signatures:** | | | | | | |

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# 1. INTRODUCTION

Engeny Australia Pty Ltd (Engeny) have been engaged by Urbex Pty Ltd to provide the stormwater management strategy as supporting information to the development application for the Early Release stages (the Site) of the proposed Southern Thornlands Priority Development Area (PDA). This report outlines the ultimate stormwater infrastructure plan for the proposed development in accordance with the Redland City Council (RCC) City Plan.

The layout for the proposed development which consists of multiple delivery stages for multiple catchments is shown within Appendix A.

This document has been prepared with the following objectives:

- Provide a stormwater treatment train which aims to protect receiving waters by limiting the quantity of key pollutants discharged in stormwater from urban developments.
- Prevent potential instream erosion downstream of urban developments by controlling the magnitude and duration of sediment transporting flows.
- Provide protection to instream ecosystems from significant effects of increased runoff frequency by capturing the initial portion of runoff from impervious areas. This approach aims to ensure the frequency of hydraulic disturbance to instream ecosystems in developed catchments is similar to that of the undeveloped catchment.
- Demonstrate compliance with non-worsening of stormwater quantity for modelled events over any existing discharge points to the site, with the exception of catchments discharging directly to Eprapah Creek for which Economic Development Queensland (EDQ) has advised that no detention is recommended (further details on this can be found in the *Southern Thornlands Early Release SMP Amendment* letter issued by Engeny dated 06 May 2026).

Stormwater quality and quantity will be demonstrated in compliance with the following documents and planning schemes:

- Redland City Plan Version 10
- Australian Rainfall and Runoff 2019 v4.2
- Redland City Council Planning Scheme Policy 2 – Infrastructure Works
- Queensland State Planning Policy 2017
- Queensland Urban Drainage Manual (QUDM) 2017
- Water by Design MUSIC Modelling Guidelines - November 2018.
- Economic Development Guidelines 13 – Engineering Standards – September 2017.

# 2. SITE DESCRIPTION

## 2.1 Site Location

The proposed early release development site is located on the eastern side of Springacre Road, Thornlands on five allotments. The street address and RP descriptions of the allotments are listed in Table 2.1 below.

**TABLE 2.1: PROPERTY DATA**

| Item | Street Address | RP Description |
|---|---|---|
| 1 | 62 - 74 Springacre Road, Thornlands | Lot 12 on RP 53653 |
| 2 | 76 - 94 Springacre Road, Thornlands | Lot 13 on RP 53653 |
| 3 | 96 - 108 Springacre Road, Thornlands | Lot 14 on RP 53653 |
| 4 | 110 - 118 Springacre Road, Thornlands | Lot 2 on RP 128089 |
| 5 | 124 - 138 Springacre Road, Thornlands | Lot 16 on RP 53653 |

The Site is bounded by public road to the west (Springacre Road) and Eprapah Creek to south-east, with potential for future urban residential on lots to the north, west and south, as part of a future Priority Development Area (PDA).

**Figure 2.1: Aerial Photo of the Proposed Development Sites and Surrounds**

## 2.2 Site Condition

### 2.2.1 Existing

The existing site has a combined area of approximately 40.4 ha and is currently occupied by a combination of pasture and cultivated fields, native and exotic vegetation, small and large farming sheds, farm dams and single dwelling houses. The Site also has several unsealed internal access tracks. There are several dams onsite however based on the provided survey information none the dams have low flows pipes or formed overflow weirs and as such are not considered to attenuate flows in the predevelopment scenario.

The existing properties and allotments on the western side of Springacre Road are not part of this early release development application. Figure 2.2 below details the existing structures and vegetation of the Site.

**Figure 2.2: Proposed Development Sites Existing Condition**

### 2.2.2 Proposed Development

The proposed development is to consist of internal road networks, residential lots of mixed sizes and density, parks, open space conservation zones, and stormwater management zones. All engineering services are to be provided to each allotment as part of the proposed development. This includes the following:

- Access via Springacre Road and the internal road network.
- Stormwater drainage.
- Sewer connection.
- Reticulated water connection.
- Electrical and communication services.

## 2.3 Local Government Infrastructure Plan

The Stormwater Local Government Infrastructure Plan (LGIP) for Redland City Council details the proposed major infrastructure items to service the region. An extract of the LGIP can be seen in Figure 2.3 below. As shown in Figure 2.3, there are no LGIP items within or adjacent to the proposed development site.

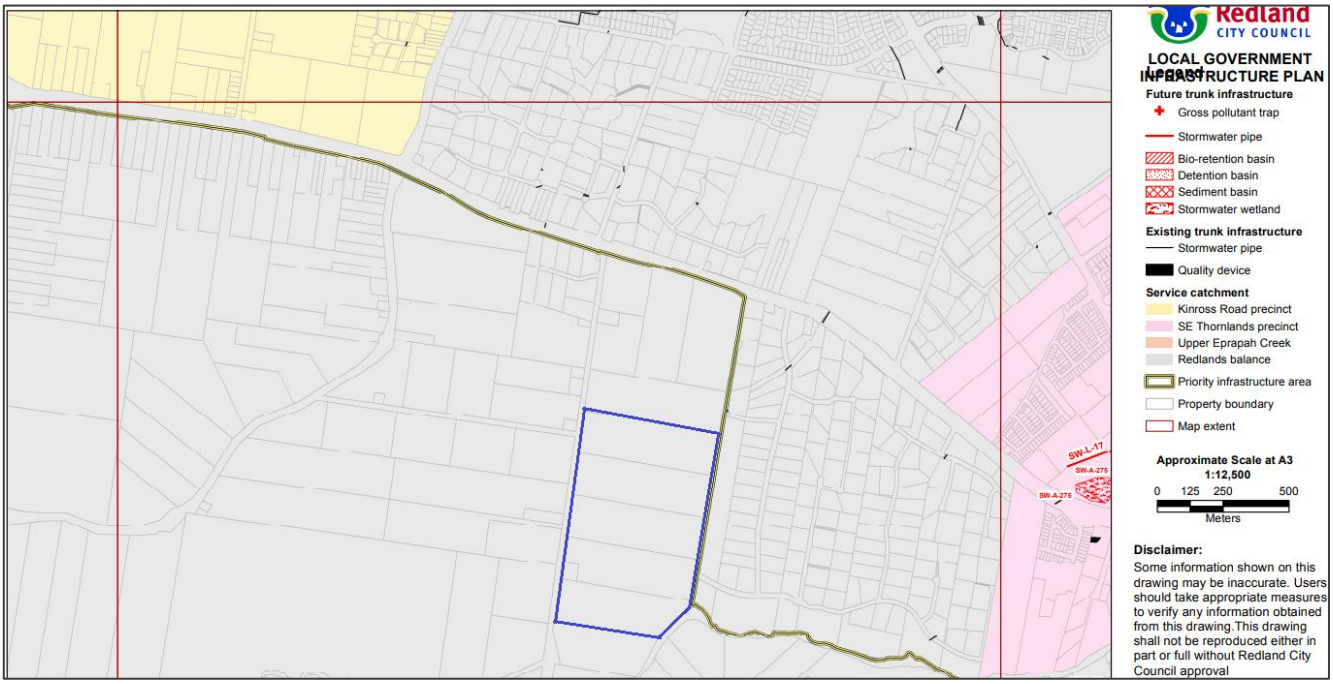



**Figure 2.3: Extraction from the RCC LGIP for Stormwater**

## 2.4 Topography and Site Drainage

The Site is divided by a central ridge which runs east-west and splits the Site into two distinct north/south catchments. The levels across the northern part of the site vary from RL 44.0 at the western boundary to RL 39.5 at the southern boundary and RL 25.0 at the north-eastern boundary.

The levels across the southern part of the site vary from RL 39.5 at the northern boundary to RL 15.0 at the south-eastern boundary.

The site falls with an approximate grade of 6.0% on average with surface water currently flowing to four discharge locations across the sites:

- The north-eastern boundary of the development discharging to an existing private property (40-60 Springacre Road) and channel near Georgina Court.
- The eastern boundary of the development discharging to the existing drainage infrastructure adjacent to Hannah Close and ultimately Eprapah Creek.
- The southern boundary of the development drains towards Eprapah Creek.
- The north-western boundary of the development discharging to an existing property (40-60 Springacre Road) and road reserve adjacent to Springacre Road.

It is noted that there is an external catchment which flows naturally to the proposed development site from the west via cross drainage under Springacre Road and overland flow.

For the purposes of stormwater modelling it shall be assumed that external flows entering the Site are doing so at undeveloped flow rates in the pre-development scenario. However, due to the nature of the potential for the upstream catchment to be developed as part of an overall PDA, the post development flow from this catchment shall be assumed to be developed in a similar nature to the internal catchments, to allow for conveyance through the Site and stormwater detention of the regional flows.

This information is shown in Figure 2.4 below.

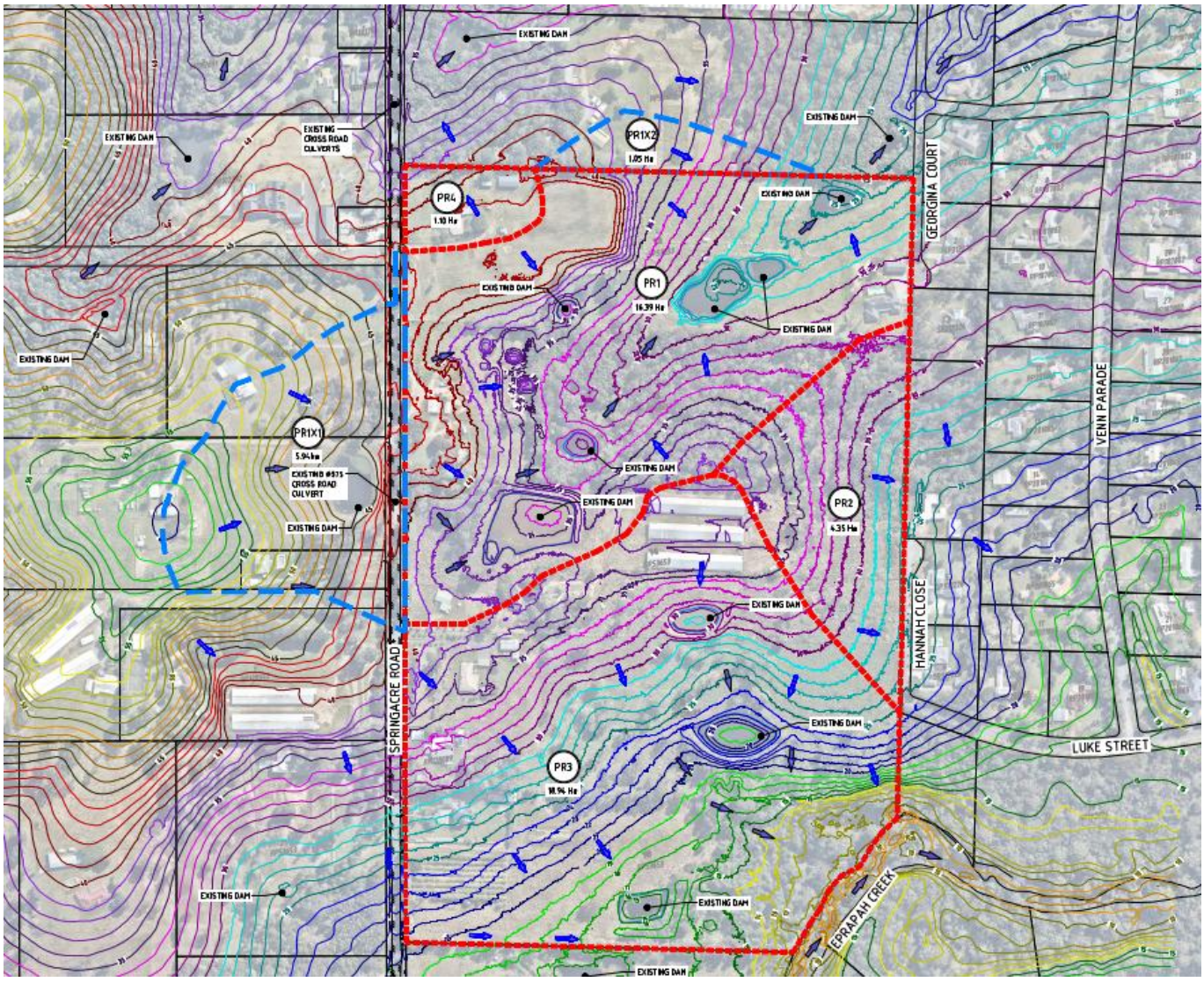



**Figure 2.4: Catchment Diagram and Discharge Points**

## 2.5 Base Data

Detailed survey of the proposed development site has been used for the purpose of determining catchments and stormwater modelling associated with this conceptual report.

## 2.6 Lawful Points of Discharge

The Site is separated by a ridge line which is shown in Figure 2.4 above. The proposed development site has four distinct discharge points:

- North-Eastern discharge point to defined waterway on adjacent private property and future development area (40-60 Springacre Road).
- Eastern discharge point to the existing drainage infrastructure adjacent to Hannah Close and ultimately Eprapah Creek.
- Southern discharge point via Eprapah Creek.
- North-Western discharge point to Springacre Road reserve and future development area (40-60 Springacre Road).

It is not proposed to create any additional points of discharge as part of the proposed development.

It is noted that at discharge point 4 nominated above, the north-western Discharge point to Springacre Road reserve and future development area, shall not be utilised in the post development scenario.

## 2.7 Earthworks and Soils

To assist in the stormwater management within the catchments of the proposed development sites, bulk earthworks will be required. Earthworks for the proposed development will ensure, where possible, all lots fall towards the street to alleviate the need for rear of lot roof water drainage systems and the associated easements.

A detailed geotechnical investigation is yet to be undertaken for the proposed development site. Given the reduced levels of the site, acid sulphate soils have not been considered. Should acid sulphate soils be identified during the construction phase of this development an acid sulphate soils management plan is to be developed and this stormwater management plan is to be revised.

## 2.8 Waterways

Stormwater which is discharged through the north-eastern discharge point is conveyed to the defined waterway on the adjacent private property / future development area and ultimately north-east under Boundary Road and ultimately Moreton Bay.

Stormwater discharged from the eastern and southern discharge points is discharged directly to Eprapah Creek and ultimately Moreton Bay.

As part of the proposed development, stormwater quantity and quality are to be managed to ensure the likelihood of any potential adverse impacts to the downstream waterways are avoided.

## 2.9 Vegetation

The Site consists of a mixture of grassed areas with scattered trees and vegetation, with some isolated pockets of dense trees. There are also several dams located onsite. As part of the proposed development the Site is to be predominantly cleared. Vegetation is to be retained wherever possible in the future greenspace and conservation areas of the site.

## 2.10 Asset Handover

The proposed bioretention/detention systems are not to be planted out until such time as 80% of the upstream catchment is developed. It is proposed that bioretention/detention systems are to be taken on as an asset, monitored and maintained by the Council after acceptance off maintenance. Following excavation and revegetation works, the detention basins are to be maintained by Council.

## 2.11 Flooding

In accordance with Redland City Council's REDeMAP interface, the proposed development site is subject to flooding from Eprapah Creek as part of the City Plan's "Flood and Storm Tide Hazard Overlay" however the extents of the creek flooding are not within the area of the Site being developed. Furthermore, internal overland flow is identified within the northern section of the Site and the conveyance of this overland flow within the pit, pipe and channel network will be included in the overall detailed design of the development. A preliminary assessment of the ultimate development flows and the subsequent containment within the central channel to the detention basin can be found in section 3 of this report.

An extract of the REDeMAP "Flood and Storm Tide Hazard Overlay" is provided in the figure below.

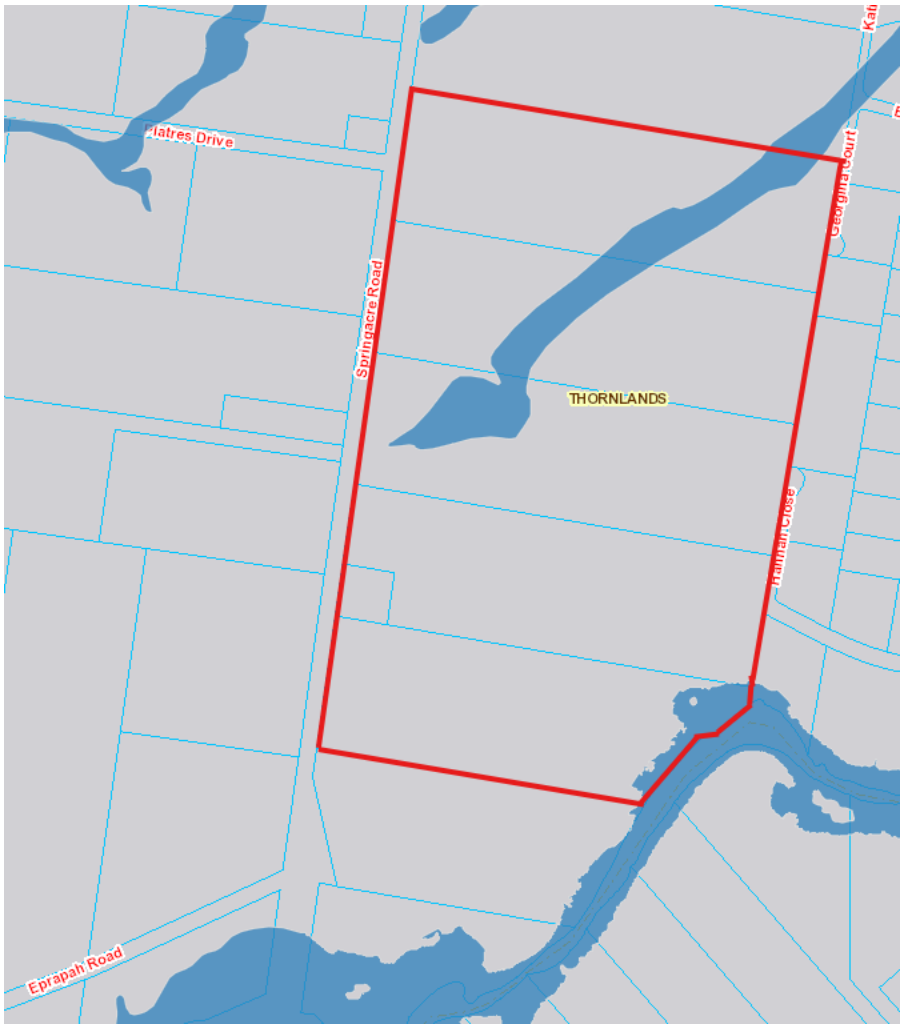



**Figure 2.5: REDeMAP - Flood and Storm Tide Hazard Overlay**

# 3. STORMWATER QUANTITY MANAGEMENT

## 3.1 General Stormwater Strategy

The earthworks design for the proposed development site shall look to retain the natural topography on-site and direct flow towards the existing discharge points. Where pre-development discharge is exceeded in the post development condition, it is proposed to install appropriately sized detention basins to ensure that the post development peak flows are mitigated to pre-development flow rates for the modelled events. This strategy shall ensure compliance with non-worsening of pre-development flows. It is noted that, in accordance with advice received from EDQ, this detention strategy does not apply to catchments that are discharging directly to Eprapah Creek. For catchments discharging directly to Eprapah Creek, only mitigation of the 1:1 AEP event is recommended to meet the Queensland State Planning Policy (SPP) 2017 waterway stability management objectives for frequent flow management.

## 3.2 Proposed Catchment Hydrology

The proposed development increases the impervious area when compared with the pre-development scenario. Road pit and pipe drainage will collect the minor flows (1:2 AEP) generated by the development, while the road reserve will collect major flows (1:100 AEP) and convey stormwater towards the proposed discharge points. A conservative impervious fraction has been assigned to all areas of the development to best model the density of the proposed development in accordance with Redland City Council's Planning Scheme policy for Infrastructure. The impervious fraction selected for all developed catchments has been taken as 85%. The proposed post development catchment plan as well as the summary of predevelopment and post development catchments can be seen in Table 3.1 and Table 3.2, and Figure 3.1 and Figure 3.2 below.

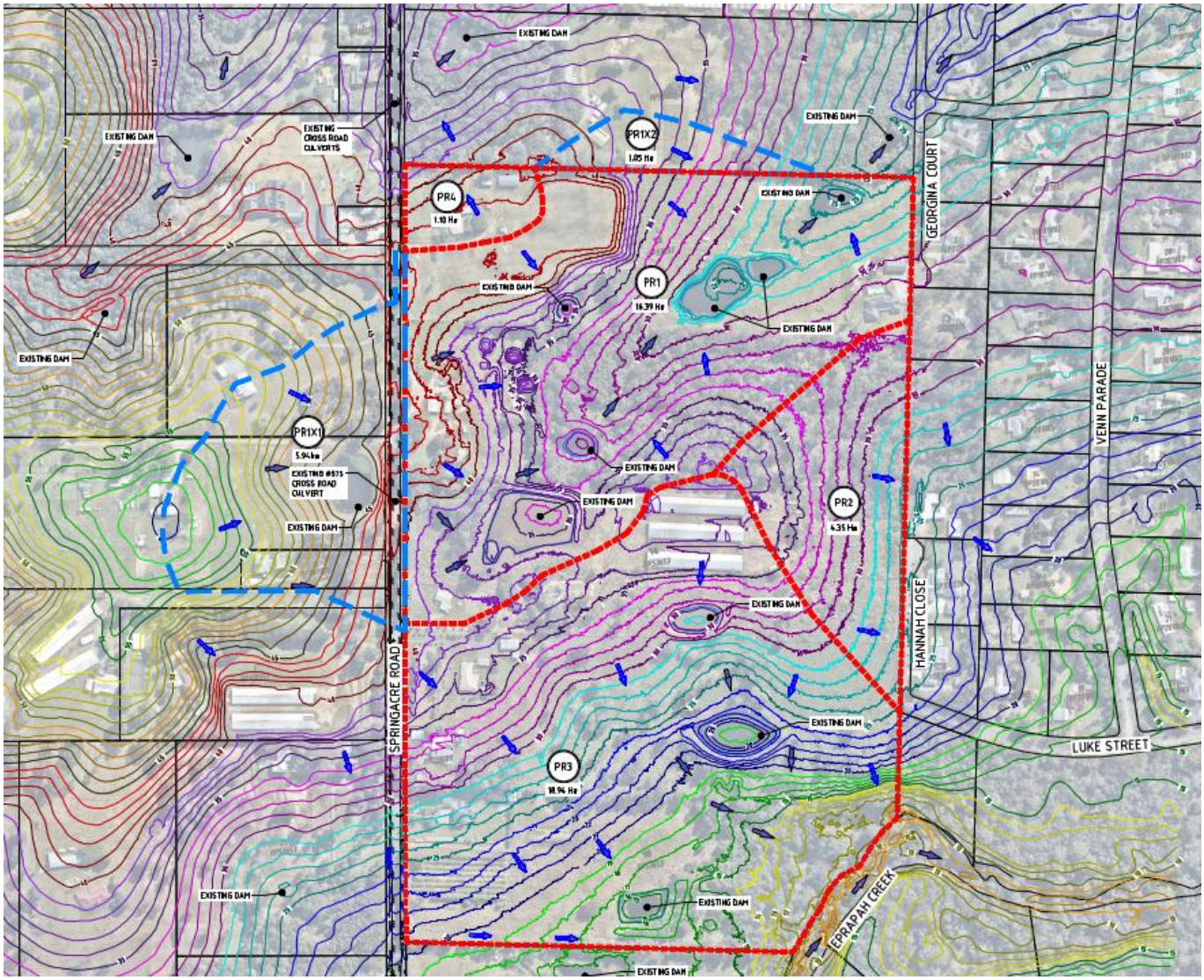



**Figure 3.1: Pre-Development Catchment Plan**

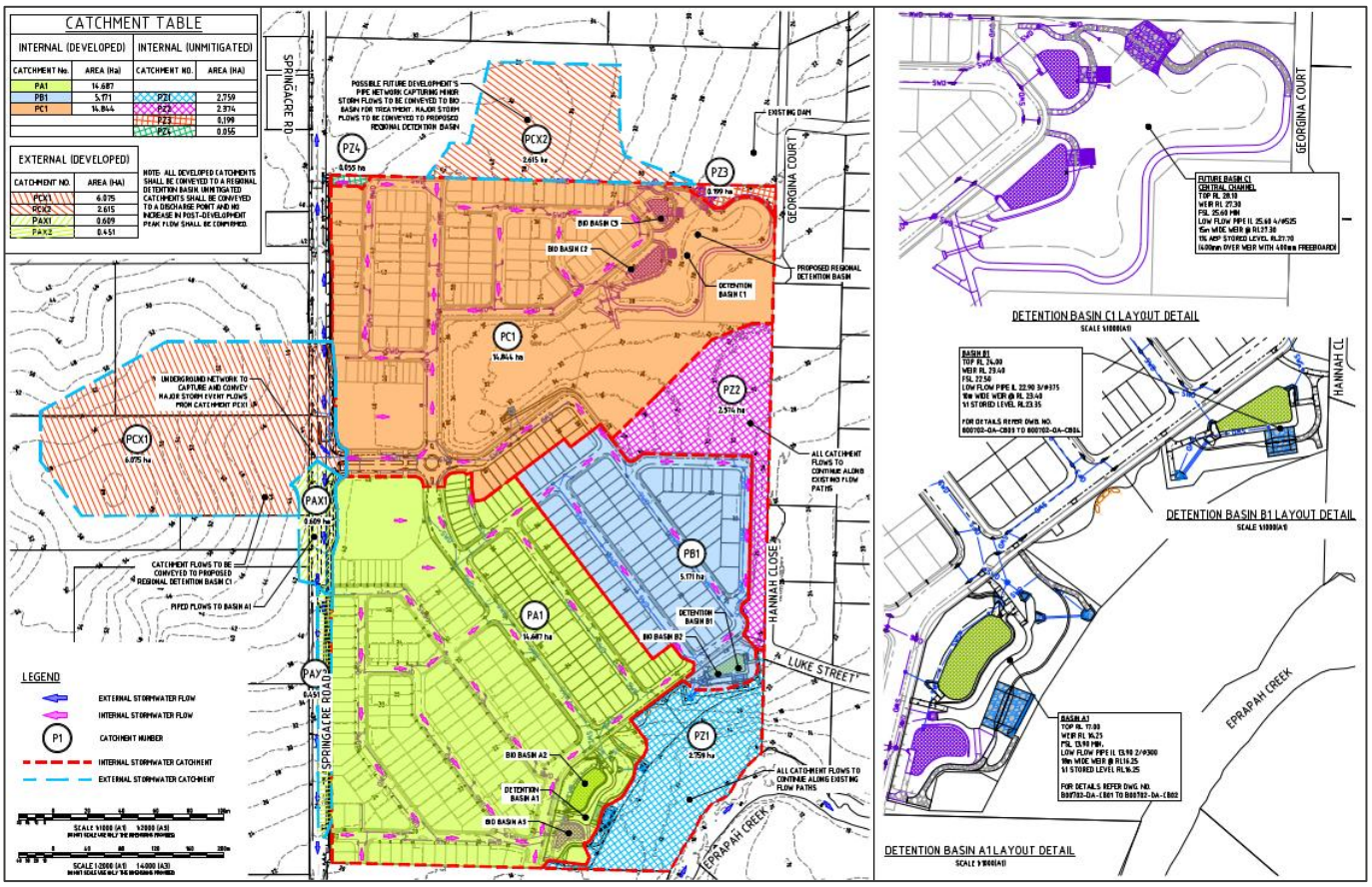



**Figure 3.2: Post Development Catchment Plan**

**TABLE 3.1: PRE-DEVELOPMENT CATCHMENT DATA SUMMARY**

| | Catchment | Area (ha) | Average Slope (%) | Impervious (%) | Impervious Area (ha) | Pervious Area (ha) |
|---|---|---|---|---|---|---|
| Internal | Pre PR1 | 16.39 | 6.00 | 5% | 0.82 | 15.57 |
| | Pre PR2 | 4.35 | 6.00 | 5% | 0.22 | 4.13 |
| | Pre PR3 | 18.94 | 6.50 | 10% | 1.89 | 17.05 |
| | Pre PR4 | 1.10 | 6.50 | 10% | 0.11 | 0.99 |
| External | Pre PR1X1 | 5.94 | 8.50 | 5% | 0.30 | 5.64 |
| | Pre PR1X2 | 1.05 | 5.50 | 5% | 0.05 | 1.00 |

**TABLE 3.2: POST-DEVELOPMENT CATCHMENT DATA SUMMARY**

| Catchment | | Area (ha) | Average Slope (%) | Impervious (%) | Impervious Area (ha) | Pervious Area (ha) |
|---|---|---|---|---|---|---|
| Internal | PST PA1 | 14.58 | 5.00 | 85% | 12.39 | 2.19 |
| | PST PB1 | 5.17 | 3.00 | 85% | 4.40 | 0.78 |
| | PST PZ1 | 2.87 | 4.00 | 5% | 0.14 | 2.73 |
| | PST PZ2 | 2.37 | 6.00 | 5% | 0.12 | 2.26 |
| | PST PC1 | 14.84 | 3.00 | 85% | 12.62 | 2.23 |
| | PST PZ3 | 0.20 | 3.00 | 5% | 0.01 | 0.19 |
| External | PST PCX1 | 6.08 | 4.00 | 85% | 5.16 | 0.91 |
| | PST PCX2 | 2.62 | 4.00 | 85% | 2.22 | 0.39 |
| | PST PAX1 | 0.60 | 3.00 | 85% | 0.51 | 0.09 |

## 3.3 Detailed Assessment

### 3.3.1 Hydrological Model Parameters

The hydrologic software package XPRAFTS was utilised to determine the peak discharge for a range of storm durations between 5 minutes and 3 hours. The analysis utilises the principles outlined in the Australian Rainfall and Runoff Guidelines 2019 v4.2 to determine the undeveloped and developed peak flows. Peak flows for each design storm event in the pre-development case and post-development case were determined in the model.

Storm rainfall losses adopted for the pre-developed (existing) and post-developed (proposed) catchments are listed in Table 3.3 and Table 3.4 below. Consistent with the recommendations in the Australian Rainfall and Runoff Guidelines, initial and continuing loss rates have been included within the model.

**TABLE 3.3: RAINFALL LOSS DATA**

| Design Scenarios | Pervious Areas Initial Loss (mm) | Pervious Areas Continuing Loss (mm/hr) | Impervious Areas Initial Loss (mm) | Impervious Areas Continuing Loss (mm/hr) |
|---|---|---|---|---|
| 1:1 – 1:100 AEP | 26.5 | 1.8 | 1.0 | 0.0 |

**TABLE 3.4: CATCHMENT MANNING'S "N" VALUE**

| Design Scenarios | Impervious Mannings n | Pervious Mannings n |
|---|---|---|
| Pre Development | 0.025 | 0.050 |
| Post Development | 0.030 | 0.060 |

### 3.3.2 External Catchment Considerations

As shown in Figure 3.2 above, external catchments to the west and north of the Site have been included within the stormwater model. Each of the external catchments have been described below:

- Catchment PCX1
  - The Location of the likely ultimate Crest of Springacre Road will result in all flows from Catchment PCX1 being directed into the proposed development site. On this basis, this catchment has been assumed to be fully developed in the post-development scenario with an impervious fraction of 85%. It is assumed that all flows up to the 1:100 AEP design event are captured and conveyed under Springacre Road to the proposed development site.
- Catchment PCX2
  - Based on the existing ridgeline, it is reasonable to expect that the ultimate development of the property to the north shall result in Catchment PCX2 discharging to the proposed development site. On this basis, this catchment has been assumed to be fully developed in the post-development scenario with an impervious fraction of 85%. It is assumed that all flows up to the 1:100 AEP design event are captured and conveyed to the proposed development site.
- Catchment PAX1
  - Based on the likely vertical geometry of Springacre Road, it is reasonable to expect that flows from external catchment PAX1 shall ultimately be directed to the proposed development site. On this basis, this catchment has been assumed to be fully developed in the post-development scenario with an impervious fraction of 85%. It is assumed that all flows up to the 1:100 AEP design event are captured and conveyed under Springacre Road to the proposed development site.

### 3.3.3 Model Discharge Points

The XP-Rafts Model considers the peak discharge at the three main discharge points for the site, as shown in Figure 3.3 below. The four discharge points modelled in the pre-development scenario can be described as:

- Discharge Point 1 - north-eastern corner of site, discharge to existing waterway
- Discharge Point 2 - eastern boundary of site, discharge to Road Reserve
- Discharge Point 3 – south-eastern corner of site, discharge to Eprapah Creek (No detention required beyond 1:1 AEP)
- Discharge Point 4 - north-western corner of site, discharge to Springacre Road.

It is noted that Discharge Point 4 conveys flow from a small catchment in the pre-development scenario (1.1 Ha) which shall be re-directed to Discharge Point 1 as part of the development works. Discharge Point 4 shall not be retained in the post development scenario.

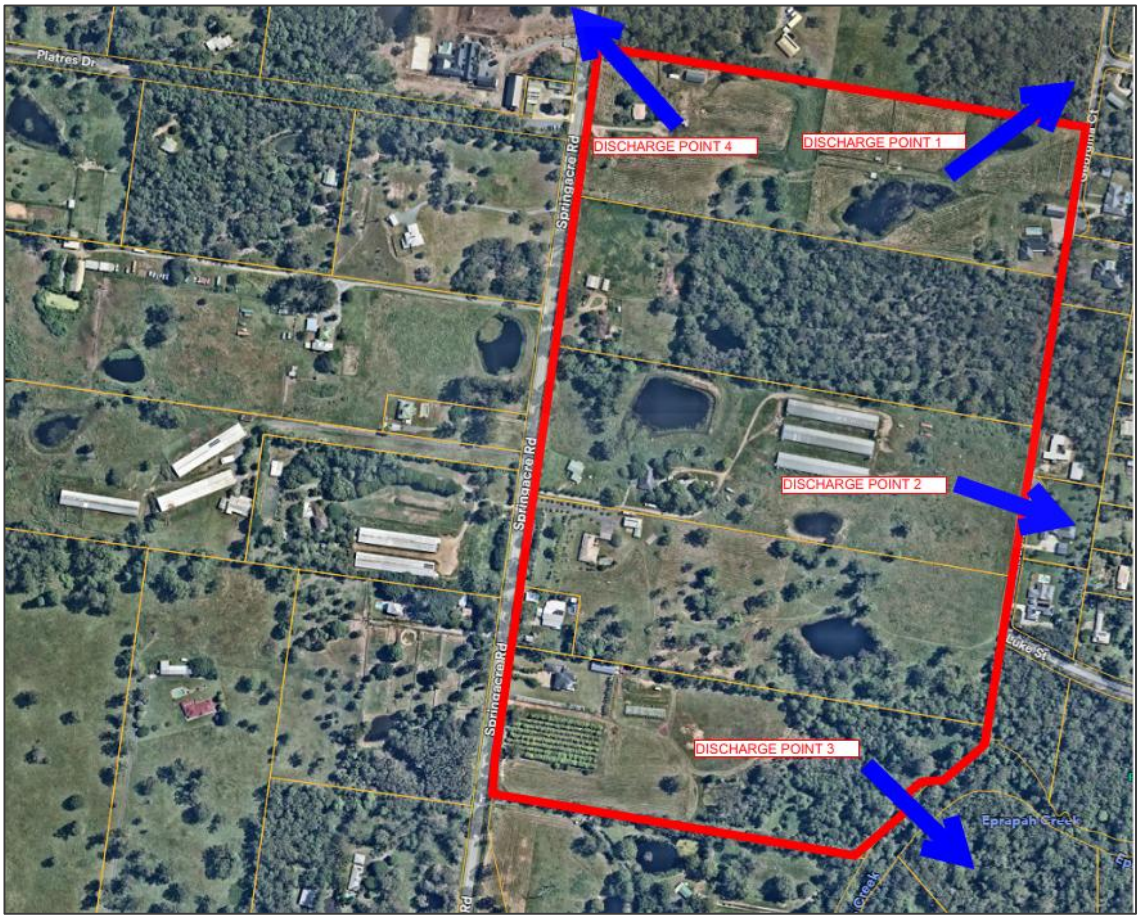



**Figure 3.3: Discharge Point Summary**

## 3.4 Hydrologic Model Validation

Validation of peak flows from the XPRAFTS hydrologic model was undertaken using the Rational Method in accordance with the Queensland Urban Drainage Manual (QUDM 2016). The Rational Method provides peak flow estimations based on the catchment area, a catchment dependent coefficient of discharge, the time of concentration (estimated time for flow from the highest point of the catchments to reach the outlet) and its corresponding rainfall intensity. Validation was undertaken for two pre-development catchments and one post-development catchment, with relevant inputs shown in Table 3.5.

**TABLE 3.5: RATIONAL METHOD INPUTS**

| Catchment ID | Area (ha) | $C_{10}$ | Time of Concentration (mins) |
|---|---|---|---|
| PR1 (Pre-Development) | 23.4 | 0.45 | 21 |
| PR3 (Pre-Development) | 18.9 | 0.40 | 18 |
| PA1 (Post-Development) | 14.6 | 0.86 | 17 |

Table 3.6 provides the results of the validation assessment. Peak flows from the XPRAFTS model are generally within 20% or less of the Rational Method peak flow estimates for all modelled design events, with only a couple of exceptions in the smaller events. As the Rational Method is intended to be used as only a guide, these variations are acceptable within the bounds of ungauged catchments. The XPRAFTS model is therefore considered suitable to assess the flows and mitigation sizing for this proposed development.

**TABLE 3.6: PEAK FLOW COMPARISON**

| Catchment ID | Design Event (1:x AEP) | XPRAFTS Peak Flow ($m^3/s$) | Rational Method Peak Flow Estimate ($m^3/s$) | Difference (%) |
|---|---|---|---|---|
| PR1 (Pre-Development) | 1:1 | 1.75 | 2.06 | -15% |
| | 1:2 | 2.69 | 2.99 | -10% |
| | 1:5 | 4.32 | 4.26 | 1% |
| | 1:10 | 5.35 | 5.05 | 6% |
| | 1:20 | 6.76 | 6.17 | 9% |
| | 1:50 | 8.18 | 7.56 | 8% |
| | 1:100 | 9.36 | 8.53 | 10% |
| PR3 (Pre-Development) | 1:1 | 1.46 | 1.63 | -10% |
| | 1:2 | 2.22 | 2.38 | -7% |
| | 1:5 | 3.49 | 3.40 | 3% |
| | 1:10 | 4.36 | 4.01 | 9% |
| | 1:20 | 5.54 | 4.91 | 13% |
| | 1:50 | 6.54 | 5.98 | 9% |
| | 1:100 | 7.50 | 6.74 | 11% |
| PA1 (Post-Development) | 1:1 | 4.52 | 2.82 | 60% |
| | 1:2 | 5.67 | 4.13 | 37% |
| | 1:5 | 7.15 | 5.91 | 21% |
| | 1:10 | 8.21 | 6.97 | 18% |
| | 1:20 | 9.38 | 8.53 | 10% |
| | 1:50 | 10.86 | 10.38 | 5% |
| | 1:100 | 12.02 | 11.67 | 3% |

## 3.5 Detention Basin Design Parameters

A series of detention basins were implemented to mitigate peak flows across the full range of events modelled for the catchments draining to the north-eastern discharge point (Discharge Point 1 - Basin C1), and only the 1:1 AEP flows mitigated for the catchments draining to the south-eastern discharge point (Discharge Point 3 - Basin A1 and Basin B1) into Eprapah Creek. The location of these basins is shown in Figure 3.2 and Appendix A. Through an iterative design process, the detention basins were given the discharge parameters outlined within Table 3.5 below. It is noted that minor flows (up to the 1:2 AEP) from catchment PB1 will be piped to Basin B1 and flows greater than the 1:2 AEP will be directed towards Basin A1. Concept design of the basins is provided in Appendix A. 300 mm freeboard from the 1:100 AEP stored water level to the crest has been achieved.

**TABLE 3.7: DETENTION BASIN SUMMARY**

| Detention Basin Name | A1 | B1 | C1 |
|---|---|---|---|
| Catchment ID | PA1, PB1 (flows greater than 1:2 AEP) | PB1 (flows up to 1:2 AEP) | PAX1, PCX1, PC1, PCX2 |
| **Basin Characteristics** | | | |
| Basin Base Level | RL 13.9 | RL 22.8 | RL 25.6 |
| Top of Crest Level | RL 17.0 | RL 24.0 | RL 28.1 |
| Basin Maximum Depth to Crest | 2.80 | 0.8 | 2.14 |
| Water Volume Stored in 1:1 AEP Flood Event | 4,200 $m^3$ | 700 $m^3$ | 3,700 $m^3$ |
| Water Level in 1:1 AEP Flood Event | 16.25 | 23.35 | 26.9 |
| Water Volume Stored in 1:100 AEP Flood Event | 6,700 $m^3$ | 1,000 $m^3$ | 10,200 $m^3$ |
| Water Level in 1:100 AEP Flood Event | 16.7 | 23.6 | 27.74 |
| **Low Flow Discharge** | | | |
| Pipe Size and Type | DN 300 RCP | DN 375 RCP | DN 450 RCP |
| No. Barrels | 2 | 3 | 4 |
| **High Flow Discharge** | | | |
| Weir Crest Level | RL 16.25 | RL 23.4 | RL 27.3 |
| Weir Width | 18.0 m | 10.0 m | 15.0 m |

## 3.6 Peak Flow Reporting

A summary of the peak flows at each discharge point, for the pre-development, post-development, and post-development mitigated scenarios are provided in Table 3.8 to **Peak flows mitigated for the 1:1 AEP only*

Table 3.11. As shown in the below tables, the development is expected to increase peak flows discharging from site, but with incorporation of the proposed detention basins, peak flows are mitigated. Preliminary sizing of the detention basins and integration in the overall proposed site layout indicate that there are sufficient space and volume available within the development to facilitate appropriate attention of the stormwater flows.

**TABLE 3.8: PEAK FLOW REPORTING – DISCHARGE POINT 1 (NORTH-EAST)**

| Design Event (1:x AEP) | Pre-development Scenario Peak Flow ($m^3/s$) | Post-development Scenario Peak Flow ($m^3/s$) | Post-development Mitigated Scenario Peak Flow ($m^3/s$) | % Reduction (Mitigated – Pre-Development) |
|---|---|---|---|---|
| 1:1 | 1.88 | 5.73 | 1.83 | -2.8% |
| 1:2 | 2.72 | 7.20 | 2.61 | -4.1% |
| 1:5 | 4.37 | 9.09 | 3.07 | -29.8% |
| 1:10 | 5.44 | 10.53 | 4.61 | -15.3% |
| 1:20 | 6.93 | 12.06 | 6.52 | -5.9% |
| 1:50 | 8.86 | 14.44 | 8.27 | -6.7% |

| | | | | |
|---|---|---|---|---|
| 1:100 | 10.19 | 16.02 | 9.65 | -5.3% |

**TABLE 3.9: PEAK FLOW REPORTING – DISCHARGE POINT 2 (EAST)**

| Design Event (1:x AEP) | Pre-development Scenario Peak Flow ($m^3/s$) | Post-development Scenario Peak Flow ($m^3/s$) | Post-development Mitigated Scenario Peak Flow ($m^3/s$) | % Reduction (Mitigated – Pre-Development) |
|---|---|---|---|---|
| 1:1 | 0.40 | 0.22 | 0.22 | -45.8% |
| 1:2 | 0.62 | 0.34 | 0.34 | -45.5% |
| 1:5 | 0.99 | 0.54 | 0.54 | -45.7% |
| 1:10 | 1.23 | 0.67 | 0.67 | -45.7% |
| 1:20 | 1.47 | 0.80 | 0.80 | -45.5% |
| 1:50 | 1.74 | 0.95 | 0.95 | -45.6% |
| 1:100 | 2.04 | 1.11 | 1.11 | -45.7% |

**TABLE 3.10: PEAK FLOW REPORTING – DISCHARGE POINT 3 (SOUTH-EAST)**

| Design Event (1:x AEP) | Pre-development Scenario Peak Flow (m3/s) | Post-development Scenario Peak Flow (m3/s) | Post-development Mitigated Scenario Peak Flow (m3/s)* | % Reduction (Mitigated – Pre-Development)* |
|---|---|---|---|---|
| 1:1 | 1.48 | 6.15 | 1.24 | -16.6% |
| 1:2 | 2.83 | 7.72 | 3.11 | 9.9% |
| 1:5 | 3.49 | 9.69 | 5.20 | 48.8% |
| 1:10 | 4.45 | 11.41 | 6.88 | 54.7% |
| 1:20 | 5.61 | 13.00 | 8.51 | 51.8% |
| 1:50 | 6.70 | 15.50 | 10.63 | 58.6% |
| 1:100 | 7.52 | 17.12 | 12.07 | 60.6% |

**Peak flows mitigated for the 1:1 AEP only*

**TABLE 3.11: PEAK FLOW REPORTING – DISCHARGE POINT 4 (NORTH-WEST)**

| Design Event (1:x AEP) | Pre-development Scenario Peak Flow ($m^3/s$) | Post-development Scenario Peak Flow ($m^3/s$) | Post-development Mitigated Scenario Peak Flow ($m^3/s$) | % Reduction (Mitigated – Pre-Development) |
|---|---|---|---|---|
| 1:1 | 0.13 | 0.01 | N/A | -94.7% |
| 1:2 | 0.21 | 0.01 | N/A | -95.1% |
| 1:5 | 0.29 | 0.02 | N/A | -94.9% |
| 1:10 | 0.35 | 0.02 | N/A | -94.0% |
| 1:20 | 0.48 | 0.03 | N/A | -94.6% |
| 1:50 | 0.53 | 0.03 | N/A | -94.5% |
| 1:100 | 0.60 | 0.03 | N/A | -94.4% |

## 3.7 Eprapah Creek Impacts

Due to the substantial difference in size of the Eprapah Creek catchment compared to the Site local catchment, the critical duration for Eprapah Creek is expected to be significantly longer than the Site local catchment critical duration. The relative catchment sizes and expected time of concentrations are summarised below:

- Local Catchment – 24 ha. Critical duration of 1 hour.
- Eprapah Creek Catchment (sub-catchment reporting to Site boundary) - 1,470 ha. Critical duration of 3 hours (informed by *Upper Eprapah Creek Catchment Study* (Engeny, 2012)).

Due to the above differences in time of concentration, this would result in the peak flows from the Site local catchment discharging prior to the peak flows from Eprapah Creek, meaning that no observed increases to Eprapah Creek peak flows or levels are expected. Additionally, as no detention of peak flows discharging to Eprapah Creek is required by EDQ, mitigation of the 1:1 AEP event flows to achieve waterway stability in accordance with the SPP is sufficient and a hydraulic assessment is not needed to demonstrate no external impacts.

## 3.8 Flooding and Overland Flow

An analysis of the current Redland City Council City Plan - Flood and Stormtide Hazard Overlay indicates that all the proposed Early Release works are outside of the Flood Overlay extent. Furthermore, the creek flooding on the south-east site boundary is set back significantly from the proposed lots and stormwater detention infrastructure. The overlay indicates a flood level of approximately 11.5m RL while the development site is generally above 17.5m RL, with only minor stormwater infrastructure below this level at approximately 14.5m RL. As such, a flood assessment has not been undertaken during this phase of the development.

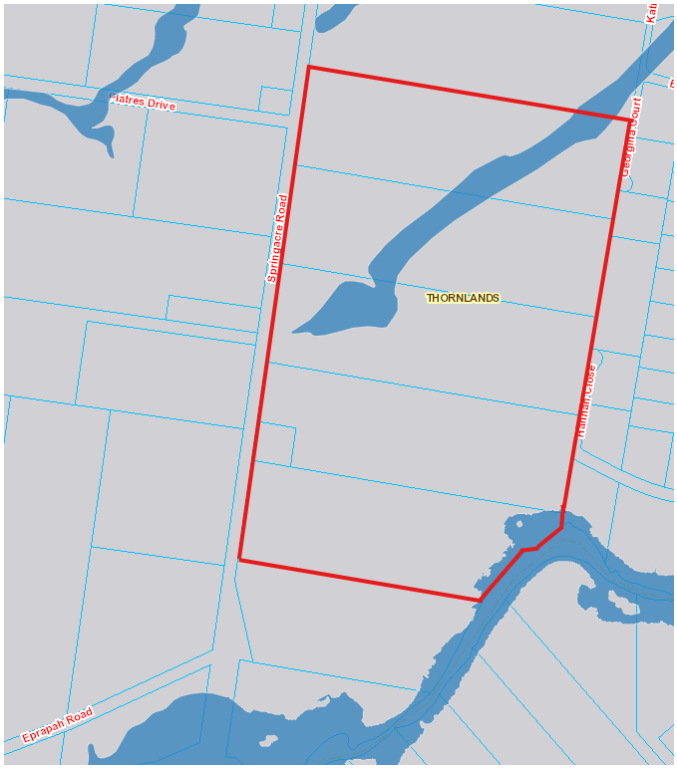



**Figure 3.4: Redland City Council City Plan - Flood and Stormtide Hazard Overlay**

It is anticipated that a flood model and associated reporting will be undertaken as part of the overall Southern Thornlands Priority Development Area (PDA) in the future. This report will deal with not only the extents of flooding and overland flow within the PDA, but also the afflux on adjacent properties with the potential to reduce the number and extent of detention basins throughout the overall catchment.

Overland flow within the proposed development is to be contained wholly within the road reserve and the drainage reserves. As part of the current application, a preliminary 2D analysis of the development flows during a 1:100 AEP event has been undertaken by others, including preliminary sizing of major culverts, as well as determining the flood extents of the main centre channel.

Additionally, as part of the operational works submission, a detailed hydraulic/hydrologic model shall be prepared to confirm the overland flow characteristics within the central drainage channel of the proposed development site, including confirmation of the major culverts and subsequent immunity levels.

Based on the information within the above sections, the storage area provided internally within the road reserve and within the drainage channel / detention basins shall be sufficient to convey both internal flows and flows generated within the developed external catchment.

# 4. STORMWATER QUALITY MANAGEMENT

## 4.1 Stormwater Quality Management Strategy

### 4.1.1 Environmental Values

The proposed development site flows to a number of discharge points, as identified in above sections of this report. All flow discharged from the Site is eventually conveyed to nearby waterways and subsequently discharged to Moreton Bay. The development of the Site will involve land disturbance for the purpose of creating residential and commercial lots and the associated access roads. During the construction phase, the most significant water quality objective will be that of suspended solids. To ameliorate any environmental harm that may occur, it is proposed that a series of bunded areas and sediment control devices within the sites be used to control stormwater quality during the construction period.

Dedicated temporary sediment basins will also be installed on the bottom of each catchment and will have sufficient capacity to contain the treatment within the sites. These temporary sediment basins, for construction phase erosion and sediment control, will be designed in accordance with Appendix B of Best Practise Erosion and Sediment Control (IECA Australasia, Nov 2008). Where practical, it is planned that the sediment basins will be decommissioned and replaced with bio-retention/detention basins when construction of a majority (>80%) of residential dwellings and commercial buildings has been completed. If sedimentation basins are not to be converted to bioretention they are to be de-watered, de-silted and decommissioned in accordance with the IECA Guidelines.

During the operational phase, pollutants from a development of this type are not expected to be a significant concern. As per the RCC City Plan and to be consistent with best practices with respect to water quality, the MUSIC modelling package has been used for the water quality objective analysis.

### 4.1.2 Water Quality Objectives

The treatment train performance will also be assessed against the State Planning Policy 2017 (SPP) Stormwater Management Design Objectives, as the SPP benchmarks have been triggered by the proposed development. As such the development will adopt formal stormwater quality treatment in accordance with the Water by Design guidelines.

The applicable Water Quality treatment objectives are:

**TABLE 4.1: WATER QUALITY OBJECTIVES**

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

### 4.1.3 Strategy

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC), version 6.3.0, developed by eWater, has been used to quantify the water quality output for the developed catchment. The model's algorithms are based on the known performance characteristics of common stormwater quality improvement measures and modelled based on the Water by Design – MUSIC Modelling Guidelines Version 3.0 – 2018.

For the post-developed condition, water sensitive urban design has been employed using Stormwater Quality Improvement Devices. The stormwater management strategy is summarised as follows:

- Internal Catchment
  - Stormwater which falls within the internal catchment shall fall towards the pit and pipe network
  - Stormwater shall be conveyed via a pit and pipe network to a number of appropriately sized bioretention cells located within the central drainage channel in the case of the northern catchment, and in the combined quality / quantity stormwater pods located around the development discharge points for the southern catchment.
  - Once appropriately treated, stormwater shall be discharged from the stormwater quality treatment basins and subsequently from site.
- External Catchment
  - It is assumed that any treatment of the major western external catchments shall be undertaken by the adjacent landowner prior to discharge to the proposed development site.
  - Given the catchment characteristics and limited potential for treatment of the future northern external catchment, it has been assumed that the current proposed development will treat the post development stormwater runoff of the minor external catchment to the north. Refer to the Quality Catchment plan within the Appendix A.
  - All stormwater from external catchments discharged into the proposed development site shall be conveyed via pit and pipe network and overland flow through the site to the drainage corridor and discharged from site.

In order to control course sediment and gross pollutants entering the bio-retention system, a pre-treatment course sediment forebay will be installed at the pipe inlets to each of the bio-retention basins.

Access to the bioretention zones for the combined bioretention/detention basins will be provided.

### 4.1.4 Climate Data

Climate data for the catchment was sourced from the Bureau of Meteorology (BoM). Rainfall data was obtained from Redlands HRS Station (Station ID: 40265) for the 10 years between 1997 and 2006 at six (6) minute intervals as specified by MUSIC Modelling Guidelines for South East Queensland (Water By Design, 2018).

### 4.1.5 Catchment Properties

The catchment areas for the water quality are based on the proposed development layout and is presented in Appendix A. A lumped catchment approach was considered appropriate and adopted for the assessment of the urban residential catchments. Catchment QC4 discharges directly to the local flow path through the Site, and is therefore modelled as bypassing treatment by bioretention in the MUSIC 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 4.2 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 4.2: MUSIC MODEL CATCHMENT PARAMETERS**

| Catchment ID | MUSIC Land Use | Area (ha) | Impervious Fraction (%) | Basin |
|---|---|---|---|---|
| QCX3 | Urban Residential | 2.473 | 65% (Based on Table3.7, Water by Design MUSIC Modelling guidelines, 2018) | C3 |
| QC3 | Urban Residential | 1.207 | 65% | |
| QC2 | Urban Residential | 5.261 | 65% | C2 |
| QC41 | Urban Residential | 0.79 | 65% | |
| QB2 | Urban Residential | 5.171 | 65% | OFF-SITE |
| QA3 | Urban Residential | 4.582 | 65% | A3 |
| QA2 | Urban Residential | 7.936 | 65% | A2 |
| QAX1 | Urban Residential | 0.595 | 65% | |
| QA31 | Urban Residential | 1.228 | 65% | |
| QC4 | Urban Residential | 1.283 | 65% | Bypasses Treatment |

A summary of the catchments can be seen in Figure 4.1 below.

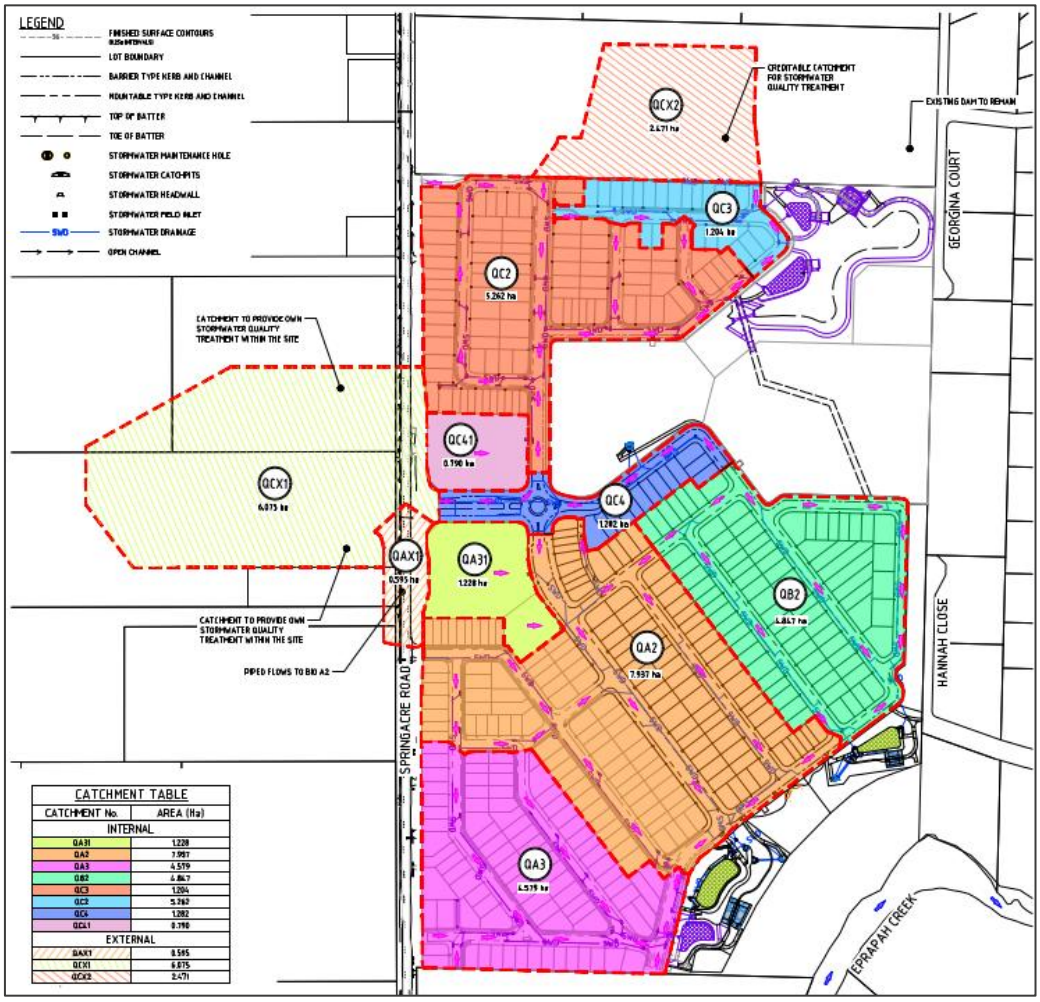



**Figure 4.1: Water Quality Catchment Layout**

The network diagram of the MUSIC Model can be seen in Figure 4.2 below.

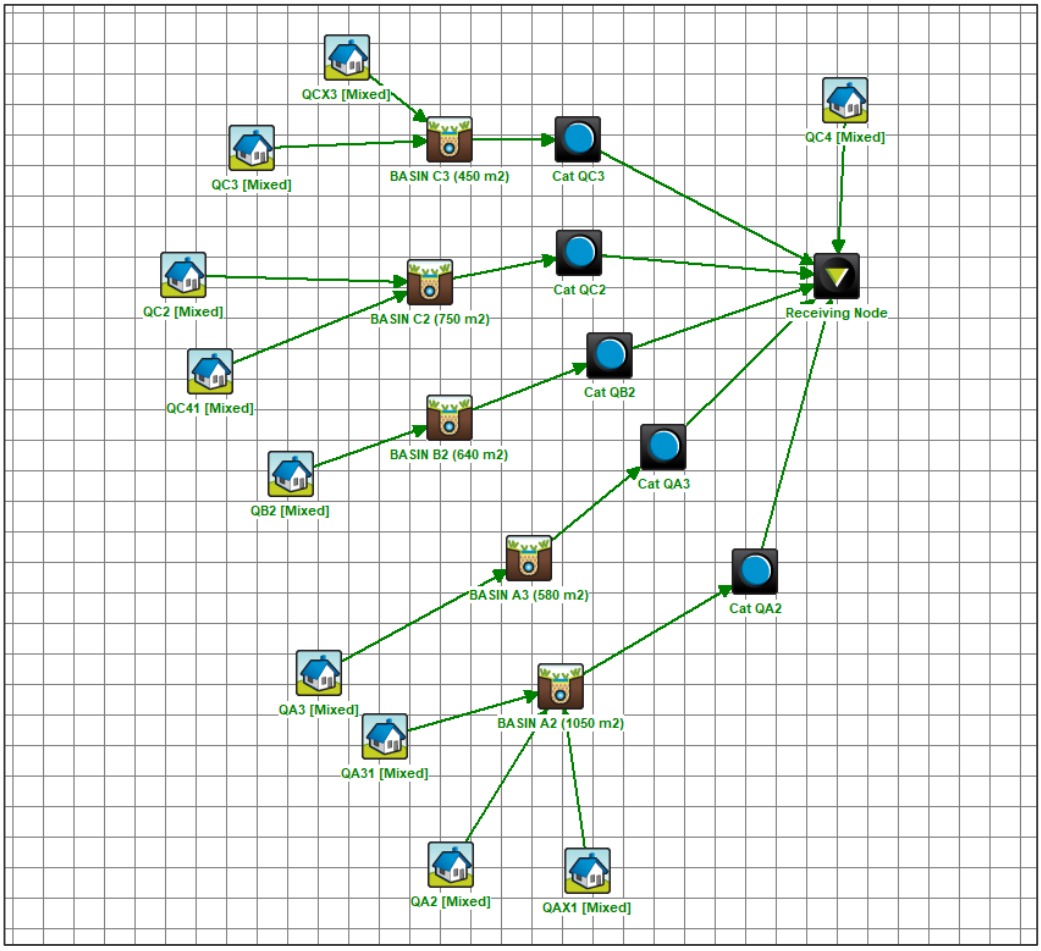



**Figure 4.2: MUSIC Model Network Diagram**

# 4.2 Developed Treated Case

Water Sensitive Urban Design (WSUD) aims to minimise the impact of a subdivision development on the natural water cycle by reducing the export of pollutants, sediments and nutrients from the site released into the natural watercourse. To treat the stormwater runoff from the Site, various treatment devices can be used throughout the development area, and these concepts can be integrated into the overall design of the road layouts, road cross sections, stormwater layouts and water supply reticulation systems.

There can be several individual devices that can be placed together to form an overall 'stormwater treatment train'. By using a series of devices, the sediment, pollutants and nutrients in the stormwater run-off can be treated so that the final discharge from the site will meet environmental guidelines.

## 4.2.1 Bioretention Areas

Opportunity exists at stormwater drainage outlet points of the proposed development to provide bioretention. Modelling of the proposed bioretention basins was carried out over a range of sizes based on the proposed development layout. The location of the bioretention basins can be seen in Figure 4.1 and Appendix A. When sizing bioretention basins in the MUSIC model, the surface area allocated for each of the bioretention basins was calculated from the filter area, batter slopes and extended detention areas to ensure an appropriate value was assigned.

The overall treatment of pollutants within the music model indicated that the use of Gross Pollutant Traps is not required as part of the stormwater quality treatment train. In order to control course sediment and gross pollutants entering the bioretention system, a pre-treatment course sediment forebay will be installed at the inlet of the bioretention basins. Course sediment forebays will be sized to a 3-month recurrence interval storm and with a clean out frequency of no less than one year. Detailed design of course sediment forebays will be undertaken during the detailed design phase. Figure 4.3 below details the typical cross section for bioretention basins.

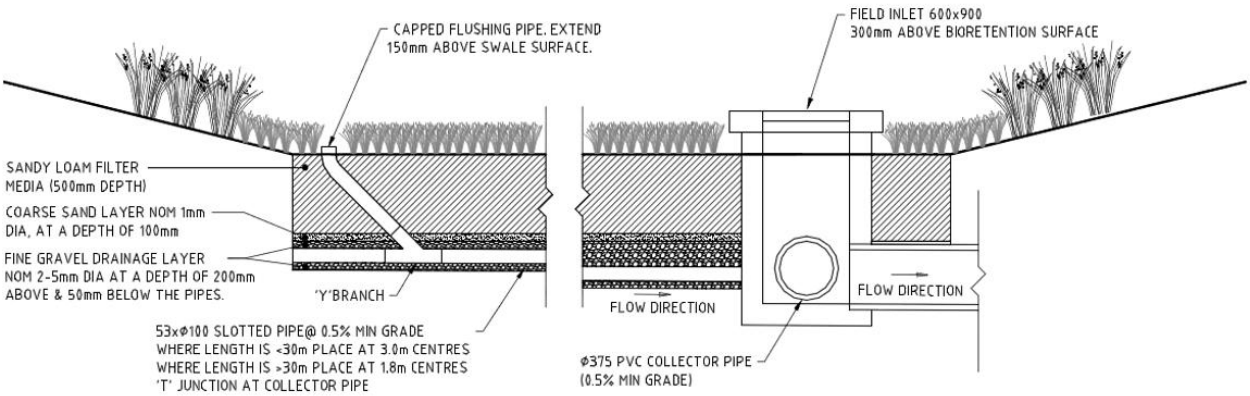



**Figure 4.3: Typical Bioretention Basin Section**

In order to model conditions expected during the lifespan of the bioretention basin, filter media parameters within the MUSIC model have been selected based on conformance test reports provided by local suppliers. Table 4.3 below details the proposed parameters of the bioretention basins used within the MUSIC model. Concept design of the basins is provided in Appendix A.

**TABLE 4.3: BIORETENTION BASIN MODELLING PARAMETERS**

| Parameter | Basin A2 | Basin A3 | Basin B2 | Basin C2 | Basin C3 |
|---|---|---|---|---|---|
| Catchment IDs | QA31/QAX1/QA2 | QA3 | QB2 | QC41/QC2 | QCX3/QC3 |
| Filter Area (m2) | 1050 | 580 | 640 | 750 | 450 |
| Surface Area (m2) | 1050 | 580 | 640 | 750 | 450 |
| Unlined filter media perimeter (m) | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Extended Detention Depth (m) | 0.3 | 0.3 | 0.3 | 0.3 | 0.3 |
| Filter Depth (m) | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 |
| Filter Media Hydraulic Conductivity (mm/hr) | 200 | 200 | 200 | 200 | 200 |
| Equivalent Overflow Weir Width (m) | 105 | 58 | 64 | 75 | 45 |
| Course Sediment Management | Sediment Forebay | Sediment Forebay | Sediment Forebay | Sediment Forebay | Sediment Forebay |

## 4.2.2 Coarse Sediment Management

Coarse sediment forebays are to be installed at the pipe outlet for each basin in accordance with the Healthy Land and Water Bioretention Technical Design Guidelines 2014. Course sediment forebays shall be appropriately sized for the upstream catchments. Coarse Sediment forebays shall have the following design characteristics:

- Removal Efficiency: 80%
- Sediment Loading Rate: 0.6 $m^3$/Ha/yr
- Design Flow: $Q_{3Month}$
- Turbulence Factor: 0.5
- Minimum Cleanout: Annual
- Minimum Forebay Depth: 200 mm.

Preliminary sizing of the basins is shown in Table 4.4 below:

**TABLE 4.4: PRELIMINARY SEDIMENT FOREBAY SIZING**

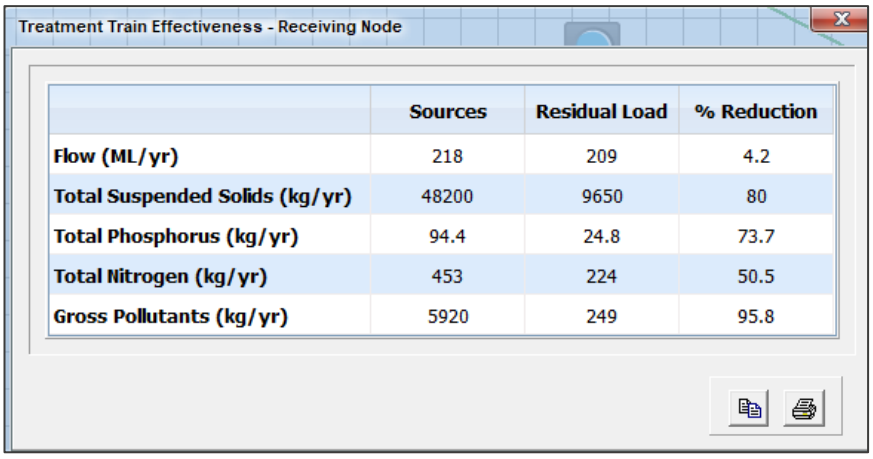
| Basin | A2 | A3 | B2 | C2 | C3 |
|---|---|---|---|---|---|
| Area (m2) | 50 | 25 | 25 | 25 | 15 |

### 4.2.3 MUSIC Analysis and Results

A MUSIC analysis was carried out on the proposed development site based on the 'treatment train' shown in Table 4.5. The results of the annual pollutant load reductions based on the above design calculations are shown in Table 4.5.

**TABLE 4.5: SUMMARY OF POLLUTANT TARGETS FOR TREATMENT TRAIN**

| Indicator | WQO's Target | WQO's Achieved | Objectives Met |
|---|---|---|---|
| TSS (Total Suspended Solids) | 80% | 80% | YES |
| TP (Total Phosphorus) | 60% | 73.7% | YES |
| TN (Total Nitrogen) | 45% | 50.5% | YES |
| GP (Gross Pollutants) | 90% | 95.8% | YES |




| | Sources | Residual Load | % Reduction |
|---|---|---|---|
| Flow (ML/yr) | 218 | 209 | 4.2 |
| Total Suspended Solids (kg/yr) | 48200 | 9650 | 80 |
| Total Phosphorus (kg/yr) | 94.4 | 24.8 | 73.7 |
| Total Nitrogen (kg/yr) | 453 | 224 | 50.5 |
| Gross Pollutants (kg/yr) | 5920 | 249 | 95.8 |

**Figure 4.4: Treatment Train Effectiveness**

## 4.3 Construction of Bioretention Basins

### 4.3.1 Bioretention Basin Layers

The layers of the bioretention basin have been selected based on the recommendations within the Bioretention Technical Design Guidelines Version 1.1 and are as follows:

- Filter Layer
  - 500 mm thick Sandy Loam Layer in accordance with the FAWB Guidelines.
- Transition Layer
  - 100 mm thick layer of well graded sands containing less than 2% fines.
- Drainage Layer
  - 300 mm thick layer of fine gravel (2-5mm) with less than 2% fines and minimum saturated hydraulic conductivity of 4000 mm/hr

- Underdrainage System
  - An underdrain system of slotted drainage pipes (100mm diameter)
    - 1% longitudinal grade;
    - 2.5 m centres; and
    - maximum run length of 25m.
  - Slotted pipes are to flow to larger PVC collector pipes with 1% longitudinal grades and the following maximum collection areas:
    - DN 100 78m2
    - DN 150 229m2
    - DN 225 343 m2
    - DN 300 1455 m2
  - The underdrainage layout for the basins can be seen within Appendix A.

The bioretention basin has been modelled within MUSIC with an exfiltration rate of 0 mm/hr. Geofabric or any other liner is not to be used between the layers within the bioretention system due to elevated risks associated with clogging.

The following parameters must all be satisfied with the selection of the transition and drainage layers:

- D15 (Transition Layer) ≤ 5 x D85 (Filter Media)
- D15 (Drainage Layer) ≤ 5 x D85 (Transition Layer)

### 4.3.2 Bioretention Filter Media

The filter media used within the bioretention basin is to be in accordance with the Facility for Advancing Water Biofiltration (FAWB) "Guideline Specifications for Soil Media in Bioretention Systems" – 2009 Version.

### 4.3.3 Construction Methodology

On completion of civil works, the bioretention shall be excavated to the base with the underdrainage system, drainage media, transition layer, and filter media installed. Landscape works are to be installed along the batters of the bioretention basin in accordance with the Water by Design / Healthy Land and Water - Guidelines for the construction and establishment of bioretention systems and wetlands v2 2022.

The top of the filter media is to have geofabric installed and overlain by topsoil and turf. At such time that the upstream catchment of the bioretention basin reaches 80% buildout, the topsoil, turf and geofabric are to be removed and the bioretention basin is to be planted out in accordance with the Water by Design / Healthy Land and Water - Guidelines for the construction and establishment of bioretention systems and wetlands v2 2022. Reference is made to the landscape plans which detail final planting of the bioretention basin batters and surface area.

## 4.4 Construction Phase Erosion and Sediment Control

### 4.4.1 Construction Management Plan

As previously specified, the major stormwater pollutant during the construction phase will be that of suspended solids. To ensure adverse impacts to downstream waterways are mitigated during the construction phase, best practice erosion and sediment control measures are required.

It should be noted that an erosion and sediment control strategy has been prepared as part of this conceptual management plan. It shall be the responsibility of the developer, through their principal contractor, to ensure that temporary sediment and erosion controls are installed and maintained correctly.

### 4.4.2 Water Quality Management Plan

Internal catchments where surface disturbance and earthworks are occurring are to incorporate temporary sediment basin/s for construction phase erosion and sediment control in accordance with IECA best practices for erosion and sediment control (IECA Australasia, Nov 2008).

Sediment control should be able to be achieved by applying the following best practice sediment and erosion control management measures during the construction phase:

(1) Establish a single stabilised entry/ exit point for the site works.

(2) Construct a shake-down grid at the entrance to facilitate the removal of sediment from vehicles leaving the site. The access road extending from the end of existing road or kerb to the grid should comprise a 150-200mm deep pad of 40mm crushed rock.

(3) Install sediment fences along the lower boundary of the development works.

(4) Install bins and/ or wind-proof litter areas on-site to minimise the dispersion of gross pollutants.

(5) Maintain on site spare materials necessary for the emergency repair of all erosion control devices. This includes silt fences, clean crushed rock for reapplication to the entrance road and for replacement of rock within temporary drainage channels.

(6) Following each days' construction works, ensure that any material on road surfaces is swept from the road, and not permitted to be washed down the gutters and piped drainage systems.

(7) Quality of pooled water within sediment basins are to be monitored prior to dewatering, sufficient time should be given to allow sediment to settle (possibly with the assistance of a suitable flocculent if necessary) and/ or filtering during pumping operations.

(8) Final establishment of basins at outlets should not occur until full stabilisation of upstream catchments has occurred; preferably these should be temporarily turfed during the maintenance period while dwelling construction is occurring.

While the above provides general guidance on the management of stormwater during the construction phase, detailed Erosion and Sediment Control Management Plans will be required during the operation works application stage for each precinct/stage in accordance with International Erosion Control Association Australia (IECA) Guidelines.

# 5. WORKS SCHEDULE

The Contractor will be responsible for the maintenance of stormwater quality control devices from the possession of the Site until the Site are accepted 'Off Maintenance' by Redland City Council or until stabilisation has occurred to the satisfaction of the site superintendent. A defined sequence of actions in relation to construction of the Site has been established and the contractor is responsible for ensuring adherence to a sequence of actions for development of the Site.

**TABLE 5.1: WORKS SCHEDULE OF KEY CONSTRUCTION EVENTS FOR THE SITE**

| Construction Phase | Required Action |
|---|---|
| Site Possession | • Installation of construction exit.<br>• Construct temporary erosion and sediment control measures such as silt fencing and perimeter banks.<br>• Construct temporary works to sediment basin to dimensions nominated by superintendent. |
| Construction | • Topsoil to be stripped and stockpiled in locations agreed with the superintendent. A sediment fence is to be constructed around the bottom of the stockpile to trap sediment. A diversion drain is to be installed upstream of the stockpile.<br>• Sediment control devices require removal to allow construction access and will be reinstated at the completion of each workday.<br>• Bulk earthworks complete.<br>• Drainage structures in place.<br>• Movement of construction equipment shall be limited to the area of work and existing roads.<br>• Disturbed areas are to be stabilised following final trimming. Areas are to be restored progressively.<br>• Surface stabilisation treatment complete.<br>• Planting to be undertaken in accordance with the vegetation management plan.<br>• Kerb sediment traps are to be provided at each drainage pit adjacent disturbed areas. |
| Maintenance | • Regularly check capacity of erosion control devices.<br>• Disturbed areas are to have 80% coverage within 30 days of trimming.<br>• Ensure permanent erosion control structures are stable. |

In addition to the above table, the "*Guidelines for the construction and establishment of bioretention systems and wetlands v2 2022*" from Water by Design / Healthy Land and Water will be used as a guide during the construction and establishment phase of the works.

# 6. CONCLUSION

The stormwater management plan for the Early Release stages (the Site) of the proposed Southern Thornlands Priority Development Area has been prepared to support the Development Application and provide recommendations to the management of stormwater quality and quantity. The various methods recommended as part of this stormwater management plan are considered best practices for developments of this type. The proposed stormwater strategy is also consistent with the Redland City Council City Plan.

The combined bioretention/detention basins proposed for installation at strategic locations within the subject site are predicted to result in:

(1) Stormwater detention to ensure post development peak flows do not exceed the pre-development peak flows discharged from the Site for the 1:100 AEP discharging to the north-east discharge point (Discharge Point 1) and for the 1:1 AEP discharging into Eprapah Creek (Discharge Point 3) .

(2) Appropriate stormwater quality treatment in accordance with the State Planning Policy (SPP).

(3) No interaction of development extents and infrastructure within the Eprapah Creek flood extent, nor impacts to Eprapah Creek flood behaviour as a result of discharge from the Site.

A summary of the proposed stormwater bioretention basins for the Site is provided in Table 6.1, and the detention basins in Table 6.2.

**TABLE 6.1: BIORETENTION BASIN SUMMARY**

| Parameter | Basin A2 | Basin A3 | Basin B2 | Basin C2 | Basin C3 |
|---|---|---|---|---|---|
| Catchment ID | QA31/QAX1/QA2 | QA3 | QB2 | QC41/QC2 | QCX3/QC3 |
| Filter Area ($m^2$) | 1050 | 580 | 640 | 750 | 450 |

A summary of the proposed stormwater bioretention basins for the Site is provided in Table 6.2.

**TABLE 6.2: DETENTION BASIN SUMMARY**

| Parameter | Basin A1 | Basin B1 | Basin C1 |
|---|---|---|---|
| Catchment ID | PA1, PB1 (flows greater than 1:2 AEP) | PB1 (flows up to the 1:2 AEP) | PAX1, PCX1, PC1, PCX2 |
| 1:1 AEP Detention Basin Volume ($m^3$) | 4,200 | 700 | 3,700 |
| 1:100 Detention Basin Volume ($m^3$) | 6,700 | 1,000 | 10,200 |

# 7. QUALIFICATIONS

(a) In preparing this document, including all relevant calculation and modelling, Engeny Australia Pty Ltd (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.

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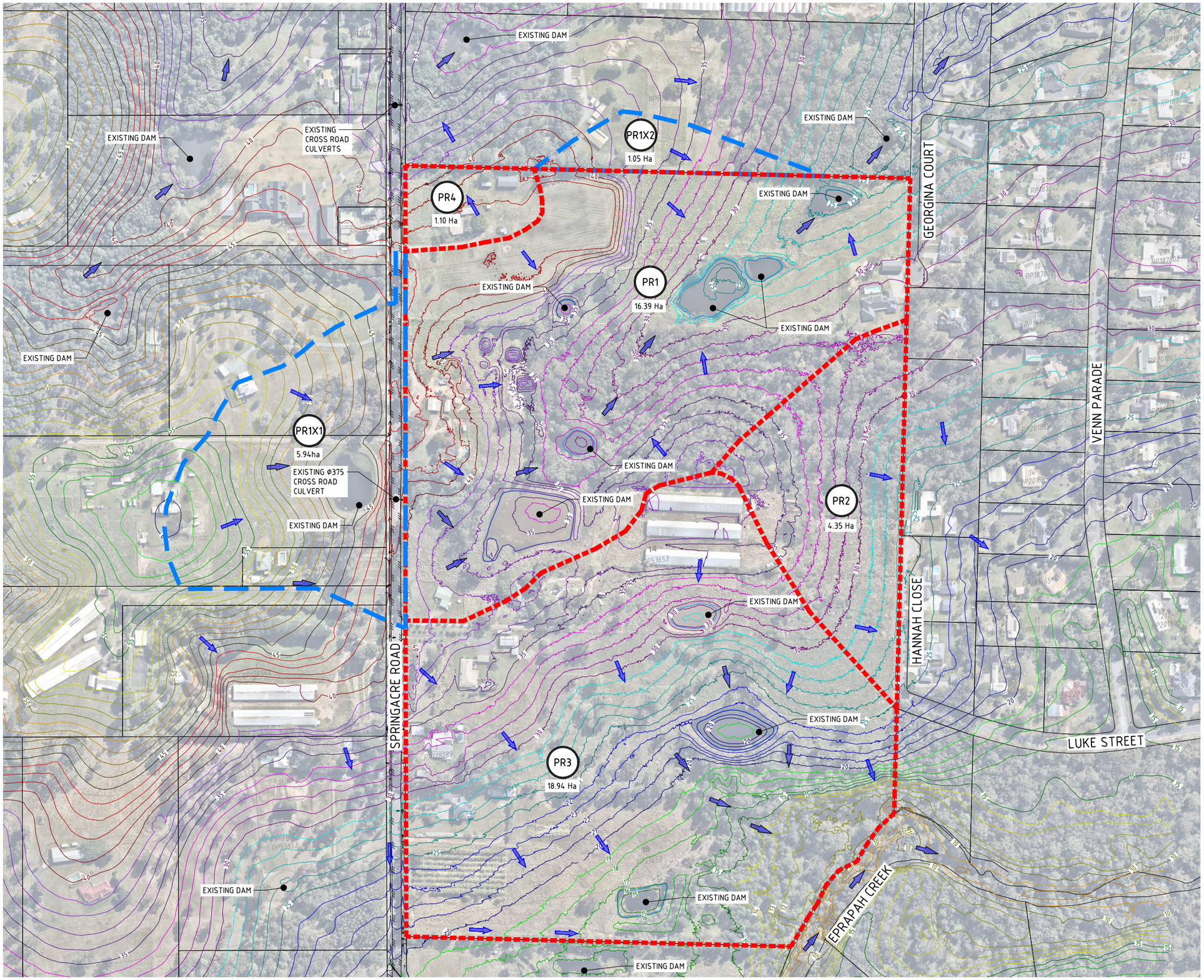
(g) This Report does not provide legal advice.

# APPENDIX A: SITE LAYOUT, CATCHMENTS, AND CONCEPT ENGINEERING PLANS




## CATCHMENT TABLE

| INTERNAL | | EXTERNAL | |
|---|---|---|---|
| CATCHMENT No. | AREA (Ha) | CATCHMENT NO. | AREA (Ha) |
| PR1 | 16.39 Ha | PR1X1 | 5.94 Ha |
| PR2 | 4.35 Ha | PR1X2 | 1.05 Ha |
| PR3 | 18.94 Ha | | |
| PR4 | 1.10 Ha | | |

## LEGEND

- EXISTING CONTOURS
- LOT BOUNDARY
- INTERNAL STORMWATER CATCHMENT
- EXTERNAL STORMWATER CATCHMENT
- PR1 — CATCHMENT NUMBER
- STORMWATER OVERLAND FLOW
- CONCENTRATED STORMWATER FLOW

0 40 80 120 160 200m

40 30 20 10

SCALE 1:2000 (A1) 1:4000 (A3)
DO NOT SCALE USE ONLY THE DIMENSIONS PROVIDED.

| No. | Amendments | Drawn | Design | Design Chk | Appd | Date |
|---|---|---|---|---|---|---|
| B | MINOR AMENDMENTS INCLUDING STORMWATER BASIN AREAS AS PER EDQ CONDITIONS | ES | PDW | PDW | PI | 18/06/26 |
| A | ORIGINAL ISSUE | ES | PDW | PDW | PI | 12/12/25 |

ENGINEERING CERTIFICATION
Peter Ingerman
Registered Engineer
Date 18/6/2026
9424
Registered Accreditation

URBEX

EMPOWER

Client: URBEX PTY LTD

Project: SOUTHERN THORNLANDS PRECINCT 1 - ST 1 & 2 RAL

Title: PRE DEVELOPMENT CATCHMENT PLAN

Datum: AHD PSM 79006 RL 67.474 (RCC) COORD

NOT FOR CONSTRUCTION

Project No. / Drawing No.: B00702-DA-SW01

Rev: B

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User: ETHAN SCHAFER

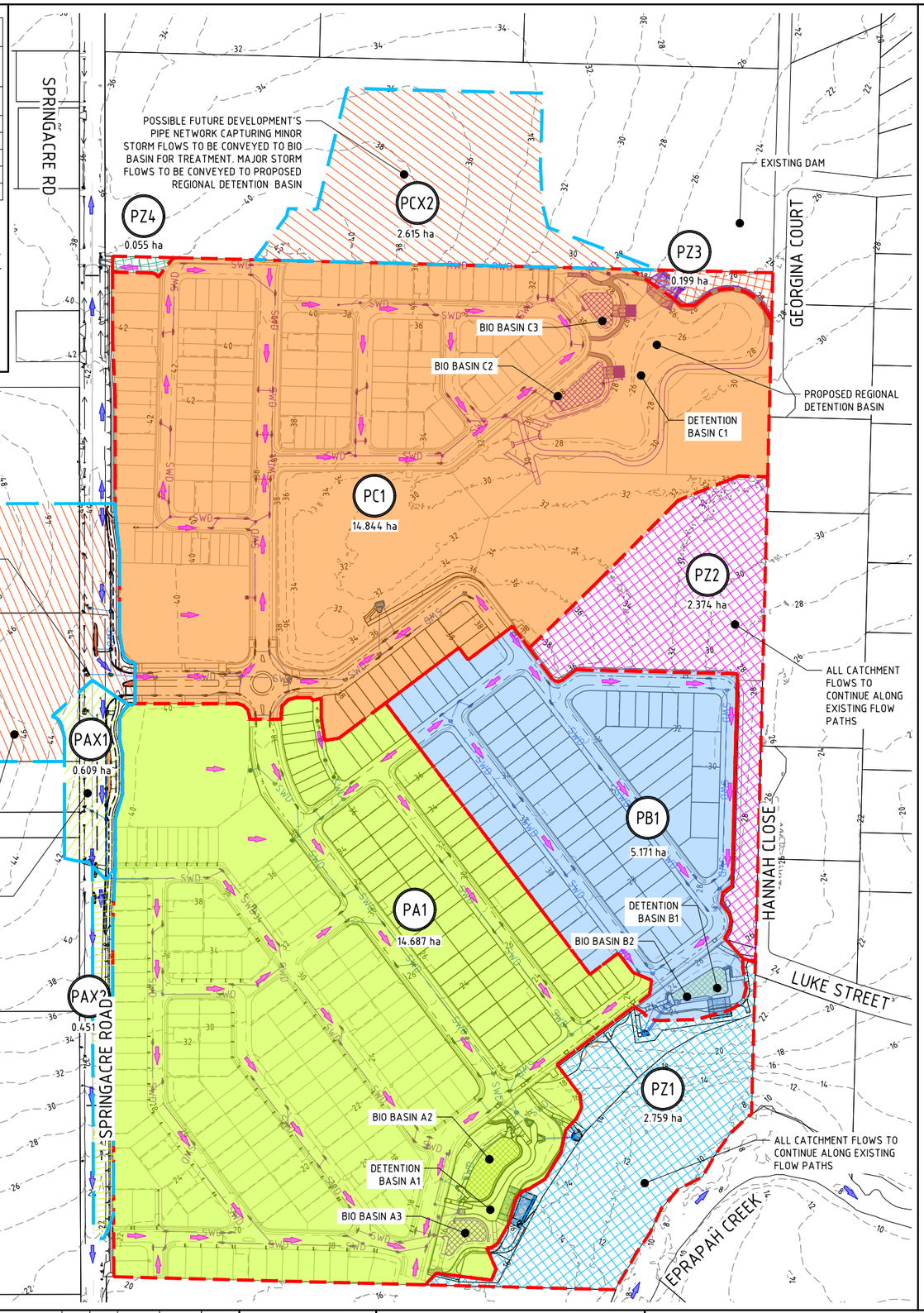
Docusign Envelope ID: DD00EEE6-5AF5-8F0A-81F9-443FB7E80205

# CATCHMENT TABLE

| INTERNAL (DEVELOPED) | | INTERNAL (UNMITIGATED) | |
|---|---|---|---|
| CATCHMENT No. | AREA (Ha) | CATCHMENT NO. | AREA (HA) |
| PA1 | 14.687 | | |
| PB1 | 5.171 | PZ1 | 2.759 |
| PC1 | 14.844 | PZ2 | 2.374 |
| | | PZ3 | 0.199 |
| | | PZ4 | 0.055 |

| EXTERNAL (DEVELOPED) | |
|---|---|
| CATCHMENT NO. | AREA (HA) |
| PCX1 | 6.075 |
| PCX2 | 2.615 |
| PAX1 | 0.609 |
| PAX2 | 0.451 |

NOTE: ALL DEVELOPED CATCHMENTS SHALL BE CONVEYED TO A REGIONAL DETENTION BASIN. UNMITIGATED CATCHMENTS SHALL BE CONVEYED TO A DISCHARGE POINT AND NO INCREASE IN POST-DEVELOPMENT PEAK FLOW SHALL BE CONFIRMED.

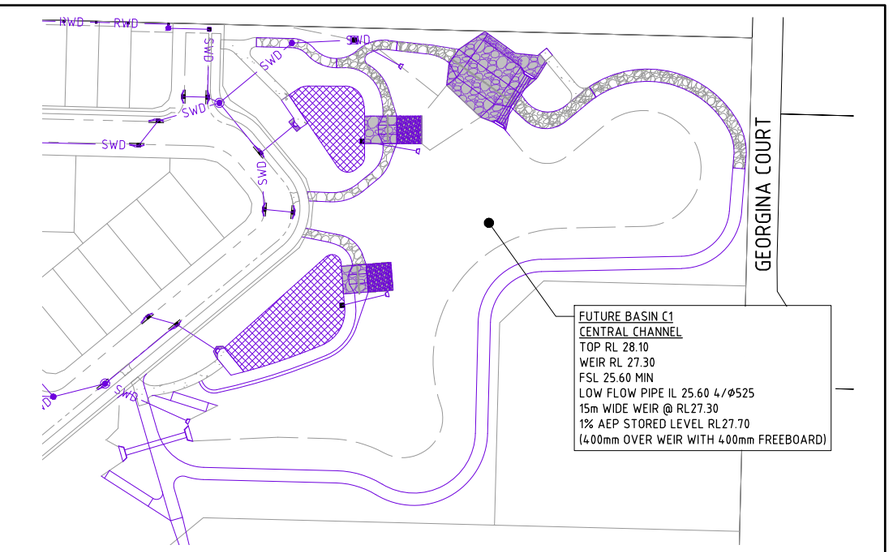



## LEGEND

- EXTERNAL STORMWATER FLOW
- INTERNAL STORMWATER FLOW
- P1 CATCHMENT NUMBER
- INTERNAL STORMWATER CATCHMENT
- EXTERNAL STORMWATER CATCHMENT

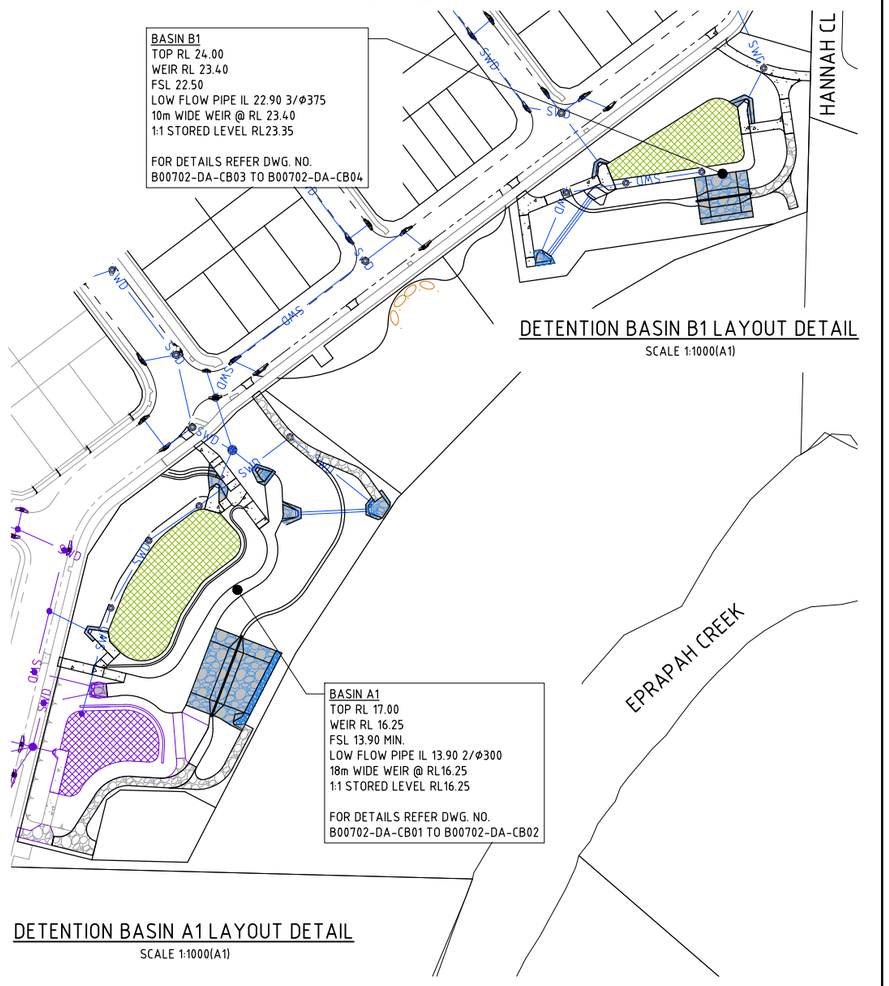
SCALE 1:1000 (A1) 1:2000 (A3)
DO NOT SCALE USE ONLY THE DIMENSIONS PROVIDED.

SCALE 1:2000 (A1) 1:4000 (A3)
DO NOT SCALE USE ONLY THE DIMENSIONS PROVIDED.




## DETENTION BASIN C1 LAYOUT DETAIL

SCALE 1:1000(A1)




## DETENTION BASIN B1 LAYOUT DETAIL

SCALE 1:1000(A1)

## DETENTION BASIN A1 LAYOUT DETAIL

SCALE 1:1000(A1)

| No. | Amendments | Drawn | Design | Design Chk | Appd | Date |
|---|---|---|---|---|---|---|
| B | MINOR AMENDMENTS INCLUDING STORMWATER BASIN AREAS AS PER EDQ CONDITIONS | ES | PDW | PDW | PI | 18/06/26 |
| A | ORIGINAL ISSUE | ES | PDW | PDW | PI | 12/12/25 |

ENGINEERING CERTIFICATION
Peter Ingerman
Registered Engineer
Date 18/6/2026
9424
Registered Accreditation

URBEX

EMPOWER

Client: URBEX PTY LTD
Project: SOUTHERN THORNLANDS PRECINCT 1 - ST 1 & 2 RAL
Title: POST DEVELOPMENT CATCHMENT PLAN

Datum: AHD PSM 79006 RL 67.474 (RCC) COORD

NOT FOR CONSTRUCTION

Project No. / Drawing No. / Rev: B00702-DA-SW02 B

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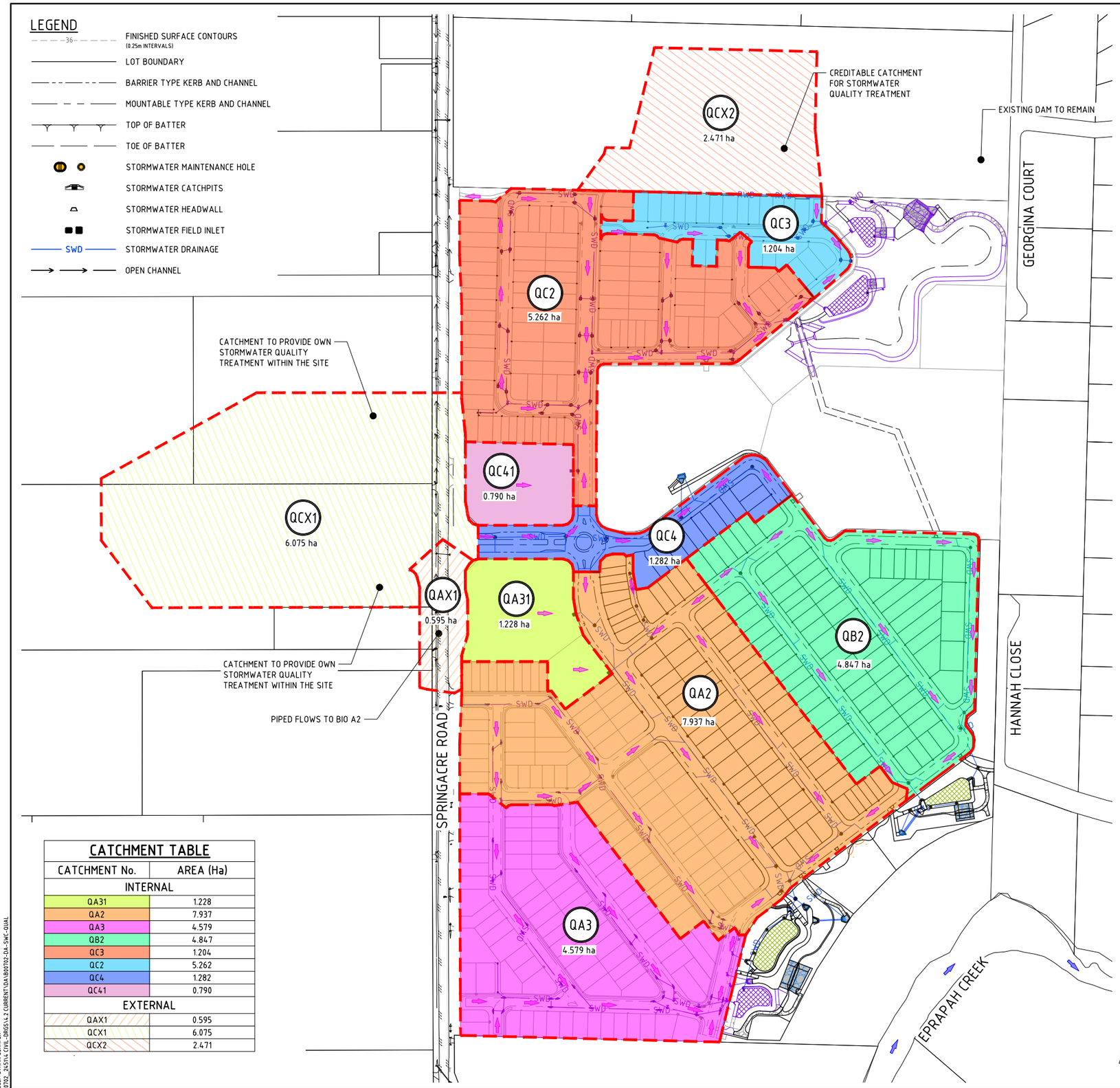
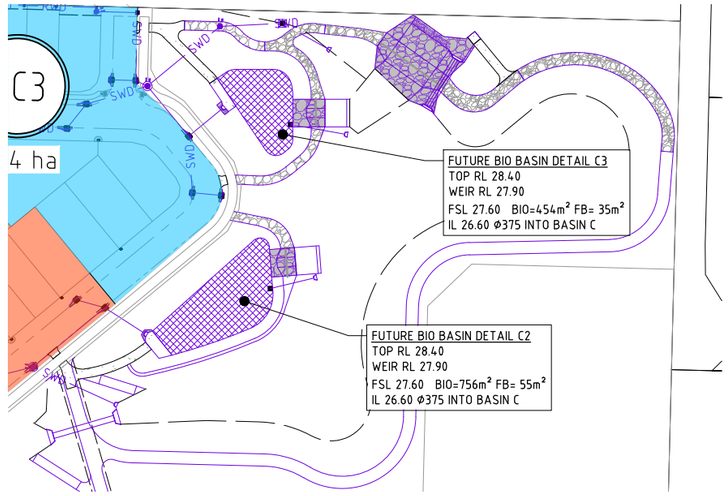
## LEGEND

- FINISHED SURFACE CONTOURS (0.25m INTERVALS)
- LOT BOUNDARY
- BARRIER TYPE KERB AND CHANNEL
- MOUNTABLE TYPE KERB AND CHANNEL
- TOP OF BATTER
- TOE OF BATTER
- STORMWATER MAINTENANCE HOLE
- STORMWATER CATCHPITS
- STORMWATER HEADWALL
- STORMWATER FIELD INLET
- SWD — STORMWATER DRAINAGE
- OPEN CHANNEL




## CATCHMENT TABLE

| CATCHMENT No. | AREA (Ha) |
|---|---|
| INTERNAL | |
| QA31 | 1.228 |
| QA2 | 7.937 |
| QA3 | 4.579 |
| QB2 | 4.847 |
| QC3 | 1.204 |
| QC2 | 5.262 |
| QC4 | 1.282 |
| QC41 | 0.790 |
| EXTERNAL | |
| QAX1 | 0.595 |
| QCX1 | 6.075 |
| QCX2 | 2.471 |

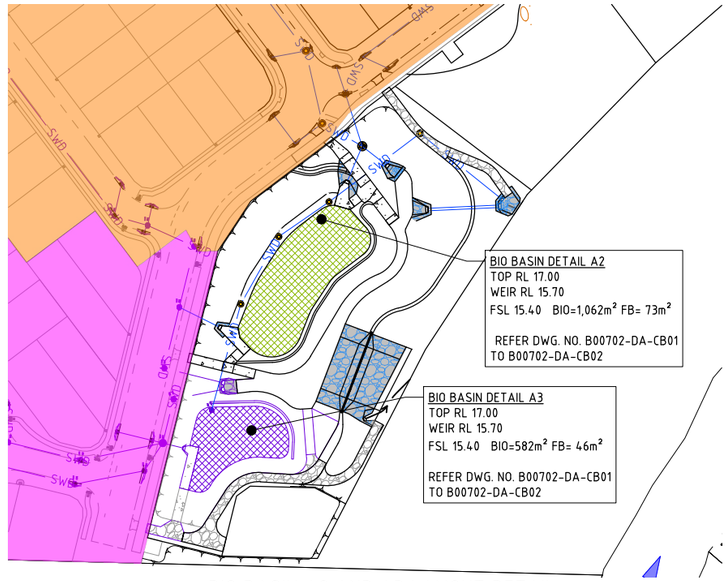



FUTURE BIO BASIN C2 AND C3 LAYOUT DETAIL

SCALE 1:1000(A1)

BIO BASIN B2 LAYOUT DETAIL

SCALE 1:1000(A1)




BIO BASIN A2 AND A3 LAYOUT DETAIL

SCALE 1:1000(A1)

0 40 80 120 160 200m
40 30 20 10
SCALE 1:2000 (A1) 1:4000 (A3)
DO NOT SCALE USE ONLY THE DIMENSIONS PROVIDED.

0 20 40 60 80 100m
20 15 10 5
SCALE 1:1000 (A1) 1:2000 (A3)
DO NOT SCALE USE ONLY THE DIMENSIONS PROVIDED.

| No. | Amendments | Drawn | Design | Design Chk | Appd | Date |
|---|---|---|---|---|---|---|
| B | MINOR AMENDMENTS INCLUDING STORMWATER BASIN AREAS AS PER EDQ CONDITIONS | ES | PDW | PDW | PI | 18/06/26 |
| A | ORIGINAL ISSUE | ES | PDW | PDW | PI | 12/12/25 |

ENGINEERING CERTIFICATION
Peter Ingerman
Registered Engineer
Date 18/6/2026
9424
Registered Accreditation

URBEX EMPOWER

Client: URBEX PTY LTD
Project: SOUTHERN THORNLANDS PRECINCT 1 - ST 1 & 2 RAL
Title: STORMWATER QUALITY CATCHMENT PLAN

Datum: AHD PSM 79006 RL 67.474 (RCC) COORD

NOT FOR CONSTRUCTION

Project No. / Drawing No.: B00702-DA-SW03
Rev: B

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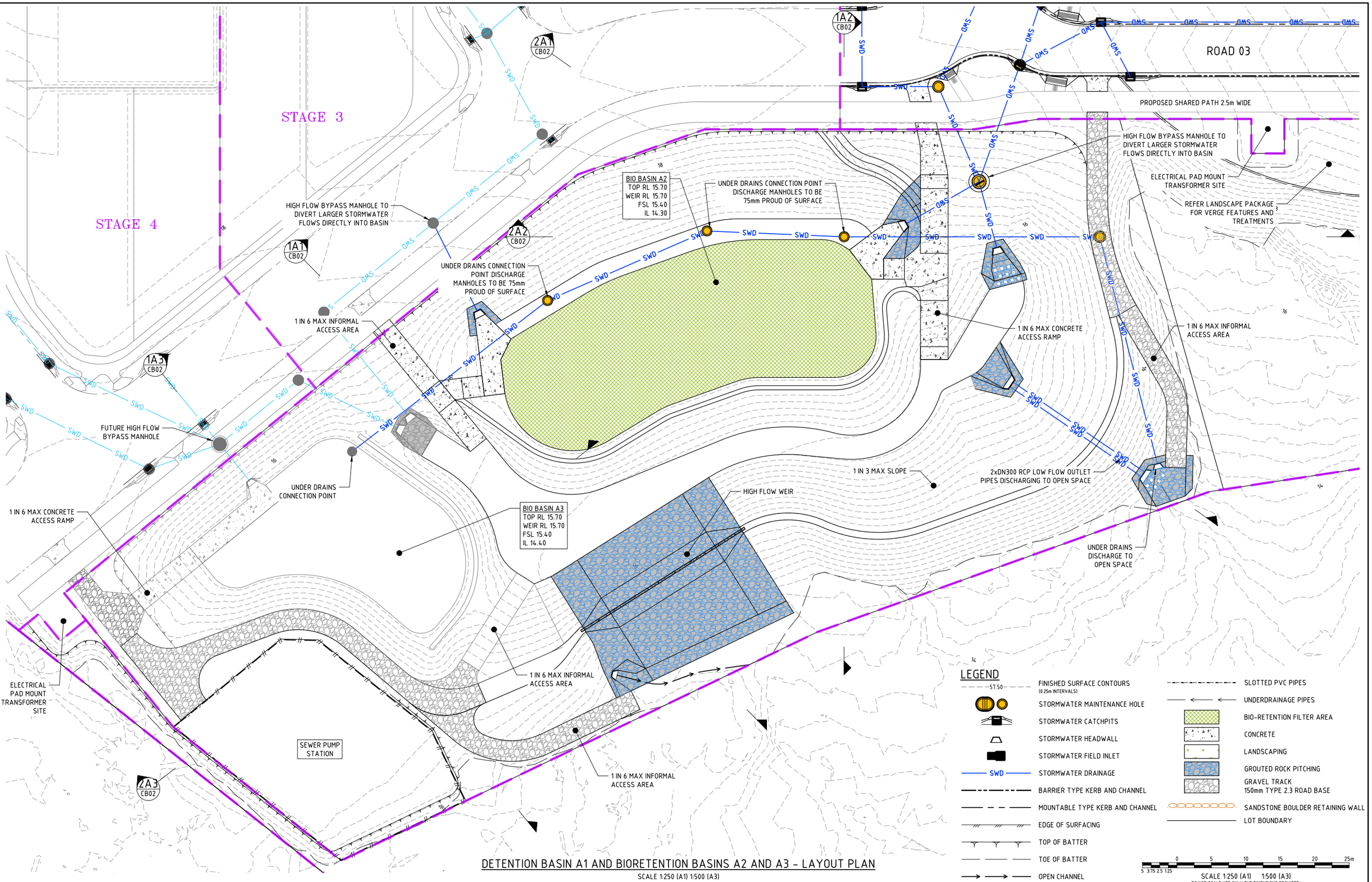


## DETENTION BASIN A1 AND BIORETENTION BASINS A2 AND A3 – LAYOUT PLAN

SCALE 1:250 (A1) 1:500 (A3)

| No. | Amendments | Drawn | Design | Design Chk | Appd | Date |
|---|---|---|---|---|---|---|
| B | MINOR AMENDMENTS INCLUDING STORMWATER BASIN AREAS AS PER EDQ CONDITIONS | ES | PDW | PDW | PI | 18/06/26 |
| A | ORIGINAL ISSUE | ES | PDW | PDW | PI | 12/12/25 |

ENGINEERING CERTIFICATION
Peter Ingerman
Registered Engineer
Date 18/6/2026
9424
Registered Accreditation

URBEX

EMPOWER

Client: URBEX PTY LTD

Project: SOUTHERN THORNLANDS PRECINCT 1 - ST 1 & 2 RAL

Title: BIORETENTION BASIN A2 AND A3 LAYOUT PLAN

Datum: AHD PSM 79006 RL 67.474 (RCC) COORD

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Project No. / Drawing No.: B00702-DA-CB01

Rev: B

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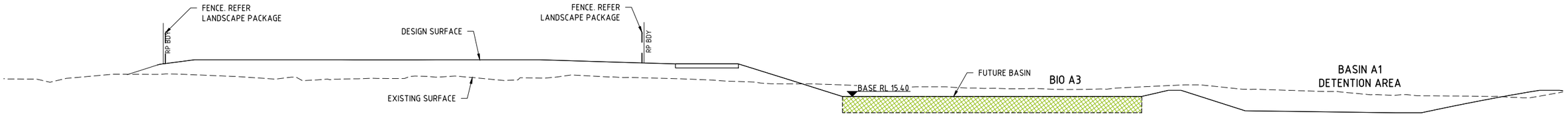
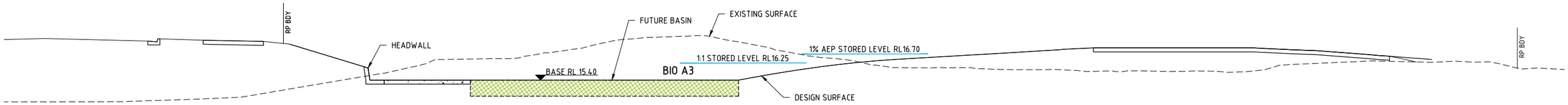



2A3 CB01 SECTION
SCALE 1:100 (A1)




1A3 CB01 SECTION
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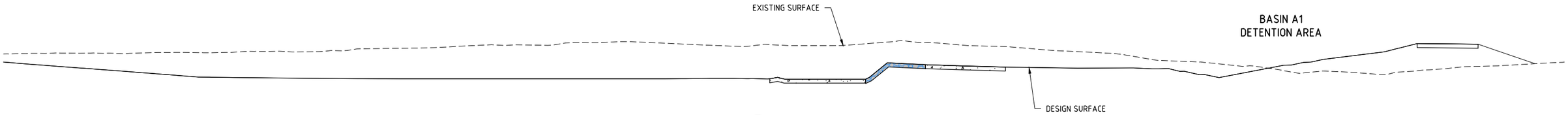
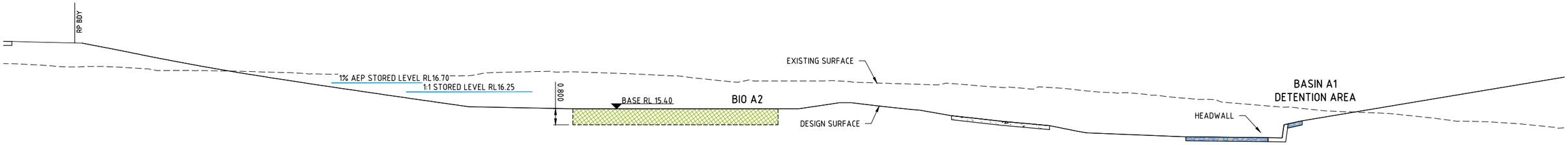



2A2 CB01 SECTION
SCALE 1:100 (A1)




2A1 CB01 SECTION
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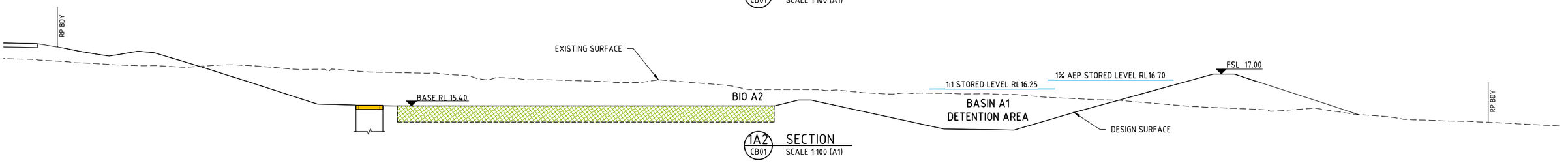


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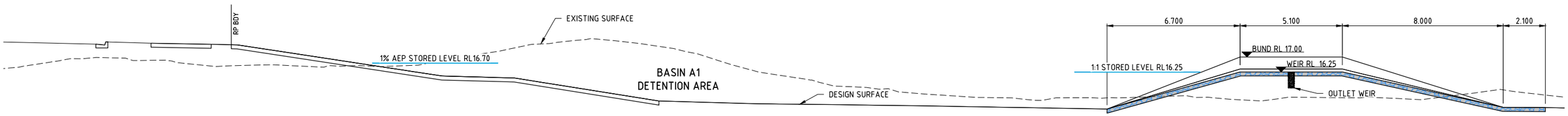


1A1 CB01 SECTION
SCALE 1:100 (A1)

0 2 4 6 8 10m
2.0 1.5 1.0 0.5
SCALE 1:100 (A1) 1:200 (A3)
DO NOT SCALE USE ONLY THE DIMENSIONS PROVIDED.

| No. | Amendments | Drawn | Design | Design Chk | Appd | Date |
|---|---|---|---|---|---|---|
| B | MINOR AMENDMENTS INCLUDING STORMWATER BASIN AREAS AS PER EDQ CONDITIONS | ES | PDW | PDW | PI | 18/06/26 |
| A | ORIGINAL ISSUE | ES | PDW | PDW | PI | 12/12/25 |

ENGINEERING CERTIFICATION
Peter Ingelman
Registered Engineer
Date 18/6/2026
9424
Registered Accreditation

URBEX

EMPOWER

Client: URBEX PTY LTD

Project: SOUTHERN THORNLANDS PRECINCT 1 - ST 1 & 2 RAL

Title: BIORETENTION BASIN A2 AND A3 CROSS SECTIONS

Datum: AHD
PSM 79006
RL 67.474
(RCC) COORD

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Project No. / Drawing No.: B00702-DA-CB02
Rev: B

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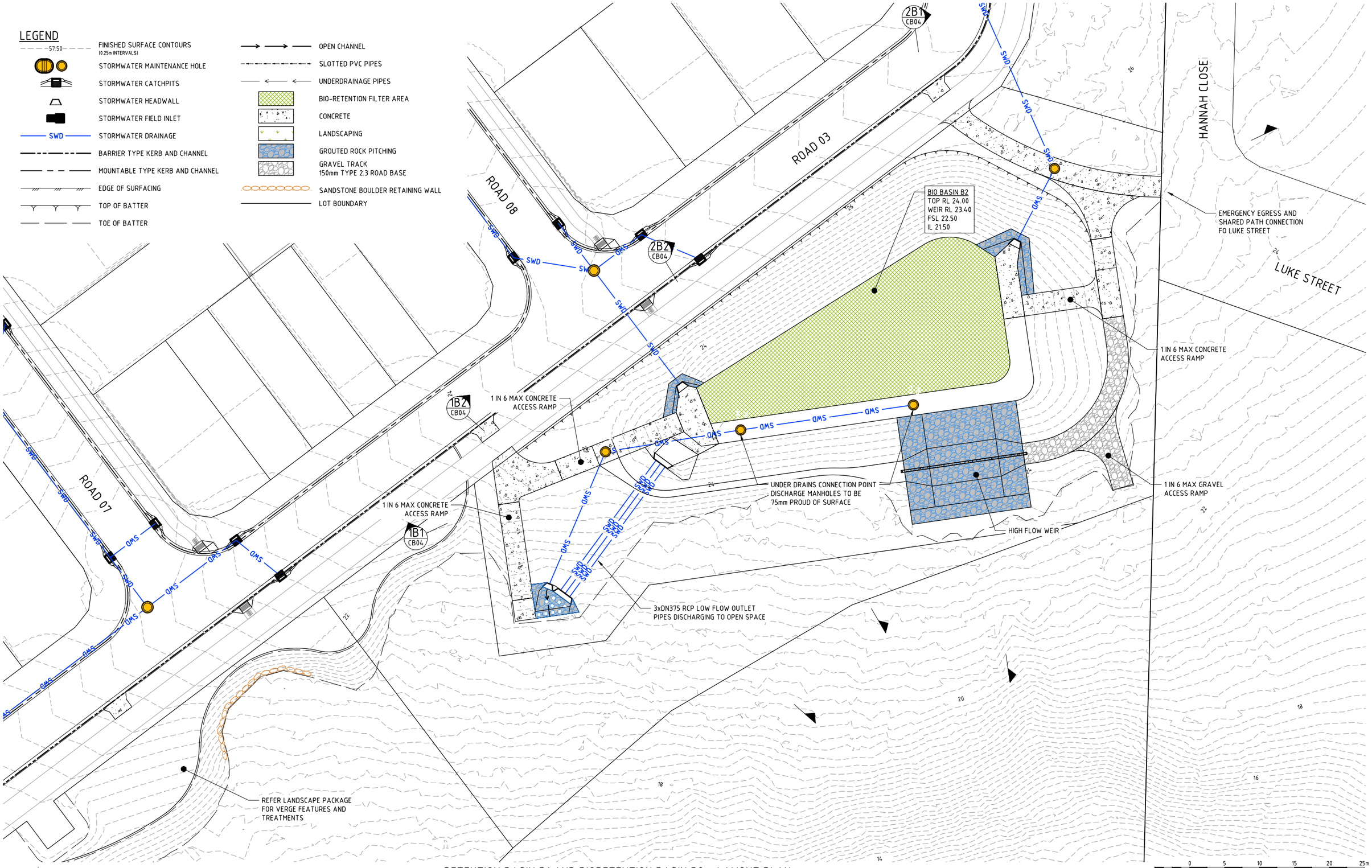


## DETENTION BASIN B1 AND BIORETENTION BASIN B2 - LAYOUT PLAN

SCALE 1:250 (A1) 1:500 (A3)

| No. | Amendments | Drawn | Design | Design Chk | Appd | Date |
|---|---|---|---|---|---|---|
| B | MINOR AMENDMENTS INCLUDING STORMWATER BASIN AREAS AS PER EDQ CONDITIONS | ES | PDW | PDW | PI | 18/06/26 |
| A | ORIGINAL ISSUE | ES | PDW | PDW | PI | 12/12/25 |

ENGINEERING CERTIFICATION
Peter Ingerman
Registered Engineer
Date 18/6/2026
9424
Registered Accreditation

URBEX

EMPOWER

Client: URBEX PTY LTD

Project: SOUTHERN THORNLANDS PRECINCT 1 - ST 1 & 2 RAL

Title: BIORETENTION BASIN B2 LAYOUT PLAN

Datum: AHD PSM 79006 RL 67.474 (RCC) COORD

NOT FOR CONSTRUCTION

Project No. / Drawing No.: B00702-DA-CB03

Rev: B

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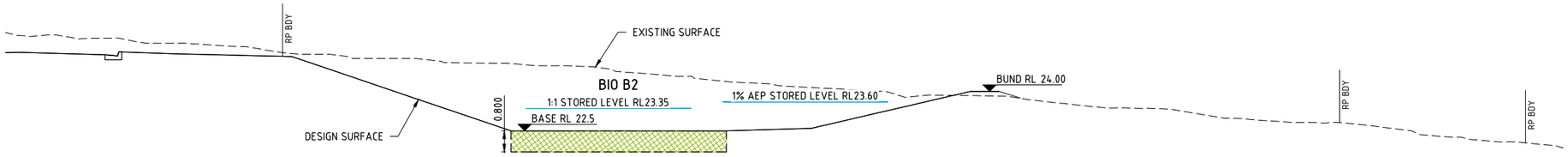


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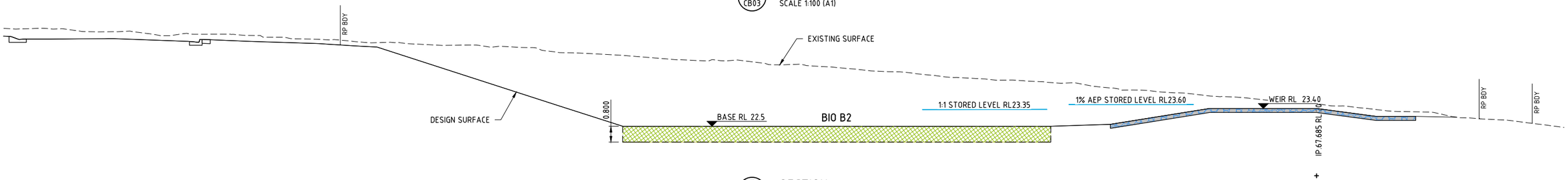


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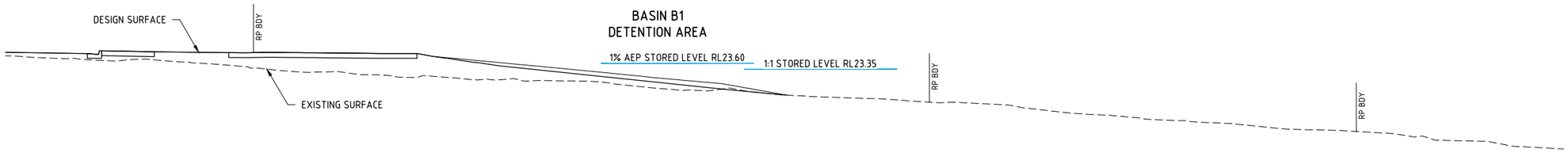


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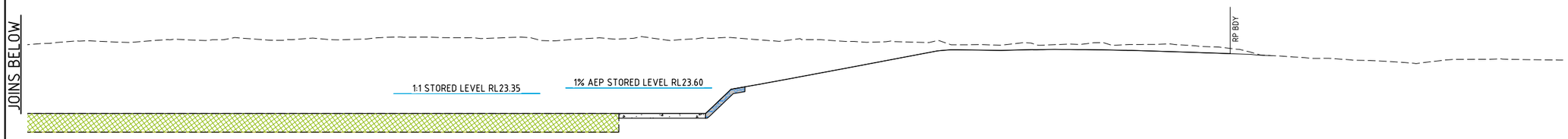


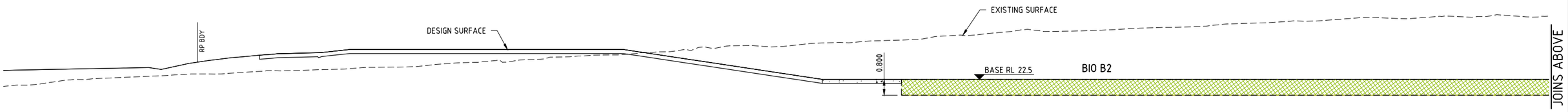


0 2 4 6 8 10m
2.0 1.5 1.0 0.5
SCALE 1:100 (A1) 1:200 (A3)
DO NOT SCALE USE ONLY THE DIMENSIONS PROVIDED.

1B1 CB03 SECTION
SCALE 1:100 (A1)

| No. | Amendments | Drawn | Design | Design Chk | Appd | Date |
|---|---|---|---|---|---|---|
| B | MINOR AMENDMENTS INCLUDING STORMWATER BASIN AREAS AS PER EDQ CONDITIONS | ES | PDW | PDW | PI | 18/06/26 |
| A | ORIGINAL ISSUE | ES | PDW | PDW | PI | 12/12/25 |

ENGINEERING CERTIFICATION
Peter Ingerman
Registered Engineer
Date 18/6/2026
9424
Registered Accreditation

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URBEX

EMPOWER

Client: URBEX PTY LTD

Project: SOUTHERN THORNLANDS PRECINCT 1 - ST 1 & 2 RAL

Title: BIORETENTION BASIN B2
CROSS SECTIONS

Datum: AHD
PSM 79006
RL 67.474
(RCC) COORD

NOT FOR CONSTRUCTION

Project No. / Drawing No.: B00702-DA-CB04

Rev: B

Plot Date: 18/06/2026 4:42:55 PM
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