PLANS AND DOCUMENTS referred to in the PDA DEVELOPMENT APPROVAL

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Queensland Government

# AURA PRECINCTS 11 - 14

## STORMWATER QUALITY MANAGEMENT PLAN

DesignFlow

Prepared for Stockland

July 2020

## Document Control Sheet

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# SUMMARY

**This document describes a stormwater quality management strategy for Aura Precincts 11-14 to meet required stormwater quality objectives.** The document should be read with the approved DesignFlow (2017) *Aura Precinct 11-12 Stormwater Quality Management Plan* which provides the stormwater quality management strategy for the catchments in Precincts 11 and 12 which drain north to Bells Creek North.

This stormwater quality management strategy covers 333ha of Precincts 11 to 14 and the surrounding development precincts of the Aura masterplan development (The Site). The development includes the creation of residential, small commercial, community, school, sports fields and recreational park land uses as well as a number of drainage corridors.

The site drains in three general directions.  A small portion of the site, in the far north west, drains north towards the floodplain of Bells Creek North. About half the development site will drain internally via a large create drainage corridor called The Brook east and then south into Bells Creek South. The other half of the site drains southwards directly to Bells Creek South.

All runoff from the site flows into a State Government declared High Ecological Value area (Pumicestone Passage) via Bells Creek which is a Ramsar listed wetland.  Consequently requirements for comprehensive stormwater quality improvement from the site are imperative. Stormwater quality objectives for development runoff from Aura have been determined as part of a wider water quality assessment of Bells Creek and Pumicestone Passage.

This strategy proposes a comprehensive combination of treatment systems responding to the very high value receiving waters.  Treatment will occur via end of line sediment basins, wetland and bioretention basin integrated into The Brook and also the linear open spaces, buffers and drainage reserves around the perimeter of the development.  In addition, rainwater tanks are used on allotments for water reuse in toilets and outdoor demands. These systems combined provide required stormwater treatment prior to discharge into Bells Creek. At-source bioretention (biopods) will be also used in the residential streets to provide extra treatment beyond the objectives.

The treatment systems have been all be located within the constraints of site levels, available space and requirements for environmental buffers (e.g. frog habitat).

The treatment strategy for Precincts 11-14 meets the stormwater objectives established for the Aura development to ensure no adverse impacts to Bells Creek and Pumicestone Passage.  This includes reducing annual pollutant loads by the required 95% for total suspended solids (TSS), 89% for total phosphorus (TP) and 68% for total nitrogen (TN). These stormwater objectives were established as part of the stormwater planning and waterway modelling for the whole Aura development as documented in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019).

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## Figures



## Tables

# 1 Introduction

The Aura development site has been the focus of extensive water quality and stormwater quality management investigations over the last 10 years. This work has established the water quality characteristics of the receiving waterways (i.e. Bells Creek), monitored the quality of stormwater quality exiting the site, completed extensive catchment and receiving waterbody modelling, established water quality objectives and defined stormwater treatment strategies to meet these objectives. These requirements are now included in Federal and State Government approvals for the site.

This report focusses on 333ha of Precincts 11-14 and surrounding precincts (referred to herein as "the site") as illustrated in Figure 1. This includes land uses including residential, commercial, community, school, sports fields and recreational parks as illustrated in Figure 2.

This report presents a SQMP for Precincts 11-14 of Aura reflecting recent investigations and consideration of site constraints and proposed development land uses and levels. The strategy ensures the stormwater quality objectives for Aura are achieved using treatment measures that respond to the site constraints while providing flexibility through future detailed design. The document should be read with the approved DesignFlow (2017) *Aura Precinct 11-12 Stormwater Quality Management Plan* which provides the stormwater quality management strategy for the catchments in Precincts 11 and 12 which drain north to Bells Creek North.

The treatment strategy for Precinct 11-14 is consistent with the stormwater objectives, planning and modelling documented in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). This report defines stormwater management objectives for the Aura development (i.e. reduction in annual pollutant loads by the required 95% for total suspended solids, 89% for total phosphorus, and 68% for total nitrogen) to ensure no adverse impacts to Bells Creek and Pumicestone Passage. The stormwater treatment strategy for Precinct 11-14 ensures these objectives are achieved.

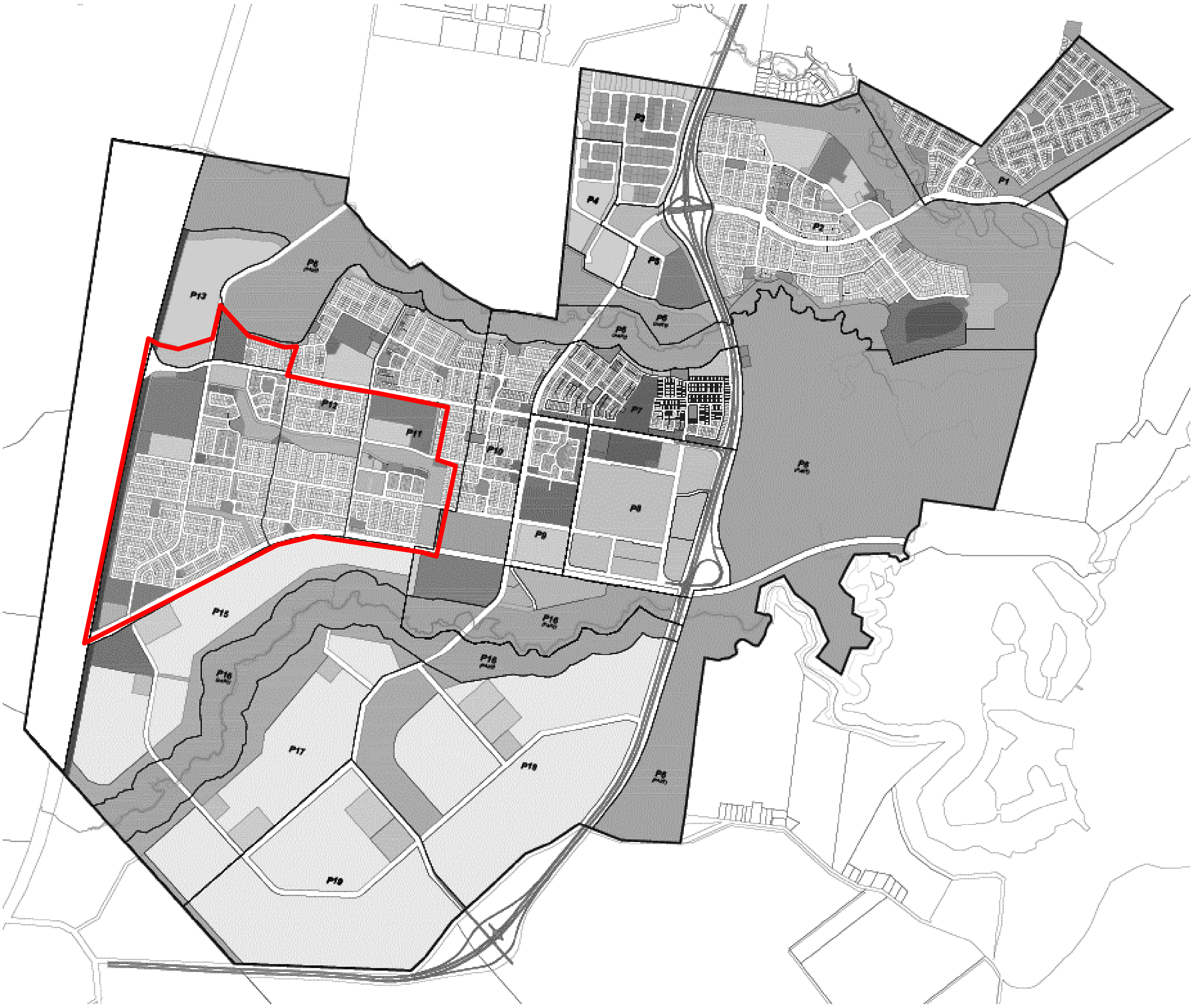



Figure 1 Aura Precincts 11 - 14 Location

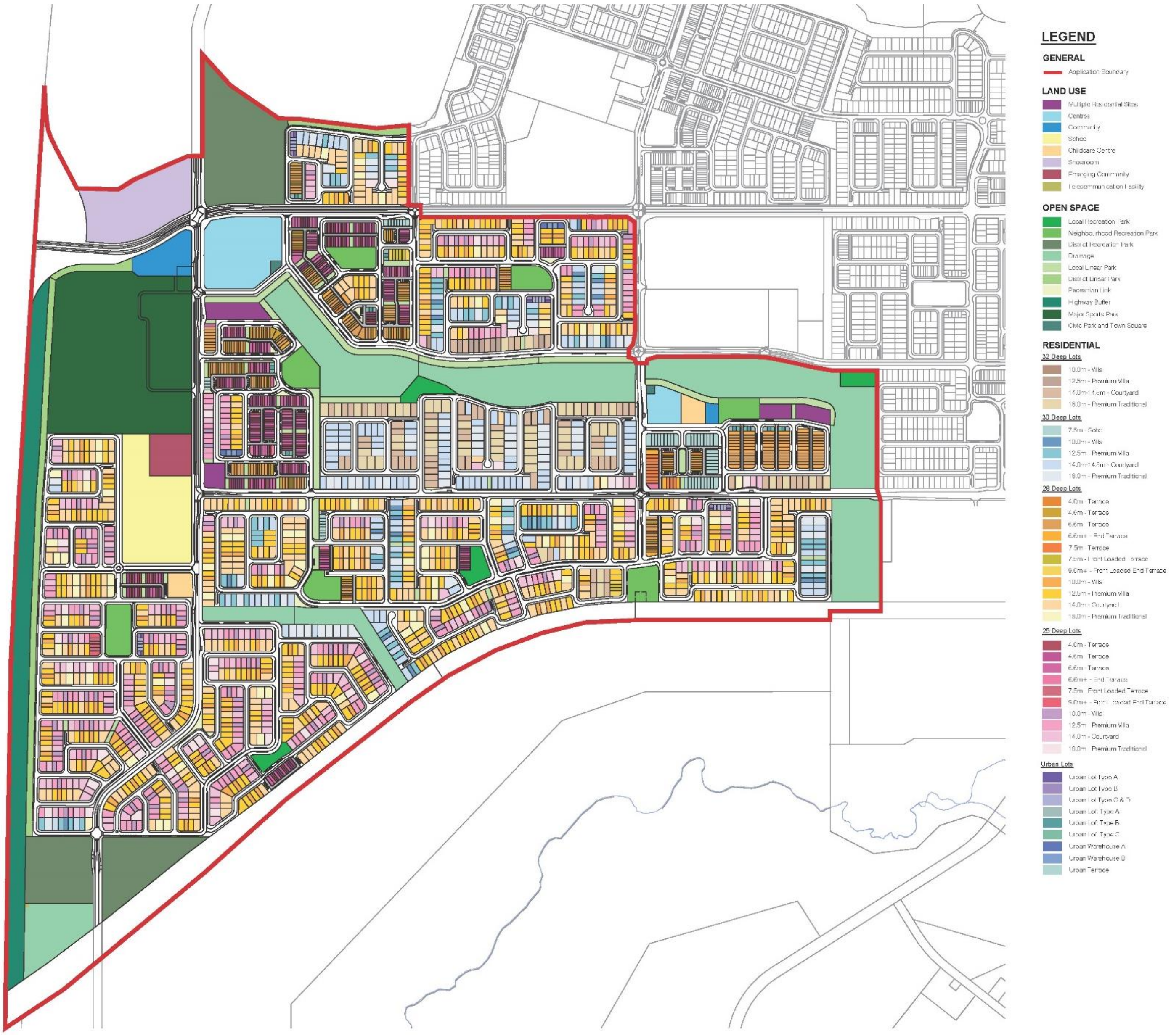



Figure 2 Aura Precincts 11 - 14 Layout

# 2 Site Characteristics

The description of the site presented in this section relates to elements that affect the stormwater quality management strategy for Precincts 11-14. More thorough site descriptions of soils, geology, climate, vegetation and habitats are not replicated as these are covered in other reports relating to the site.

## 2.1 Landuse, topography and drainage

Precincts 11-14 are located on cleared grazing land that is relatively flat with average grade of 1% grade even though the elevations on the site range between RL 8–30 m AHD.

The area is bordered by Bells Creek North and Precincts 11.1 and 11.2 to the north, Precincts 6-10 to the east and Precinct 15 and Bells Creek South to the south (Figure 3).

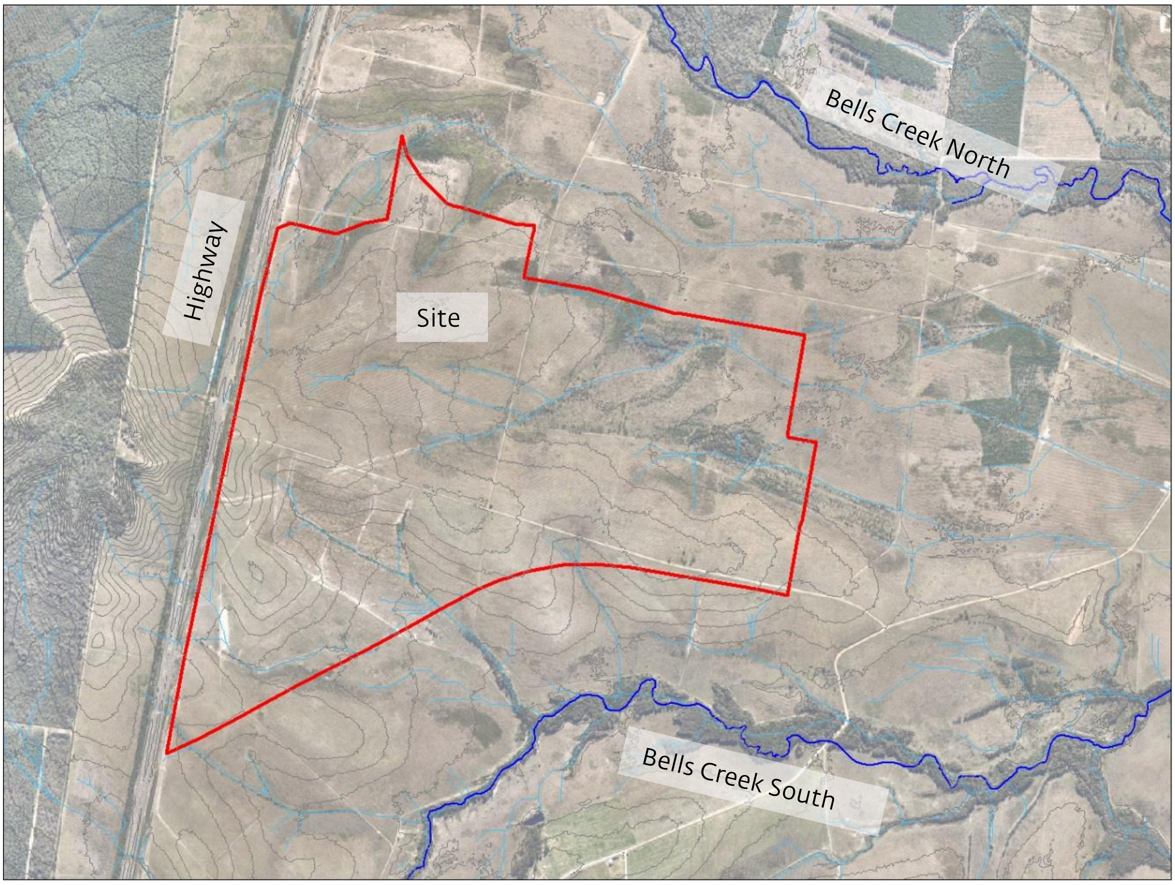



Figure 3 Existing land use, topography and drainage

The site drains in three general directions. A small portion of the site, in the far north west, drains north towards the floodplain of Bells Creek North. About half the site drains internally to a series of farm drains which drain east through Precincts 6-10 which is current being developed. The other half of the site drains southwards directly to Bells Creek South.

Planned earthworks as part of Aura will include reshaping the central portion of the site to create a waterway called The Brook that will flow east and then southwards and into Bells Creek South. The constructed waterway leading to Bells Creek South is planned to have levels of RL 8-10m AHD in the west and RL 3.0 m in the south.

Using this information in the development of the stormwater treatment strategy a catchment plan was developed.

## 2.2 Bells Creek North and South

Bells Creek North and Bells Creek South (tributaries of Bells Creek) have been modified previous but have regrown to healthy waterways that support a range of wetland and riparian flora (see photo below). The condition of the creeks, including water quality, has been extensively monitored and presented in other reports and is not covered here.

The total catchment of Bells Creek including the Aura development is 4,630ha. Precinct 11-14 and the surrounding catchments are approximately 349.9ha of this catchment (this represents 7.6% of the total Bells Creek catchment) with development application area Precinct 11-14 being 262ha. The context of Precincts 11-14 in the wider Bells Creek catchment is shown in Figure 4.

Protection of Bells Creek and the downstream Pumicestone Passage are a critical component of the Aura development and stormwater runoff from the whole area is required to meet a general "no worsening" water quality concentration condition in

Pumicestone Passage. This is discussed further with regard to the stormwater treatment objectives (Section 3).

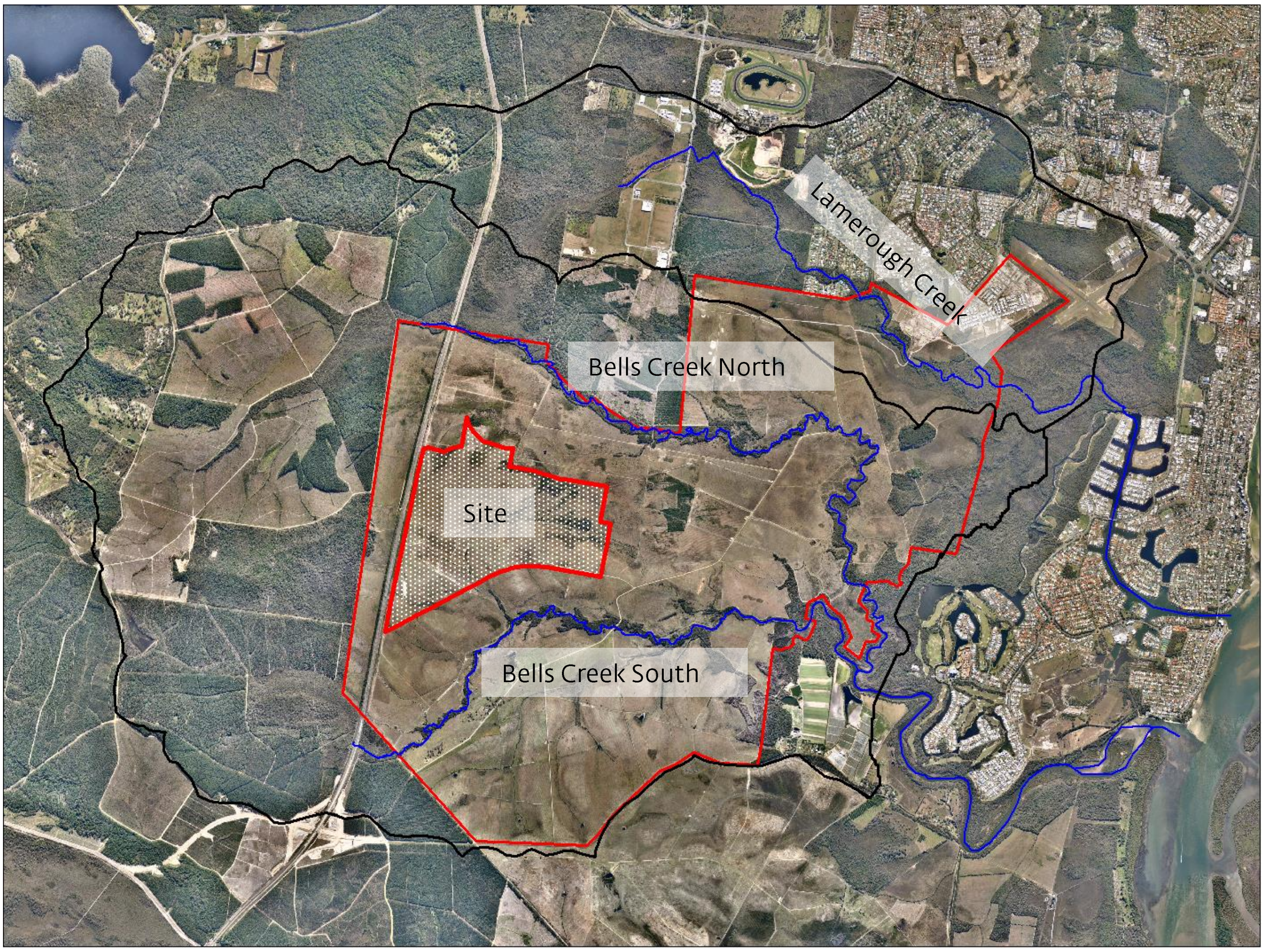



Figure 4 Bells Creek Catchment

## 2.3 Frog habitat

Frog habitat has been identified across the Aura development for the following frogs which have federal or state significance:

- Wallum Sedgefrog
- Wallum Froglet
- Wallum Rocket Frog.

Management of the Wallum Sedgefrog is to occur in accordance with the approved *Caloundra South Wallum Sedge Frog Management Plan*. Some Sedgefrog habitat areas within the development footprint will be removed and compensatory Sedgefrog habitat areas recreated within the Aura development site (typically within frog zones and buffers as per Section 2.4).

The Wallum Froglet and Wallum Rocket Frog will be managed in accordance with the *Caloundra South Acid Frog Management Plan*, the requirements of which are very similar to the Wallum Sedgefrog outlined above.

## 2.4 Waterway and frog buffers

To preserve and enhance the riparian function of Bells Creek and meet the requirements of the *Caloundra South Wallum Sedge Frog Management Plan* and *Caloundra South Acid Frog Management Plan*, the development edges in Precincts 11-14 are required to incorporate the following:

- 25m wide riparian buffers from top of waterway banks (for preservation and rehabilitation of riparian vegetation)
- 50m width Frog Zone (for creation of Wallum Frog habitat)
- 50m Frog Buffer (buffer to the Frog Zone and additional space for creation of Wallum Frog Habitat).

The Frog Buffer can incorporate some stormwater management as per *Caloundra South Wallum Sedge Frog Management Plan* and details of permitted encroachment into the frog buffer is described in Section 5.3.4.

# 3 Stormwater Treatment Objectives

There are several fundamental drivers for managing stormwater quality from Aura.

The adjacent sections of Pumicestone Passage which receive runoff from the site have been defined as having High Ecological Value (HEV) status in the *Environmental Protection Policy (EPP) – Water* (2009). Water quality objectives that accompany HEV status are of the nature of 'no worsening', but more specifically are quantified as maintaining existing water quality (20th, 50th and 80th percentiles) in the receiving waterway (Department of Environment and Heritage Protection).

Pumicestone Passage and the estuarine sections of Bells Creek have also been defined as having Ramsar wetland status. The associated significance criteria which accompany this designation include:

- Areas of the wetland being destroyed or substantially modified
- A substantial and measurable change in the hydrological regime of the wetland (e.g. volume, timing, duration and frequency of surface and groundwater flows)
- The habitat or lifecycle of native species being seriously affected
- A substantial and measurable change in the water quality of the wetland that may adversely impact on biodiversity, ecological integrity, social amenity or human health
- An invasive species that is harmful to the ecological character of the wetland becoming established, or an existing invasive species spreading.

With such significant high value environmental areas downstream of Aura, considerable investigation and planning has gone into protecting these areas from the impacts of urbanisation as outlined in a range of previous reports (not reproduced here). These reports have attempted to establish load base stormwater quality design objectives which will ensure the 'no worsening' receiving water quality requirement is achieved.

Objectives that are applied to Precincts 11-14 are based on recent catchment and waterway modelling completed for the Bells Creek catchment and Aura development site presented in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). The stormwater load based reduction targets are presented in Table 1. These exceed *State Planning Policy* requirements, reflecting the significance of the receiving waters.

Table 1: Stormwater quality design objectives

| Pollutant | Objective - Minimum reduction in mean annual load from unmitigated development |
|---|---|
| Total Suspended Solids | 95% |
| Total Phosphorus | 89% |
| Total Nitrogen | 68% |
| Gross Pollutants | 90% |

# 4 Stormwater Quality Management Strategy

This section provides an overview of the stormwater strategy and describes the treatment systems proposed for Precincts 11-14.

## 4.1 Design principles

To develop a robust stormwater treatment strategy, a number of principles were applied for managing stormwater quality. These include:

1. Flexibility – The stormwater treatment strategy will have flexibility and redundancy to allow adjustment in response to site constraints and issues identified as part of future design. This allows the design to be modified during detailed design if an unforeseen constraint is identified.
2. Avoid double treating – As much as practically possible, stormwater that has been "treated" in a wetland or bioretention system should not flow into a downstream treatment, but rather be discharged to the receiving waterway.
3. Identify end-of-line treatment opportunities – Explore all "end-of-pipe" treatment systems. Treatment systems are located along the southern perimeter of the development and need to work within the constraints of areas for frog habitat, buffer and existing Bells Creek North levels. This approach reduces the number of treatment devices needing maintenance and increases opportunities for adaptive management.
4. At-source treatments – At-source biopods (bioretention) are proposed for residential streets. These systems are proposed to provide stormwater treatment, improve street greening and also to provide a barrier for any spillages along the roads.
5. Frogs – Ensure the requirements of the *Caloundra South Wallum Sedge Frog Management Plan* and *Caloundra South Acid Frog Management Plan* are achieved.
6. Match catchments, levels and drainage to end-of line treatments– Consideration of slopes, drainage and earthworks requirements to ensure the correct catchment areas were drained to spaces that allowed suitably sited treatment system and also drainage can occur to these system to allow proper drainage into the creek or waterway following treatment.

## 4.2 Stormwater treatment strategy

A concept layout for the stormwater treatment strategy for the site is presented in Figure 5. It shows how stormwater is directed to Bells Creek North and Bells Creek South via tanks, biopods, wetlands, bioretention and swale or vegetated waterways.

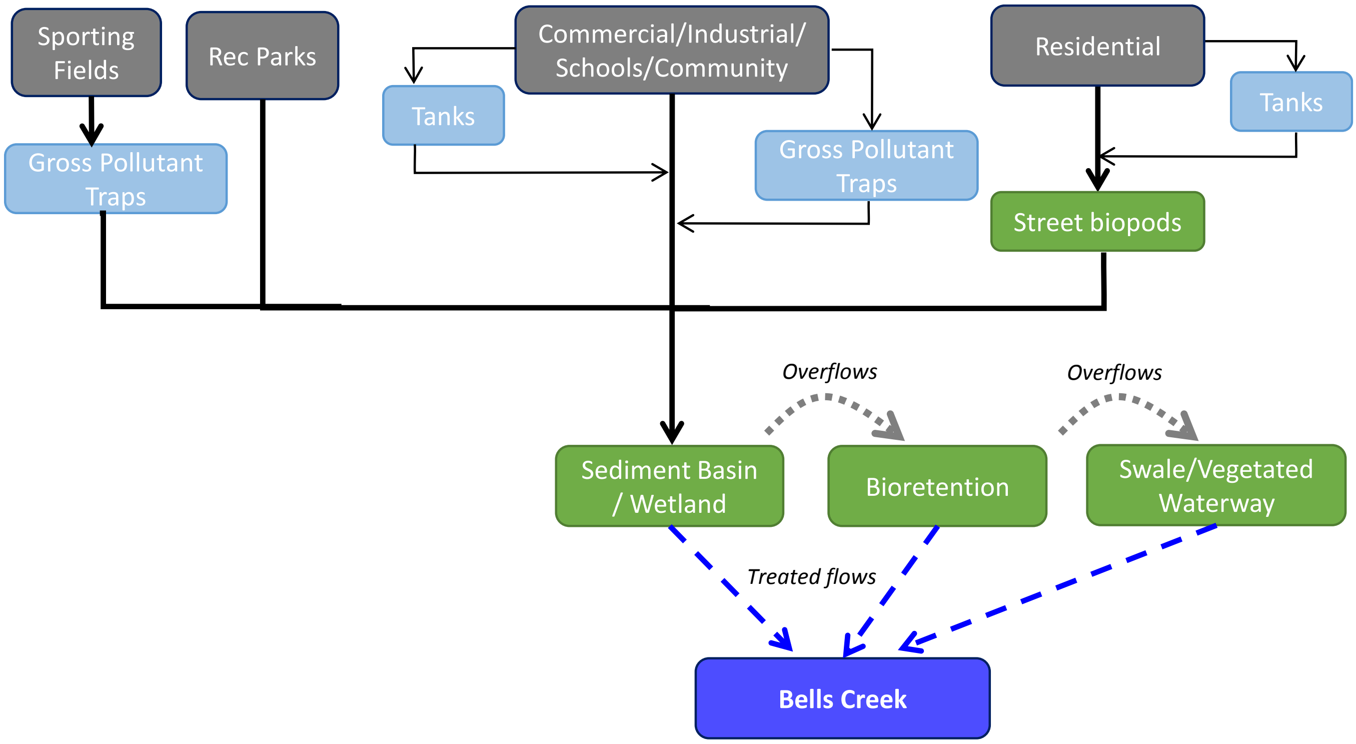



Figure 5 Stormwater treatment train flow diagram

The strategy adopts a similar approach to that taken in previous precincts of Aura. The same suite of stormwater treatment measures are used (i.e. rainwater tanks, gross pollutant traps, biopods, end-of-line bioretention and wetland systems and vegetated swales in various forms). For Precincts 11-14 treatment measures have been applied responding to proposed land uses and the constraints of the site while providing flexibility to achieve the stormwater quality objectives.

The stormwater treatment strategy includes:

1. **Tanks** are included in the strategy and will provide a water conservation function. The tanks are to be placed on residential, commercial, community and school lots and plumbed for toilets and outdoor uses. These also contribute to Aura's water conservation initiatives.
2. **Biopods** (for residential roads) will treat flows in the streets and will be installed to treat at least 30% of the residential areas. They are sized to be approximately 1.0 % of their contributing catchment areas.
3. **Gross pollutant traps** on lots for landuses which generate high volumes of litter (i.e. commercial, industrial, school, community facilities, child car and sporting ovals)
4. **End-of-line treatment systems** (i.e. combined sediment basins, wetlands and bioretention systems) have been sized to achieve the stormwater quality objectives in combination with upstream treatments. Based on concept layouts there is suitable space having given consideration to other land requirements (e.g. frog zones).
5. **A vegetated waterway** called "The Brook" will collect and convey flows from the area of the site flow south and convey water to Bells Creek South. The waterway will provide additional treatment of moderate to high flows.

Figure 6 presents the proposed catchment areas draining to the treatments and Figure 7 shows a summary of the overall treatment strategy, including the location and sizes of the end-of line treatment systems. The exact location for biopods (for allotments and roads) will be developed in further design. Design principles for biopods are described in Section 5.

Table 2 presents catchment and treatment size details for the proposed end of line treatment systems.

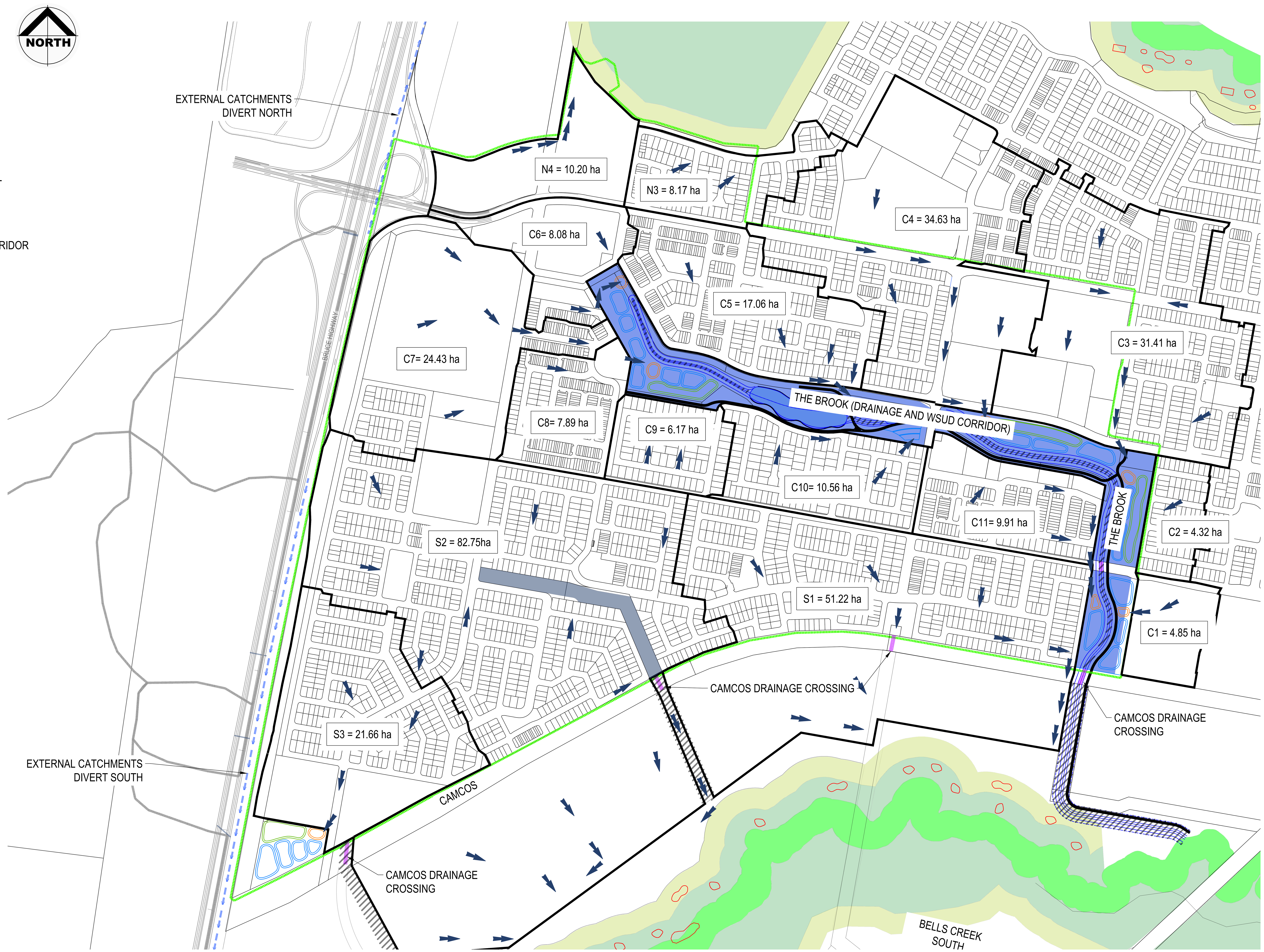
Note the sizes nominated in Table 2 for treatment areas are the wet areas of sediment basins, wetlands (i.e. normal water level) and the filter area surfaces of biopods and bioretention basins. They do not include land for required batters, access tracks etc. Total land requirements have been considered carefully when developing the concept layouts and development layout for Precinct 11-14. Refinement of the designs will occur through detailed as the catchments and earthworks of the development are developed.

Table 2 Stormwater catchments and treatment system areas for Precincts 11 - 14

| Catchment ID | Area | Inlet Pond | | Wetland | Bioretention |
|---|---|---|---|---|---|
| | (ha) | Volume (m3) | Area (m2) | (m2) | (m2) |
| N3 | 8.17 | 300 | 300 | | 2200 |
| N4 | 10.2 | 300 | 300 | | 2500 |
| C1 | 4.85 | 300 | 300 | | 2275 |
| C2 | 4.32 | | | | |
| C3 | 31.41 | 750 | 500 | 3700 | 5500 |
| C4 | 34.63 | 1125 | 750 | 4380 | 5500 |
| C5 | 17.06 | 750 | 500 | | 3675 |
| C6 | 8.08 | 300 | 300 | | 2200 |
| C7 | 24.43 | 600 | 900 | 2810 | 6500 |
| C8 | 7.89 | | | | |
| C9 | 6.17 | | | | |
| C10 | 10.56 | | | | 2275 |
| C11 | 9.91 | 300 | 300 | | 2200 |
| S1 | 51.22 | 1920 | 1280 | 6200 | 10000 |
| S2 | 82.75 | 2325 | 1550 | 10500 | 16000 |
| S3 | 21.66 | 900 | 600 | 3300 | 5200 |
| | | | | | |
| Total | 333.3 | 9870 | 7580 | 30890 | 66025 |

**LEGEND**

- PROPOSED STORMWATER CATCHMENT
- PROPOSED DRAINAGE STRUCTURE
- CATCHMENT FLOW DIRECTION
- PROPOSED WSUD AND DRAINAGE CORRIDOR
- PROPOSED DRAINAGE CHANNEL
- FROG PONDS
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- SITE BOUNDARY




## PROPOSED CATCHMENTS

SCALE 1:5000

SCALE 1:5000 @ A1
(1:10000 @ A3)

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| REVISION | DESCRIPTION | DRAFTED BY INITS | DRAFTED BY DATE | CHECKED BY INITS | CHECKED BY DATE |
|---|---|---|---|---|---|
| C | CATCHMENTS UPDATED | MJM | 16.07.20 | SL | 16.07.20 |
| B | PLAN UPDATED | MJM | 29.07.19 | SL | 29.07.19 |
| A | PRELIMINARY ISSUE | MJM | 09.11.18 | SL | 09.11.18 |

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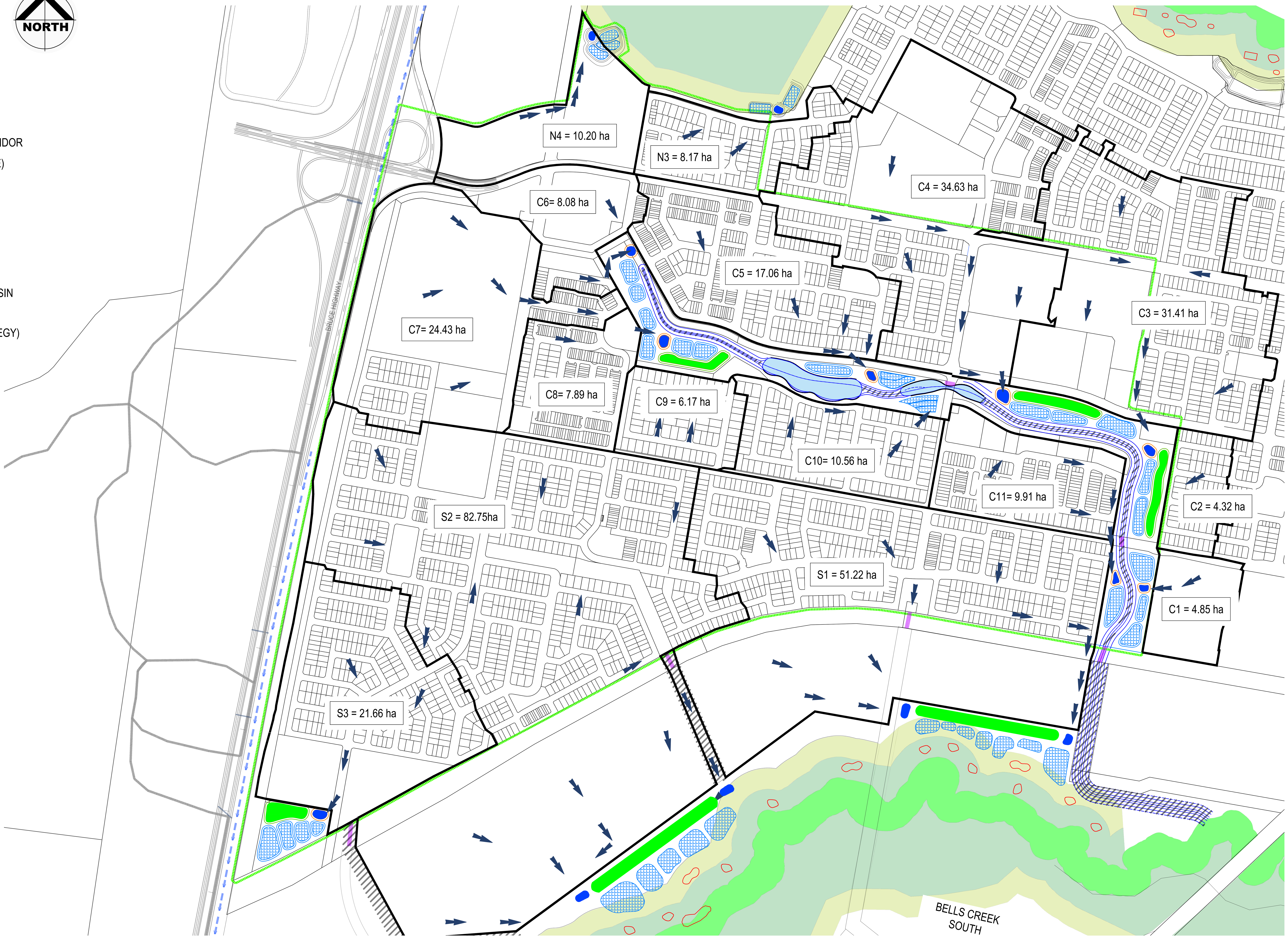
| CLIENT | STOCKLAND |
| DRAWN | MJM — DATE 16.07.20 |
| DESIGNED | SL — DATE 16.07.20 |
| SCALE | 1:5000 — A1 |
| PROJECT | AURA - STORMWATER PLANNING |
| DRAWING TITLE | PROPOSED CATCHMENTS FOR TREATMENT IN PRECINCTS 11-14 |
| PROJECT No | 4344 |
| DRAWING No | FIGURE 6 |
| REVISION | C |

XREF:
FILE: \\192.168.4.3\SHARED\PROJECTS\QLD ACTIVE\4344 AURA PRECINCT 11-15\CORRESPONDENCE\SIMON YOUNG\2019-08-01 SQMP FIGURES\4344-FIGURE 6 & 7.DWG

NORTH

**LEGEND**

- PROPOSED STORMWATER CATCHMENT
- PROPOSED DRAINAGE STRUCTURE
- CATCHMENT FLOW DIRECTION
- PROPOSED WSUD AND DRAINAGE CORRIDOR
- PROPOSED DRAINAGE CHANNEL (SWALE)
- FROG PONDS
- RIPARIAN BUFFER ZONE
- FROG ZONE
- FROG BUFFER
- SITE BOUNDARY
- END OF LINE STORMWATER QUALITY BASIN
- LAKE (NOT PART OF TREATMENT STRATEGY)
- INLET POND (SEDIMENT BASIN)
- WETLAND
- BIORETENTION




## CONCEPTUAL STORMWATER TREATMENT STRATEGY

SCALE 1:5000

SCALE 1:5000 @ A1 (1:10000 @ A3)

0 100 200 300 400 500m

| REVISION | DESCRIPTION | DRAFTED BY INITS | DRAFTED BY DATE | CHECKED BY INITS | CHECKED BY DATE |
|---|---|---|---|---|---|
| C | CATCHMENTS UPDATED | MJM | 16.07.20 | SL | 16.07.20 |
| B | PLAN UPDATED | MJM | 29.07.19 | SL | 29.07.19 |
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| DESIGNED | SL — DATE 16.07.20 |
| SCALE | 1:5000 — A1 |
| PROJECT | AURA - STORMWATER PLANNING |
| DRAWING TITLE | CONCEPTUAL STORMWATER TREATMENT STRATEGY FOR PRECINCTS 11-14 |
| PROJECT No | 4344 |
| DRAWING No | FIGURE 7 |
| REVISION | C |

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FILE: \\192.168.4.3\SHARED\PROJECTS\QLD ACTIVE\4344 AURA PRECINCT 11-15\CORRESPONDENCE\SIMON YOUNG\2019-08-01 SQMP FIGURES\4344-FIGURE 6 & 7.DWG

## 4.3 Stormwater treatment measures

The table below briefly describes the stormwater treatments measures adopted for Precincts 11-14. Many have been applied to other precincts of the Aura development.

Table 3 Summary of Stormwater Treatment Measures for Precincts 11 - 14

| Measure | Description |
|---|---|
| **Rainwater Tanks** | As part of Stockland's water conservation policy and to reduce the volumes of stormwater requiring treatment, rainwater tanks are proposed for residential, commercial, industrial, community and school land uses. Water from the tanks is to be plumbed for toilet, cold laundry tap, outdoor uses and suitable non-potable demands. While the tanks serve an important water conservation role they also act to reduce the volume of stormwater (and associated pollutants) from reaching downstream waterways. Section 5.1 outlines the proposed tank implementation for Precincts 11-14. |
| **Gross Pollutant Traps (Commercial and Industrial Lots only)** | Commercial, industrial, school, child care, community and sporting parks are a significant source of litter and sometimes sediment at ground level. Runoff from the ground level area on these landuses will pass through gross pollutant traps prior to discharging from the lot. The GPTs will focus on litter and coarse sediment. The GPTs will be owned and managed by the lot owners other than for sporting parks where the GPTs will be owned and managed by Council.<br><br>GPTs have not be included in the MUSIC model as the focus of these in Precinct 11-14 is litter and coarse sediment. |
| **Biopods (Streetscape raingardens)** | Biopods (referred to as streetscape raingardens in previous stormwater strategies) have formed an important part of the stormwater strategy for the Aura site and have been implemented as part of earlier development precincts. The systems work by receiving runoff from the kerb in set down areas in the road verge. Stormwater then percolates through a vegetated soil matrix that promotes fine filtration and biological uptake of pollutants. Treated water is collected at the base and discharged in to the stormwater system.<br><br>The street biopods are proposed to cover approximately 30% of the residential catchment areas. They are assumed to have an average 100-200mm ponding depth.<br><br>Biopods are proposed for the roads in the residential area, they have not been included in the MUSIC modelling assessment of treatment performance (Section 6) because it is not known exactly where they will be located. They will provide additional treatment to that predicted by the MUSIC modelling. |
| **Constructed Wetlands** | Constructed wetlands are proposed to manage stormwater from the larger catchments in Precincts 11-14. The wetlands will receive flows from the drainage network hold water for treatment for approximately 2 days with overflows being transferred to adjacent bioretention basins.<br><br>Constructed wetland systems are shallow extensively vegetated water bodies that use enhanced sedimentation, fine filtration and pollutant uptake processes to remove pollutants from stormwater. Water levels rise during rainfall events (by up to 350mm) and outlets are configured to slowly release flows, typically over two to three days, back to dry weather water levels. Wetlands consist of an inlet zone (sediment basin to remove coarse sediments), a macrophyte zone (a shallow heavily vegetated area to remove fine particulates and facilitate the uptake of soluble pollutants) and a high flow bypass (to protect the macrophyte zone).<br><br>The proposed operation of the wetlands and interaction with the subsequent bioretention |

| Measure | Description |
|---|---|
| | basins is described in Section 5.3. Treated flows from the wetlands will be discharged to either Bells Creek North or South. Overflows from the wetland will enter bioretention basins located immediately around the wetland perimeter to receive further treatment. During large events, overflows from the inlet pond will drain via overflow swales.<br><br>The wetlands will all be designed in accordance with *the WSUD Technical Design Guidelines for SEQ* (Water by Design). |
| **Bioretention Basins** | Bioretention basins are proposed to receive stormwater that overflows from the wetlands as part of the end-of-line treatment systems. There are a number of advantages in considering the bioretention systems in this manner:<br><br>• bioretention systems accept untreated stormwater thus avoiding double treating stormwater<br>• bioretention systems do not receive regular "trickle' flows (that can cause algal growth and block their surface)<br>• minimises the hydraulic head required to operate the wetland and bioretention treatment combination and minimises the level the development pad is required to be lifted to enable free draining treatment systems<br>• by combining the active storages of the wetlands and bioretention, much more water can be treated through the bioretention because of the relatively large areas of the wetlands and the faster treatment rates of bioretention. In this way, less water overflows the overall treatment systems.<br><br>Treated flow that collects in the underdrainage pipes will combine with treated water from the wetlands and discharge into Bells Creek North or the waterway leading to Bells Creek South.<br><br>Design of the bioretention systems will occur in accordance with *Bioretention Technical Design Guideline* (Water by Design). |
| **The Brook Vegetated Channel**<br><br>**and**<br><br>**Overflow Swales** | Within The Brook, all flows from the wetlands and bioretention systems will enter this vegetated channel. For treatment flows, no further treatment will occur. For the occasional 'overflows' which are not fully treated in the wetland and bioretention systems, additional treatment will occur in The Brook will flowing to the outlet at Bells Creek South.<br><br>In other locations outside of The Brook, Overflows (i.e. high flow bypass flows) from the wetland and bioretention systems will be directed to wide shallow vegetated areas that will convey flows downstream. The areas will act to filter the overflows and slow flows down before entering the creek.<br><br>The systems will essentially act like occasional flowing wide swales. |

## 4.4 The Brook

Most of Precincts 11-14 will drain internally via a large create drainage corridor called The Brook. The Brook forms a significant landscape feature within the urban design for Precincts 11-14 and will provide a number of functions including but not limited to the following:

- Parklands
- Pedestrian connectivity
- Visual amenity
- Stormwater treatment
- Flood conveyance
- Urban ecology

Significant conceptual design has occurred to define the landscape character of the difference sections of The Brook and integrate the stormwater management, earthworks (3D surface design), flood conveyance and parkland functions. Suitable space has been allowed in the design for all these features as well as transitions between these features. The landscape conceptual design for The Brook is presented in *Aura Precinct 11-14 Landscape Master Plan Report* (Urbis, 2020) and the conceptual earthworks presented in *Engineering Services Report Aura Precincts 11 (Part), 12 (Parts), 13 (Part) and 14* (Calibre, 2020).

In terms of stormwater management, a range of sediment basins, wetlands and bioretention basins are proposed throughout The Brook. The location of these has been carefully considered to match the incoming catchments. The Brook drainage swale will provide stormwater treatment of moderate to large storm events which exceed the capacity of the sediment basins, wetlands and bioretention basins.

As shown in Figure 8, lakes are proposed in the central part of The Brook. The design and delivery of these lakes will be consistent with the *Caloundra South Infrastructure Agreement*. The lakes do not form part of the stormwater treatment strategy presented in this report. All stormwater will be treated prior to entering the lakes.

Figure 8  The Brook Landscape Masterplan

# 5 Design Principles

## 5.1 Rainwater Tanks

Rainwater tanks are an important part of Stockland's water conservation and stormwater management strategy for Aura. Table 4 summaries the proposed tank approach for Precincts 11-14 which is consistent with the tank approach outlined in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019). These have been written into the Plan of Development for Precincts 11-14 to ensure compliance with this Stormwater Quality Management Plan.

Table 4: Rainwater tank approach for Precinct 11-14

| Landuse | Roof Area | Tank size (minimum) | Tank Connections / Fixtures / Uses |
|---|---|---|---|
| **Residential** - Detached/attached dwellings (Lot >300m²) | 50% roof area <u>must</u> connect / drain to tank | 5kL per dwelling | Tanks <u>must</u> be connected to and supply water to all of the following:<br>• Toilets (all toilets)<br>• Laundry cold (all cold taps in laundry)<br>• Outdoor taps (all outdoor taps) |
| **Residential** - Detached/attached dwellings (Lot = 225-300m²) | 50% roof <u>must</u> connect / drain to tank | 3kL per dwelling | Tanks <u>must</u> be connected to and supply water to all of the following:<br>• Toilets (all toilets)<br>• Laundry cold (all taps in laundry)<br>• Outdoor taps (all outdoor taps) |
| **Residential** - Detached/attached dwellings (Lot <225m²) | No tanks | | |
| **Residential** - Medium density dwellings | 75% roof <u>must</u> connect / drain to tank<br><br>If multiple buildings then 50% of total roof area must connect / drain to tank | 1kL per dwelling | Tanks <u>must</u> be connected to and supply water to all of the following:<br>• Toilets (all toilets)<br>• Laundry cold (all taps in laundry)<br>• Outdoor taps (all outdoor taps) |
| **All non-residential uses** including but not limited to:<br>• Commercial<br>• Retail<br>• Industrial<br>• School<br>• Community | 50% roof <u>must</u> connect / drain to tank<br><br>If multiple buildings then 50% of total roof area must connect / drain to tank | 1KL per toilet or urinal or 25kL/ha Minimum 5 KL size | Tanks <u>must</u> be connected to and supply water to all non-potable uses and fixtures including but not limited to:<br>• Toilets (all toilets)<br>• Urinals (all urinals)<br>• Laundry cold (all taps in laundry)<br>• Outdoor taps (all outdoor taps) |

## 5.2 Streetscape bioretention

Biopods are to be used in approximately 30% of the residential areas across Precincts 11 - 14. The biopods will be located within the residential streets, receive water flowing along kerns and be set down in the verges. They are size to be typically 1% of their contributing catchment area and have 100-200mm ponding depths.

The detailed design for each biopod will be developed during further stages of design. Stockland has extensive experience on other Precincts of Aura in delivering biopods in different locations. While the particular aspects of the biopods will differ between the locations the operating principles are all similar and council's requirements will be accommodated.

Important design considerations will include:

- Biopod filter media set back a minimum of 1m from the back of kerb.
- Biopod filter media minimum width of 1.0m
- Batters of 1 in 2 or flatter
- Avoid safety fencing and pedestrian trip hazards
- No conflict with services other than sewer which may pass under a biopod, with correct protection.
- Consider one-way cross-fall pavement for streets
- Locate biopods to avoid driveways and parking areas
- Ensure sufficient traffic barriers to prevent vehicle entry into biopods
- Moving pedestrian pathways and non-compatible services to the opposite verge from the biopod to create space where required.

There are many variations of biopod designs but the proposal for Precincts 11-14 will be to create systems similar to other areas of Aura so that maintenance can be streamlined. An example biopod is provided in the photo below.


Photo: Example of biopod (Aura Precinct 2)

## 5.3 Wetland and Bioretention System Concept Designs

Concept designs for the end-of-line treatment systems (i.e. constructed wetlands, bioretention basins and overflow swales) involved a number of steps:

1. Resolving the function of the treatment systems (i.e. how they interact hydraulically to maximize treatment performance)
2. Identifying available space for treatment adjacent to Bells Creek North and accommodating the required buffers and finding sufficient space within the proposed waterway flowing to the south
3. Ensuring there is sufficient space for the contributing catchments
4. Completing MUSIC modelling to confirm treatment performance
5. Completing survey of creek levels (top of bank and standing water level)
6. Defining operating levels in the wetlands and bioretention systems (using discharge levels into the creek)
7. Optimising the drainage levels and associated earthworks in the development.

The following sections summarise the considerations and findings of this process.

### 5.3.1 Treatment system operation

The wetland and bioretention treatment systems receive flows from drainage pipes throughout the development (Figure 7). As flow enters the treatment systems it follows the sequence below (refer to Figure 9):

- Inlet pond - Flows from pipes enter an inlet pond where coarse sediment will settle out and low flows will pass via a pit/pipe system to the wetland.
- Wetland - Flows enter the macrophyte zone of a wetland for treatment. The wetland will treat base flows and small storm events with treated flows discharging directly downstream to Bells Creek or the constructed waterway ("The Brook"). Wetlands will typically have a 48-72hr notional detention time and a maximum depth of 350mm above normal water level (when bioretention is engaged as well).
- Bioretention – During rainfall events, the wetlands begin to fill and as water levels increase by more than 50-100mm they will overtop weirs into adjacent bioretention basins. As flow increases water ponds over the bioretention by up to 300mm. The ponded water is combined with that over the wetland. As a storm ends, water then flows through the bioretention media (the majority) and through the wetland outlet. Treated flows from the bioretention basins will be discharged to Bells Creek North or the constructed waterway in the south. Bioretention basins are divided into "cells" to provide management flexibility, promote better flow spreading and allow easier construction and maintenance.
- Overflow swales – The vast majority of stormwater will pass through the wetland and bioretention system to achieve the performance objectives listed in Section 3. Large storm events will overflow a weir in the inlet pond and pass through an overflow swale which will be vegetated. The swale will promote sedimentation and filtration of sediment and particulate phosphorus and discharge large flow events to the creek.

The design of the treatment systems in The Brook has undergone a conceptual design process to locate and size the systems in relation to the catchments and define design levels to ensure hydraulic function. Conceptual earthworks and cross sections of The Brook including the treatment systems and drainage are provided in *Engineering Services Report Aura Precincts 11 (Part), 12 (Part), 13 (Part) and 14* (Calibre, 2019).

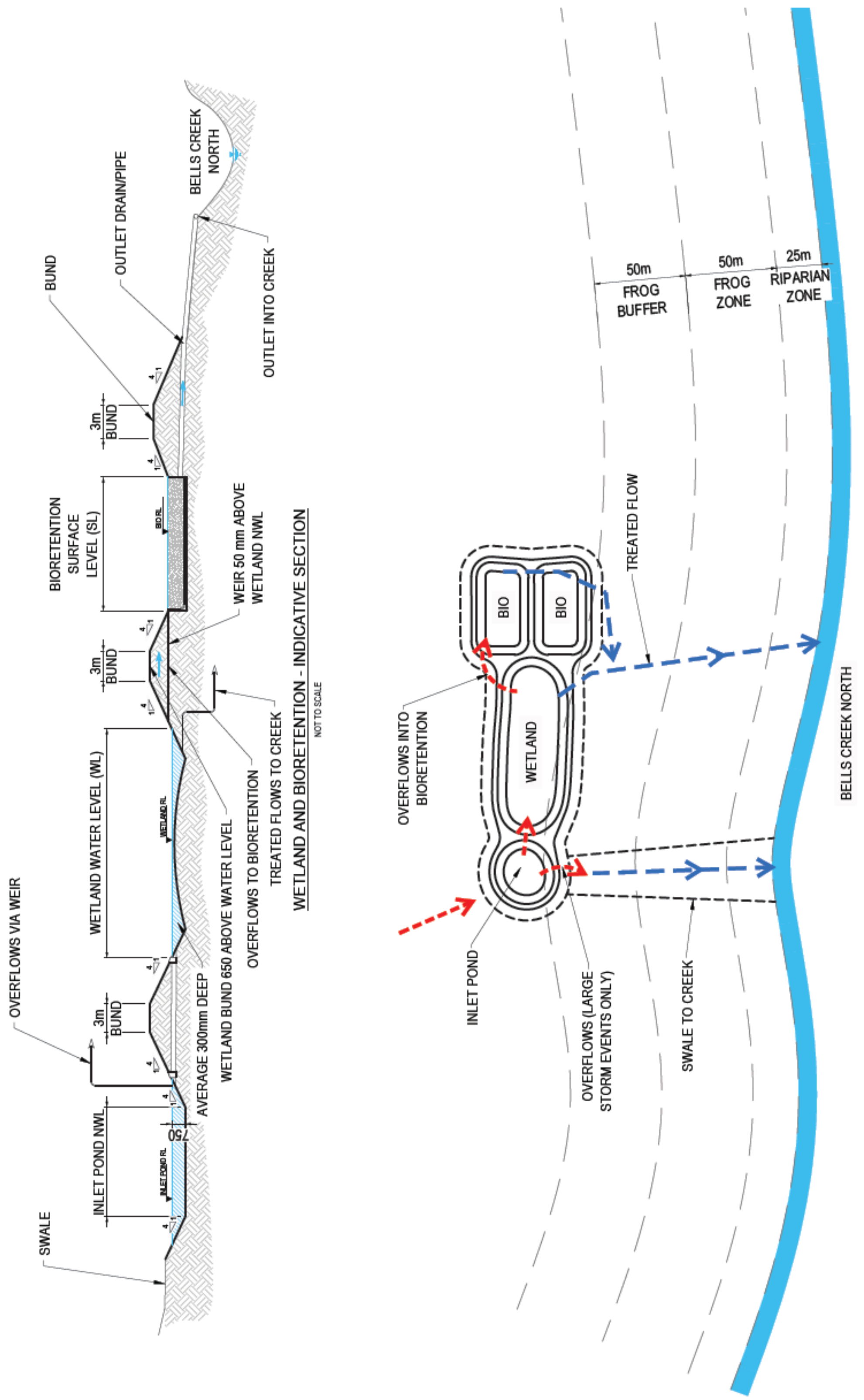


Figure 9 Function and operating levels wetland and bioretention treatment systems

### 5.3.2 Operating levels

A critical consideration of the end-of-line treatment systems is the operating levels and how the systems will discharge into Bells Creek. Figure 9 provides a conceptual cross section through the wetlands and bioretention systems to illustrate how water will move through the systems and drain freely into the adjacent creek.

It shows there is 1-0-1.5m between the outfall levels in the creek / constructed waterway to the swale invert entering the wetlands. Survey of the creek standing water level and top of bank was completed as part of the conceptual design to define outfall levels, which have been set above the standing water and low flow levels in the creek.

### 5.3.3 Location and size

The end-of-line inlet ponds (sediment basins), wetlands and bioretention systems have been carefully located considering the constraints including:

- Existing Wallum Sedgefrog habitat (no stormwater management allowed)
- Riparian buffer of 25m (no stormwater management allowed)
- Frog zone of 50m (no stormwater management allowed)
- Frog buffer of 50m (stormwater management allowed) following appropriate criteria (Section 5.3.4)
- Existing vegetation
- Existing drainage
- Interaction with The Brook and surrounding development edges to ensure there is space for the treatment systems
- Flood immunity requirements
- Parkland, following appropriate criteria (Section 5.3.5)
- Suitable discharge points for treated stormwater.

Sufficient space for the treatment areas as well as batters and access tracks etc. have been provided.

### 5.3.4 Frog buffer considerations

Stormwater treatment systems are to be located in parts of the frog buffer ensuring the following criteria are met (developed in consultation with Australian Wetlands Consulting):

1. No more than 40% of the Frog Buffer can be used for stormwater management devices, including drainage channels. Stormwater management devices must be placed uniformly along the length of the Frog Buffer to ensure no restriction to the overall connectivity of Wallum Sedgefrog (WSF) habitat within the Frog Zone and Frog Buffer.
2. Where stormwater management is located within the Frog Buffer, an average minimum set back of 20m is required between all the edges of each stormwater management measure and the Frog Zone boundary. This set back distance does not apply to stormwater outlet drainage channels.

3. The stormwater management measures must be set back 30m from the create Frog Ponds within the Frog Zone and Frog Buffer. Drainage channels and swales from the stormwater management measures to the creek can be closer than 30m.
4. The final locations of the stormwater management devices will be determined during detailed design. The location will consider the proposed WSF breeding ponds, foraging habitat and overall habitat connectivity to ensure compliance with Key Performance Criteria 5, listed in Table 6.2a within the *Wallum Sedgefrog Management Plan* and Table 8.2a within the *Acid Frog Management Plan*.

### 5.3.5 Parklands considerations

Stormwater treatment systems have been placed in parklands in accordance with the *Caloundra South Infrastructure Agreement*:

1. Land provided for stormwater treatment facilities for the park are to have a minimal impact on the park's functionality.
2. Max. 5% of total park area for stormwater treatment
3. Where possible, stormwater treatment facilities are to be integrated with planting areas and form part of the overall vegetated area.
4. 30% of the parkland area can be below the 5yr ARI
5. Max grade 1:4, 1:6 preferred for maintenance requirements.

### 5.3.6 End-of-line concept designs

Proposed sizes, shapes and configurations for wetland and bioretention systems were resolved by considering available areas for the treatment systems, catchments, required treatment areas and surveyed outfall levels. The operational principles as shown in Figure 9 were applied to develop the concepts.

High level concept designs have been developed for all the end of line stormwater treatment systems to ensure there is enough space within the development layout. In particular, extensive refinement of the concept designs has been developed for the systems located in the centre of Precincts 11-14 along The Brook drainage corridor. Council earthworks design has been developed for these systems and the drainage corridor to define the edge of development.

The conceptual design outcomes are reflected in the stormwater treatment locations and shapes presented in Figure 7. The stormwater treatment systems have been drawn to scale on this plan to match the areas defined in Table 2

The size and location of the stormwater treatment systems will 'evolve' in response to catchment changes or other constraints as part of design development and detailed design. There is sufficient redundancy and flexibility in the proposed designs to accommodate minor changes. On the basis of these concept designs, there is a high level of certainty that the proposed treatment strategy is feasible and can be implemented without changing the development layout. If there is a need to change the layout to allow for the stormwater strategy this will occur as part of future development approval variations.

# 6 Performance Assessment (MUSIC modelling)

## 6.1 MUSIC modelling approach

MUSIC modelling was undertaken to quantitatively assess the performance of the proposed stormwater strategy. MUSIC version 6.3 was used for the assessment and the parameters have been established in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010).

### 6.1.1 Model structure

The Precincts 11-12 (Part) MUSIC model layout is shown in Figure 10. Details of the modelling assumptions, parameters and results are provided below.

Table 5 provides a summary of the meteorological data on which the model is based.

**Table 5 Meteorological and rainfall runoff data**

| Input | Data used in modelling |
|---|---|
| Rainfall station | 40496 Caloundra |
| Time step | 6 minute |
| Modelling period | 1997 – 2007 |
| Mean annual rainfall | 1,348 mm (for the period used) |
| Mean annual evapotranspiration | 1,628 mm |
| Rainfall runoff parameters | Per SEQ MUSIC Guidelines |
| Pollutant export parameters | Per SEQ MUSIC Guidelines |

### 6.1.2 Catchments

The stormwater catchments presented in Figure 6 were used and the various land uses (residential, commercial or parkland) within these catchments were measured. The model uses split land uses, so that particular areas could be directed to treatment while others may bypass (for example, roof runoff can be directed to tanks).

The overall catchment areas Figure 7 and details of the split catchments are shown in Table 6.

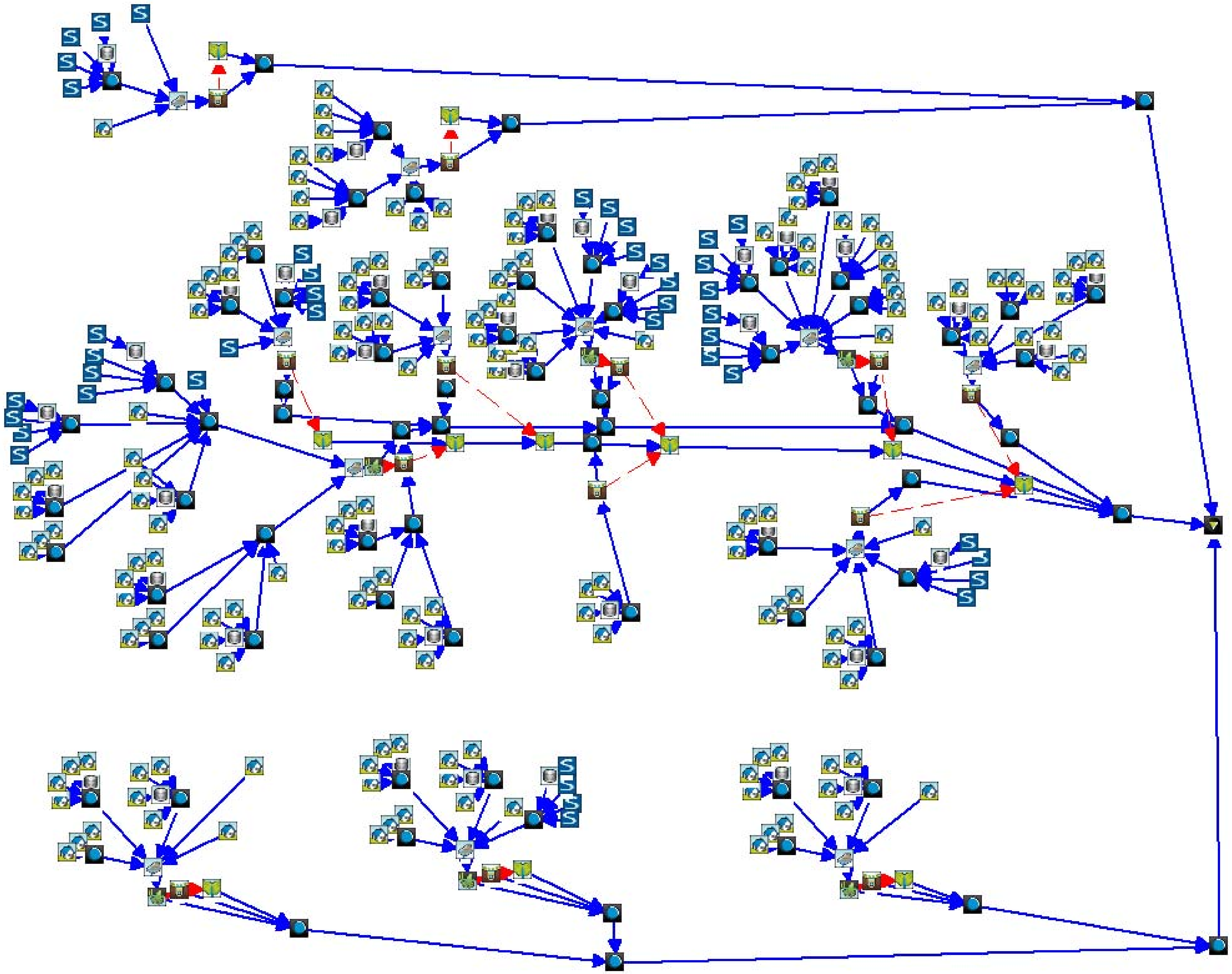

Figure 10 Precincts 11-14 MUSIC model layout

Table 6 Catchment land use area details

| Catchment ID | Residential >300m² | Residential 225-300m2 | Residential <225m2 | Residential Medium Density | Commercial / Community | School | Major Road/Rail | Park | Total |
|---|---|---|---|---|---|---|---|---|---|
| | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) | (ha) |
| N3 | 7.21 | 0.72 | 0.24 | | | | | | 8.17 |
| N4 | | | | | 3.80 | | 1.40 | 5.00 | 10.20 |
| C1 + C2 | 3.81 | 0.38 | 0.13 | 4.85 | | | | | 9.17 |
| | | | | | | | | | |
| C3 | 20.13 | 2.01 | 0.66 | 1.00 | 0.50 | 2.26 | | 4.85 | 31.41 |
| C4 | 14.91 | 1.49 | 0.49 | 0.71 | 1.73 | 7.67 | | 7.63 | 34.63 |
| C5 | 9.31 | 0.93 | 5.81 | | | | | 1.02 | 17.06 |
| C6 | | | 2.18 | 0.58 | 3.92 | | 1.40 | | 8.08 |
| C7 | 6.60 | 0.66 | 0.22 | | 1.00 | 1.37 | 1.33 | 13.26 | 24.43 |
| C8 | 2.55 | 0.25 | 4.41 | | | | | 0.67 | 7.89 |
| C9 | 5.45 | 0.54 | 0.18 | | | | | | 6.17 |
| C10 | 10.56 | | | | | | | | 10.56 |
| C11 | 1.53 | | 6.10 | 0.59 | 1.19 | | | 0.50 | 9.91 |
| S1 | 41.39 | 4.12 | 1.36 | | | | 4.35 | | 51.22 |
| S2 | 65.71 | 6.55 | 2.16 | | | 2.61 | 5.72 | | 82.75 |
| S3 | 13.69 | 1.36 | 0.45 | | | | 1.16 | 5.00 | 21.66 |
| | | | | | | | | | |
| Total | 202.8533 | 19.01152 | 24.37516 | 7.73 | 12.14 | 13.91 | 15.36 | 37.93 | 333.3 |

| Catchment ID | Residential >300m2 | | | | Residential 225-300m2 | | | | Residential <225m2 | | | Residential Medium Density | | | | Commercial / Community | | | | School | | | | Major Road | Park | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Roof to tank (ha) | Roof to drain (ha) | Road (ha) | Ground (ha) | Roof to tank (ha) | Roof to drain (ha) | Road (ha) | Ground (ha) | Roof to drain (ha) | Road (ha) | Ground (ha) | Roof to tank (ha) | Roof to drain (ha) | Road (ha) | Ground (ha) | Roof to tank (ha) | Roof to drain (ha) | Ground (ha) | Road/Parkng (ha) | Roof to tank (ha) | Roof to drain (ha) | Ground (ha) | Road/Parking (ha) | (ha) | (ha) | (ha) |
| N3 | 1.262 | 1.262 | 1.804 | 2.886 | 0.135 | 0.135 | 0.180 | 0.270 | 0.092 | 0.059 | 0.085 | | | | | | | | | | | | | | | 8.170 |
| N4 | | | | | | | | | | | | | | | | 0.950 | 0.950 | 0.760 | 1.140 | | | | | 1.400 | 5.000 | 10.200 |
| C1 + C2 | 0.668 | 0.668 | 0.954 | 1.526 | 0.071 | 0.071 | 0.095 | 0.143 | 0.049 | 0.031 | 0.045 | 0.849 | 0.849 | 1.455 | 1.698 | | | | | | | | | | | 9.170 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| C3 | 3.523 | 3.523 | 5.033 | 8.053 | 0.376 | 0.376 | 0.502 | 0.752 | 0.258 | 0.165 | 0.238 | 0.175 | 0.175 | 0.300 | 0.350 | 0.125 | 0.125 | 0.100 | 0.150 | 0.452 | 0.226 | 1.243 | 0.339 | | 4.850 | 31.410 |
| C4 | 2.610 | 2.610 | 3.728 | 5.966 | 0.279 | 0.279 | 0.372 | 0.557 | 0.191 | 0.122 | 0.176 | 0.124 | 0.124 | 0.213 | 0.249 | 0.433 | 0.433 | 0.346 | 0.519 | 1.534 | 0.767 | 4.219 | 1.151 | | 7.630 | 34.630 |
| C5 | 1.629 | 1.629 | 2.327 | 3.723 | 0.174 | 0.174 | 0.232 | 0.348 | 2.264 | 1.451 | 2.090 | | | | | | | | | | | | | | 1.020 | 17.060 |
| C6 | | | | | | | | | 0.850 | 0.545 | 0.785 | 0.102 | 0.102 | 0.174 | 0.203 | 0.980 | 0.980 | 0.784 | 1.176 | | | | | 1.400 | | 8.080 |
| C7 | 1.154 | 1.154 | 1.649 | 2.638 | 0.123 | 0.123 | 0.164 | 0.247 | 0.084 | 0.054 | 0.078 | | | | | 0.250 | 0.250 | 0.200 | 0.300 | 0.274 | 0.137 | 0.754 | 0.206 | 1.330 | 13.260 | 24.430 |
| C8 | 0.447 | 0.447 | 0.638 | 1.021 | 0.048 | 0.048 | 0.064 | 0.095 | 1.721 | 1.103 | 1.589 | | | | | | | | | | | | | | 0.670 | 7.890 |
| C9 | 0.953 | 0.953 | 1.362 | 2.179 | 0.102 | 0.102 | 0.136 | 0.204 | 0.070 | 0.045 | 0.064 | | | | | | | | | | | | | | | 6.170 |
| C10 | 1.848 | 1.848 | 2.640 | 4.224 | | | | | | | | | | | | | | | | | | | | | | 10.560 |
| C11 | 0.268 | 0.268 | 0.383 | 0.612 | | | | | 2.379 | 1.525 | 2.196 | 0.103 | 0.103 | 0.177 | 0.207 | 0.298 | 0.298 | 0.238 | 0.357 | | | | | | 0.500 | 9.910 |
| S1 | 7.243 | 7.243 | 10.347 | 16.554 | 0.773 | 0.773 | 1.031 | 1.547 | 0.530 | 0.340 | 0.489 | | | | | | | | | | | | | 4.350 | | 51.220 |
| S2 | 11.500 | 11.500 | 16.428 | 26.285 | 1.228 | 1.228 | 1.637 | 2.456 | 0.842 | 0.540 | 0.777 | | | | | | | | | 0.522 | 0.261 | 1.436 | 0.392 | 5.720 | | 82.750 |
| S3 | 2.395 | 2.395 | 3.422 | 5.475 | 0.256 | 0.256 | 0.341 | 0.512 | 0.175 | 0.112 | 0.162 | | | | | | | | | | | | | 1.160 | 5.000 | 21.660 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Total | | | | | | | | | | | | | | | | | | | | | | | | | | 333.3 |

## 6.2 Treatment systems

A summary of the treatment system sizes is shown in Table 3 and the characteristics for MUSIC modelling purposes of each treatment system are summarised below.

### 6.2.1 Rainwater Tanks

Rainwater tanks were modelled in accordance with *MUSIC Modelling Guidelines* (Water by Design, 2010) based on the sizes defined in Table 4.

In this case tanks were modelled conservatively at 80% of the volume to allow for main water topup storage in the tanks at the request of Economic Development Queensland and the peer reviewer. Advice from Stockland is that in many situations main water backup for the tanks is being provided valves which switch to main supply (i.e. Rainbank style systems) rather than topping up the tank. In this case there is no loss of storage in the tank for mains water topup.

Given this advice, we conclude the modelling approach of using 80% of the tank volume for storage is conservative.

### 6.2.2 Inlet Ponds / Sediment Basins

The inlet area was generally set at 0.25% of the catchment with a minimum of 300m$^2$. To derive the volume a notional depth of 1.5m in larger systems (>500m$^2$) and 1m for systems smaller (<500m$^2$) given the average depth in smaller systems is reduce to the surrounding underway batters.

### 6.2.3 Wetland systems

Wetlands were modelled in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010) and the description provided in Section 5.3. An extended detention depth of 50mm was adopted with weir and bypass flows were directed to the bioretention basins. Treated pipe flows bypass the bioretention and discharge to the receiving waterways.

### 6.2.4 Bioretention basins

The end of line bioretention basins were modelled to only receive overflows from the wetlands with the adopted parameters in accordance with the *MUSIC Modelling Guidelines* (Water by Design, 2010). The only variation from the *MUSIC Modelling Guidelines* (Water by Design, 2010) is the bioretention media specifications Ortho-P of 20mg/kg and TN of 400mg/kg which have been justified previously by BMT WBM and previously accepted by EDQ reviewers.

The extended detention depth above the bioretention basins is configured to include the ponding depth above the wetlands once the wetlands spill into the bioretention basins. This is because the two systems will 'share' this ponded water and the bioretention basins will draw down much faster than the wetland systems, hence the vast majority of ponded water will filter through the bioretention media.

### 6.2.5 The Brook

The Brook was modelled as a vegetated swale with treated flows bypassing the channel because these channel will not further improve the quality of water discharged from the wetland and bioretention systems.

### 6.2.6 Overflow swales

The swales that take untreated overflows from the end-of-line treatments and the swales have the following characteristics:

- Length = 50-100m for systems next to Bells Creek North and South. Up to 400m in length for reached of The Brook (Length has been set based on location. For example The Brook drainage corridor is 2.5km in length.)
- 0.1-0.2% bed slope
- Base width = varies
- Top width = varies
- Depth = 500-800mm
- Vegetation height = 250mm
- Exfiltration = 0 mm/hour

## 6.3 Results

The results of the MUSIC modelling for flow entering Bells Creek from Precincts 11-14 using the proposed strategy are shown in Table 7. The results in Table 7 include loads from development areas and parkland area (not buffers). This model has assumed although the streetscape biopods are actually installed in accordance with the strategy, the stormwater objectives will be achieved by the end of line treatment systems thus allow flexibility in the design of the streetscape systems (coverage, location). The streetscape systems will result in additional load removal above that presented in the table below.

The results demonstrate that the proposed stormwater strategy achieves the stormwater quality load reduction objectives as outlined in Section 3.

Table 7 MUSIC modelling results

| Parameter | Unmitigated | Mitigated | % Removal |
|---|---|---|---|
| **Flow (ML/yr)** | 2,880 | 2,440 | 15.1% |
| TSS (kg/yr) | 487,000 | 17,700 | 96.4% |
| TP (kg/yr) | 1,020 | 95 | 90.7% |
| TN (kg/yr) | 6,210 | 1,870 | 69.9% |
| Gross Pollutants (kg/yr) | 64,600 | 0 | 100% |

## 6.4 Sensitivity Test

The stormwater strategy was also simulated using an updated version of the pluviograph rainfall for a longer period (1996-2009). Review of the rainfall undertaken as part of recent modelling investigations for DesignFlow & BMT (2018) found errors with the pluviograph recording resulting in under-measurement of the actual rainfall and missing information.

This pluviograph information has been corrected as part of the modelling work resulting in a longer period of information which reflects the annual average more appropriate as listed below:

- Caloundra WWTP daily = 1573mm/yr
- Caloundra WWTP Pluviograph 1997-2006 = 1348mm/yr
- Corrected WWTP Pluviograph 1997-2009 = 1570mm

The results of the MUSIC model using the updated rainfall information are presented in Table 8

**Table 8 MUSIC modelling results – Updated Rainfall**

| Parameter | Unmitigated | Mitigated | % Removal |
|---|---|---|---|
| **Flow (ML/yr)** | 3,470 | 3,010 | 13.4% |
| TSS (kg/yr) | 597,000 | 25,700 | 95.7% |
| TP (kg/yr) | 1,240 | 128 | 89.7% |
| TN (kg/yr) | 7,480 | 2,370 | 68.3% |
| Gross Pollutants (kg/yr) | 71,200 | 0 | 100% |

## 6.5 Processes and recent research not considered in modelling

There are a number of processes and a range of recent research which has not been included in the catchment modelling for the reason of being conservative. If the recent research and catchment processes were included we expect the modelling would predict further improvements to the performance of the stormwater management strategy and reduce loads to Bells Creek (compared to the results presented in this report). The processes and research not considered in the modelling are outlined below:

- **No infiltration from treatment systems** – No infiltration has been simulated in the MUSIC modelling from the WSUD systems. Experience on the Aura site, and elsewhere in Queensland, indicates that stormwater does infiltrate into existing soils from WSUD systems resulting in lower export of flows and loads (BMT WBM, 2015).
- **At source within the residential areas** – Streetscape bioretention systems form part of the WSUD strategy in the residential areas of Precincts 11-14 and will be implemented at a rate of at least 30% coverage. These systems have not been included MUSIC modelling (i.e. only the end of line systems). Including these would further reduce flows and pollutant loads.
- **Constructed wetland k & C* parameters** - Significant recent monitoring of constructed wetlands has confirmed wetlands deliver better total nitrogen removal than that predicted in MUSIC. New k and C* MUSIC model parameters have been developed to replicate the monitoring and are included in the draft *MUSIC Modelling Guidelines* (Water by Design, draft). This benefit has not been included in the catchment modelling.
- **Lower urban stormwater pollutant loads** - Recent research (Lucke et al, 2017) indicates the quality and quantity of pollutants being generated on urban land uses

in Queensland maybe lower that those predicted in MUSIC guidelines using *MUSIC Modelling Guidelines* (Water by Design, 2010). If this research is correct, then the pollutant loads entering Bells Creek from Aura may well be lower than that predicted by the modelling presented in this report. Stockland are completing event based stormwater monitoring to refine this understanding.

# 7 Conclusions

This document describes a stormwater quality management strategy for Aura Precincts 11-14 to meet required stormwater quality objectives.

This stormwater quality management strategy covers 333ha of Precincts 11 to 14 and the surrounding development precincts of the Aura development. The development includes the creation of residential, small commercial, community, school, sports fields and recreational park land uses as well as a number of drainage corridors.

The site drains in three general directions.  A small portion of the site, in the far north west, drains north towards the floodplain of Bells Creek North. About half the site drain internally via a large create drainage corridor called The Brook east and then south into Bells Creek South. The other half of the site drains southwards directly to Bells Creek South.

This strategy proposes a comprehensive combination of treatment systems responding to the very high value receiving waters.  .  It includes using rainwater tanks, at source biopods (for residential streets), gross pollutant traps and an innovative combination of precinct scale wetland and bioretention basins and a vegetated conveyance waterway.

The treatment systems have been all be located within the constraints of site levels, available space and requirements for environmental buffers (e.g. frog habitat).

The treatment strategy meets the stormwater objectives for the Aura development, as defined in *Aura Development Stormwater Quality Management Plan* (DesignFlow & BMT, 2019), to ensure there are no adverse impacts on Bells Creek and Pumicestone Passage.  This includes reducing annual pollutant loads by the required 95% for total suspended solids (TSS), 89% for total phosphorus (TP) and 68% for total nitrogen (TN).

# 8 References


Corrs Chambers McGrath (2015) *Caloundra South Infrastructure Agreement*

DesignFlow & BMT (2019) *Aura Development Stormwater Quality Management Plan*

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Water by Design (2014), *Bioretention Chapter Technical Design Guidelines for South East Queensland.*

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