Stormwater Management Report

Bethany Respite and Rec Centre, 75 Ward Street, Rockhampton

PREPARED FOR MERCY HEALTH AND AGED CARE CENTRAL QUEENSLAND LIMITED C/- BICKERTON MASTERS ARCHITECTURE

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/149-2017

Dated: 10 December 2018

18-000432 | 18 October 2018

Calibre Professional Services Pty Ltd
55 070 683 037

ROCKHAMPTON REGIONAL COUNCIL

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1 Introduction

Calibre has prepared this Stormwater Management Report in support of the Information Request Response for Development Application D/149-2017 to Rockhampton Regional Council. This Development Application for Material Change of Use (MCU) is in relation to a proposed respite and recreation centre on the site of the Bethany Aged Care facility, located at 75 Ward Street, Rockhampton. Bethany is a facility under our client Mercy Health and Aged Care Central Queensland Limited and has offered aged care facilities for a number of years. The development proposal includes a respite and recreation centre building and associated car parking and set-down facilities on the existing Bethany site (Lot 100 on SP225770).

The intent of this report is to demonstrate that the proposed stormwater management of rain events up to a 1 in 100 year ARI for the proposed development, will not result in any deterioration of the flood immunity to any of the surrounding allotments, buildings and infrastructure. The report will also discuss the overall drainage strategy for the development.

The development site currently consists of existing aged care and accommodation facilities buildings. The site of the proposed respite and recreation centre is situated near a crown in the existing topography, where a portion of the site falls to the east towards an existing car parking facility, whilst the remainder falls to open grassed land before discharge to Agnes Street. .

The locality of the subject site can be seen in the following illustration.

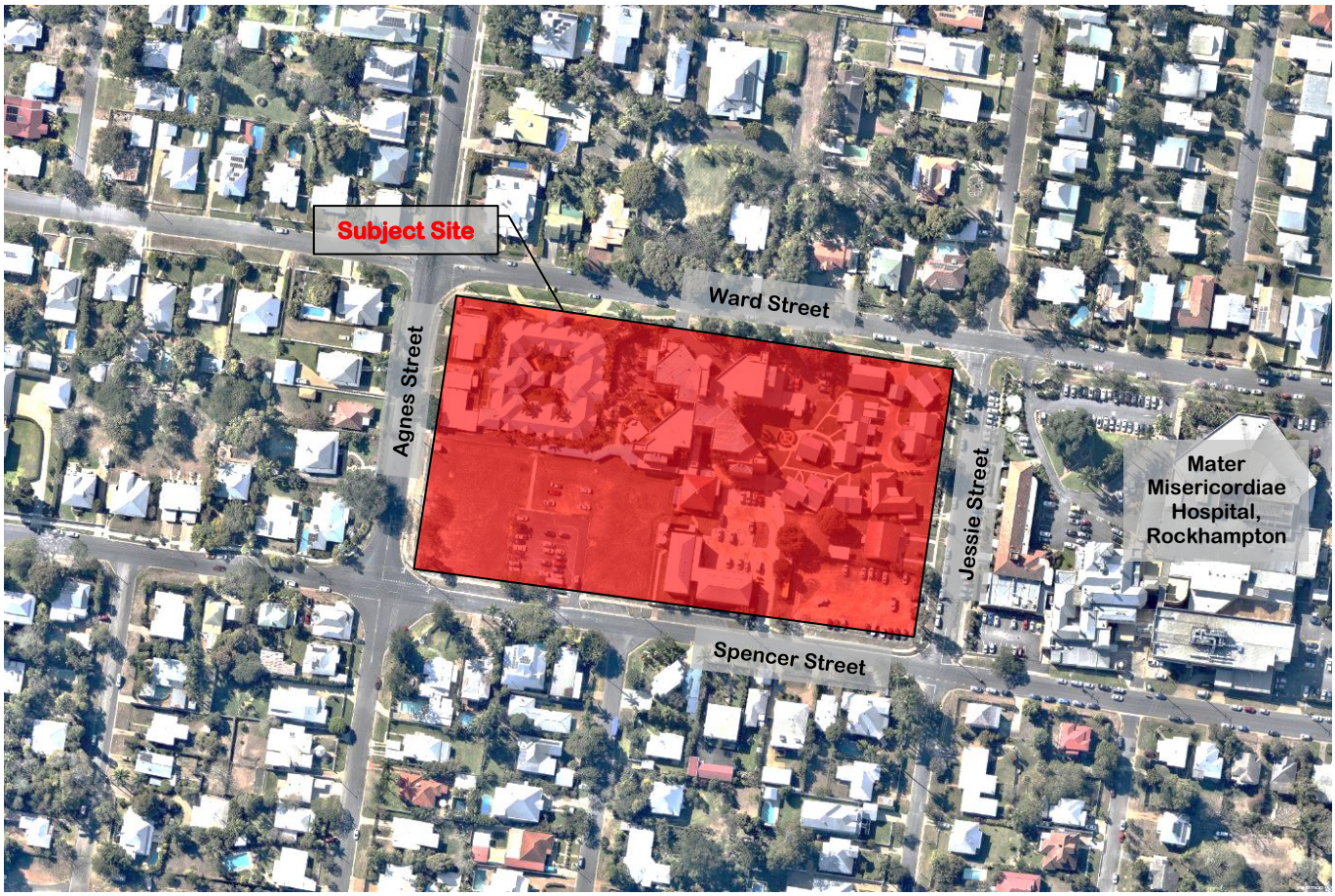

Figure 1 Locality Image

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2 Stormwater Quantity

An analysis has been undertaken for the stormwater management of the development to ensure that no adverse impacts occur to adjacent and downstream properties and infrastructure from the proposed expansions and the overall stormwater strategy for the proposed respite and recreation centre.

The Queensland Urban Drainage Manual 2017 (QUDM) has been utilised in order to determine the hydrology changes from the development. XP-RAFTS software has been utilised to calculate stormwater runoff for each catchment and an analysis of the pre-development and post-development flow rates has been undertaken.

2.1 Existing System

The subject site has been divided into two (2) catchment parcels (1 and 2), where sub-catchments have then been derived. Catchments 1-1 and 1-2 discharge towards the existing Bethany Village which ultimately discharges to the Jessie St Kerb and Channel. Catchments 2-1 and 2-2 discharge to the Agnes Street Kerb and Channel. Catchment 1-1 consists of the roof area from the existing Accommodation building. This catchment discharges to two rainwater tanks as per the VDM consulting report dated June 2012. These tanks have been considered as part of the analysis of the existing stormwater scenario.

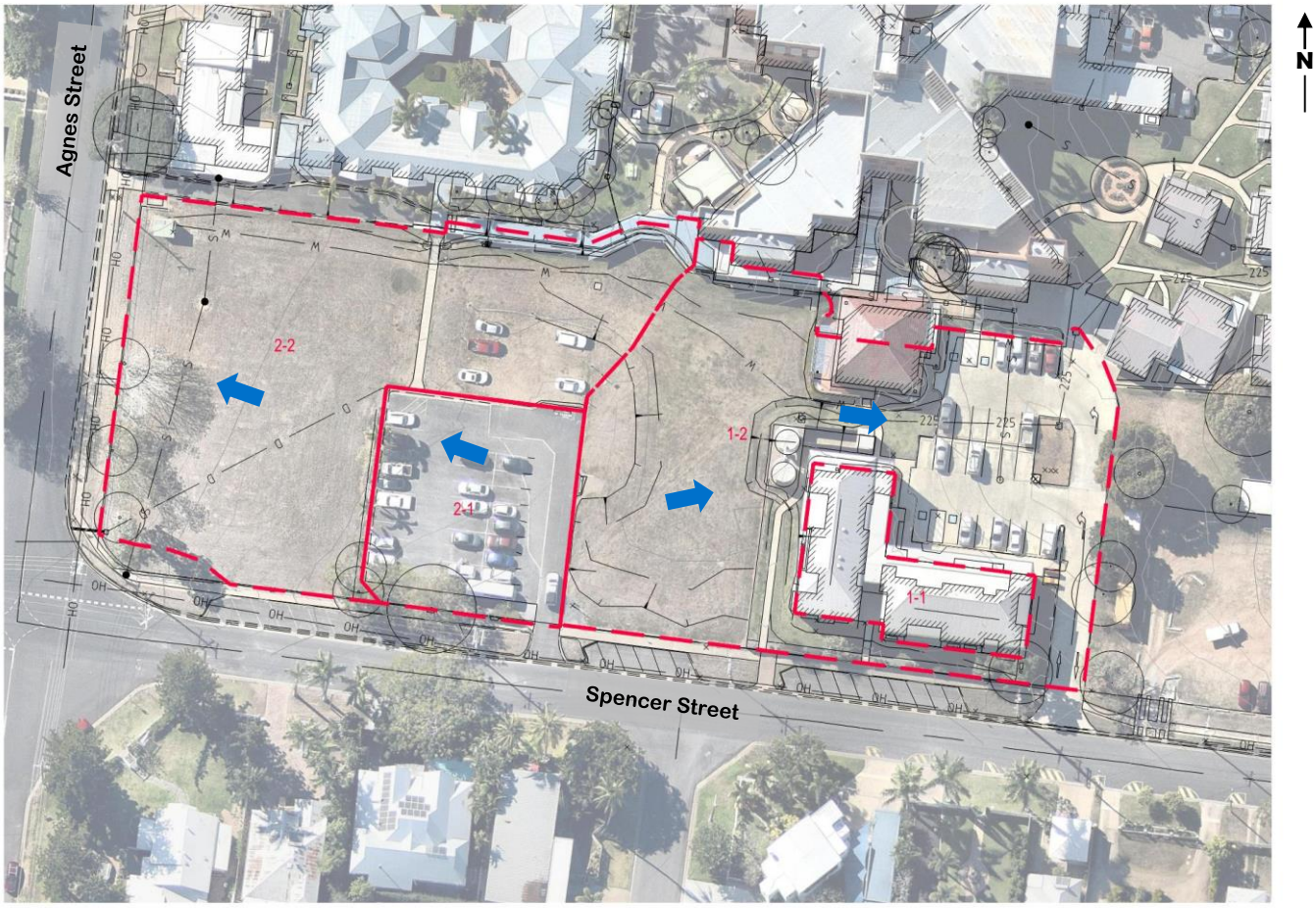

Figure 2 Pre Development Site Discharge

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2.1.1 Catchment Details

The fraction impervious values have been determined based on existing site details for each catchment and the following table details the catchment area with the fraction impervious value assigned respectively.

Table 1 Existing Catchment Details

Catchment ID	Catchment Area (m^2)	Average Slope (%)	Fraction Impervious (%)	Pervious Manning's Roughness (n)	Impervious Manning's Roughness (n)
1-1	617	Roof	100.0	N/A	0.025
1-2	3822	3.5	40.0	0.055	0.025
2-1	1070	1.5	93.0	0.055	0.025
2-2	3467	3	4.0	0.055	0.025

2.1.2 Design Rainfall Data

The adopted design rainfall intensities were sourced from the Bureau of Meteorology IFD data system for the area of Rockhampton in which the subject site is situated. The rainfall temporal pattern adopted is that suggested in Australian Rainfall and Runoff.

2.1.3 Peak Flow Calculations

The peak flow runoff from the existing site area was considered at both the downstream Bethany Car Park and the Agnes Street Kerb and Channel.

The XP-RAFTS model has been developed with nodes for each existing catchment. The node configuration adopted in the model for the pre-development scenario can be seen in the following image. Appropriate lag times between nodes were assigned based on pipe flows travel times.

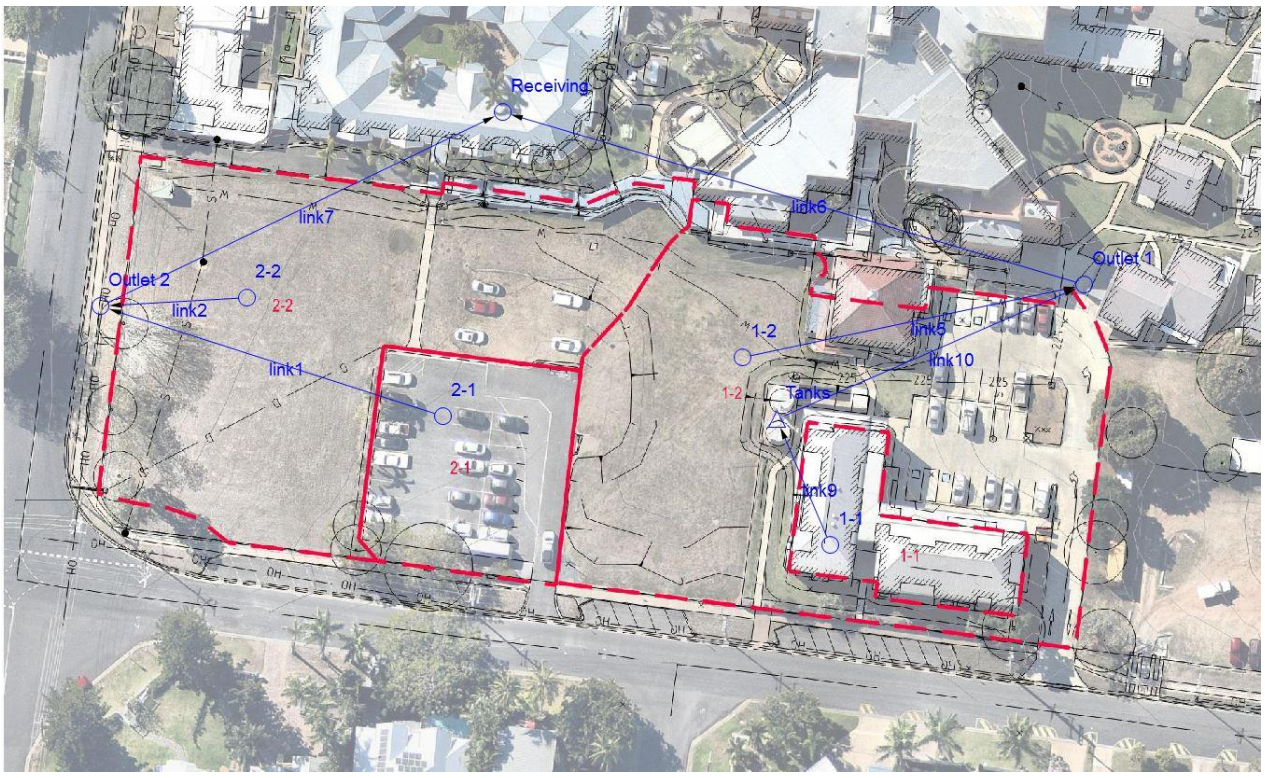

Figure 3 Pre-Development XP-RAFTS Model Configuration

The existing peak flow rates for each catchment outlet (Outlet 1 – Bethany and Outlet 2 – Agnes Street) can be seen in the following table, for each given return period.

Table 2 Existing Peak Flow Rates

Return Period AEP (%)	Peak Flow Rate (m^3/s)	
	Outlet 1	Outlet 2
63% AEP (Q1)	0.007	0.006
39% AEP (Q2)	0.012	0.009
18% AEP (Q5)	0.031	0.022
10% AEP (Q10)	0.055	0.047
5% AEP (Q20)	0.111	0.112
2% AEP (Q50)	0.215	0.218
1% AEP (Q100)	0.320	0.316

2.2 Proposed System

The proposal includes the construction of a proposed respite and recreation centre building and associated car parking/set-down areas. With the shape of the roof for the proposed building, a portion of the roofwater will discharge to the east (towards the existing Bethany Car Park) whilst the remainder is intended to discharge to the Agnes Street kerb and channel. The car park and set down areas are also planned to discharge to the Agnes Street kerb and channel. The discharge locations currently present on site will be generally maintained, however the catchment areas and characteristics will be altered with this development proposal. The proposed stormwater catchments for the development can be seen in the image below.

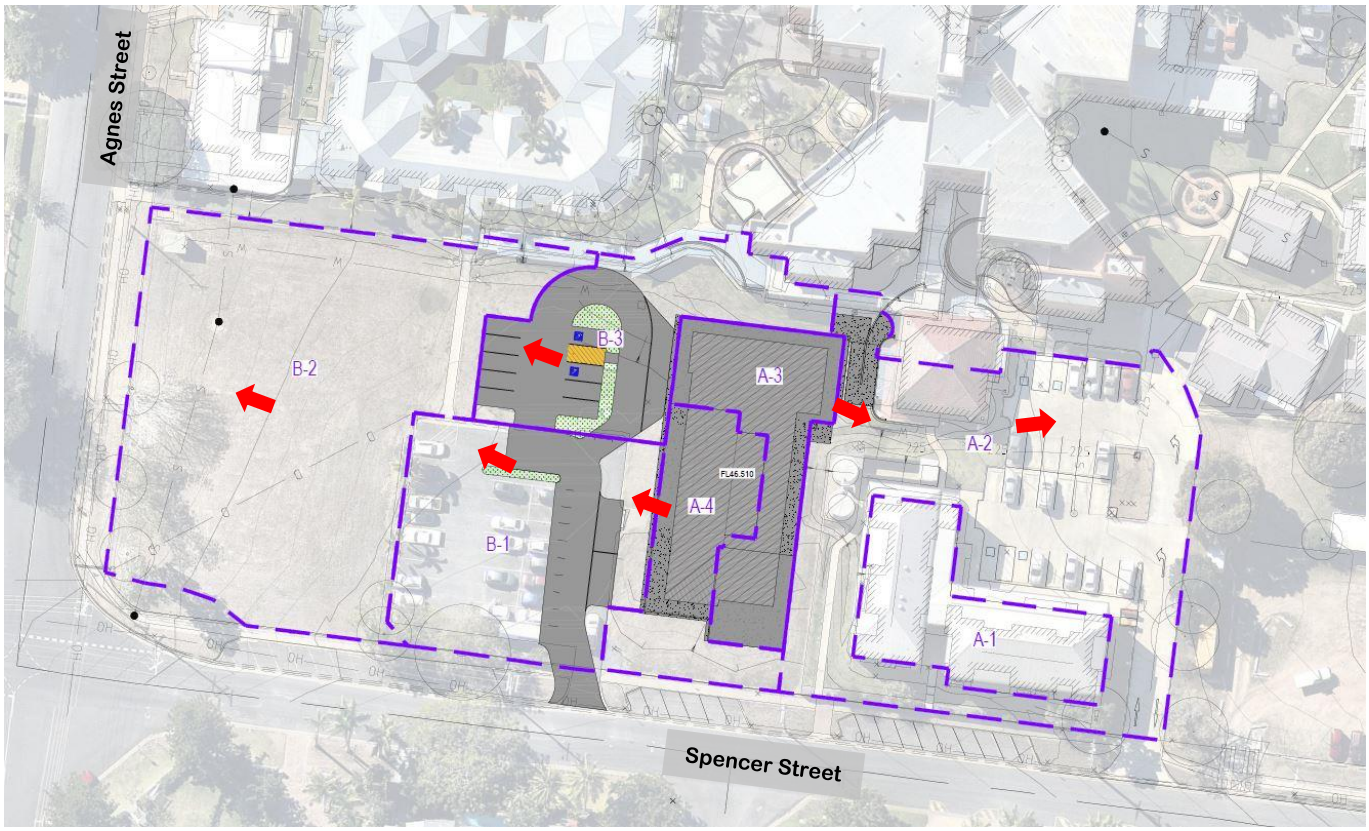

Figure 4 Post Development Site Discharge

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2.2.1 Catchment Details

The fraction impervious values have been determined based on proposed site details for each catchment and the following table details the catchment area with the fraction impervious value assigned respectively.

Table 3 Proposed Catchment Details

Catchment ID	Catchment Area (m^2)	Average Slope (%)	Fraction Impervious (%)	Pervious Manning's Roughness (n)	Impervious Manning's Roughness (n)
A-1	617	Roof	100.0	N/A	0.025
A-2	2360	3.0	69.00	0.055	0.025
A-3	605	Roof	100.0	N/A	0.025
A-4	378	Roof	100.0	N/A	0.025
B-1	1204	1.5	94.0	0.055	0.025
B-2	2729	3	98.0	0.055	0.025
B-3	877	3	67.0	0.055	0.025

2.2.2 Peak Flow Calculations

The peak flow runoff from the proposed site area was considered at both the downstream Bethany Car Park and the Agnes Street Kerb and Channel.

The XP-RAFTS model has been developed with nodes for each proposed catchment. The node configuration adopted in the model for the post-development scenario can be seen in the following image. Appropriate lag times between nodes were assigned based on pipe flows travel times.

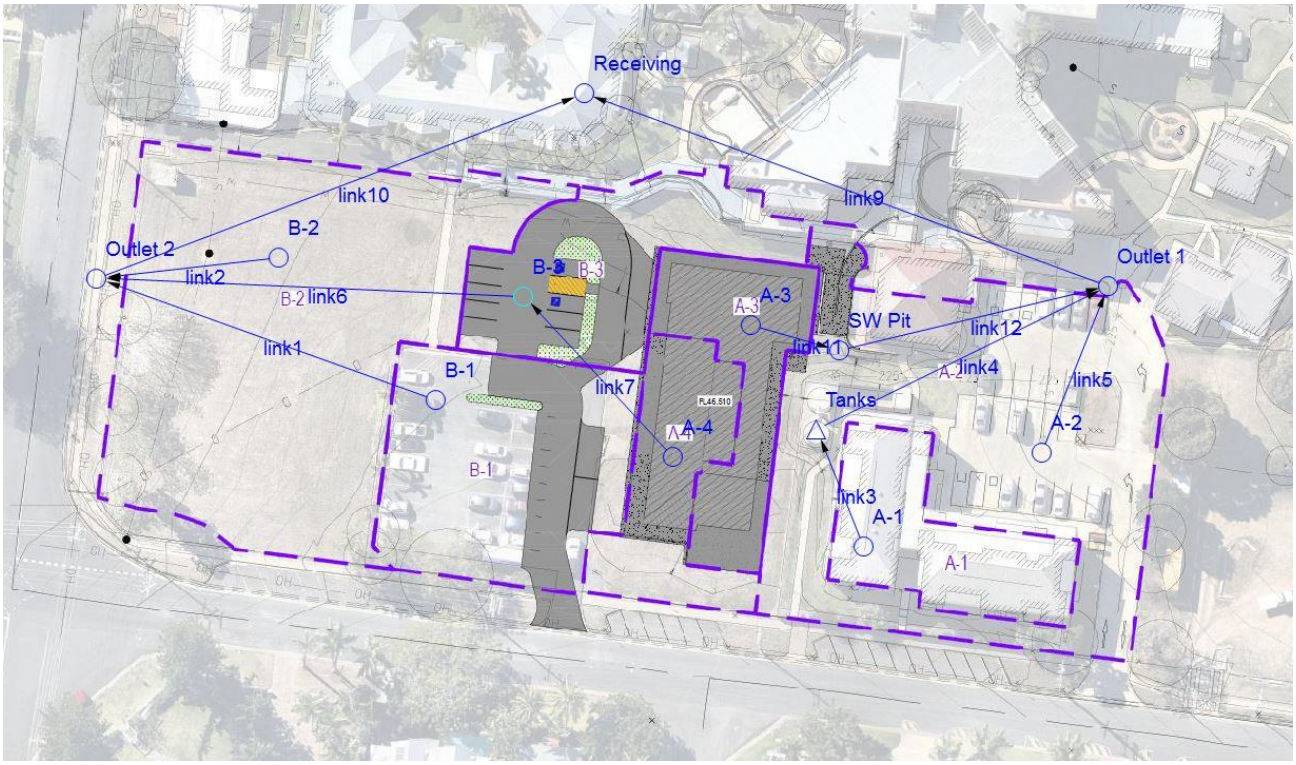

Figure 5 Post-Development XP-RAFTS Model Configuration

The existing peak flow rates for each catchment outlet (Outlet 1 – Bethany and Outlet 2 – Agnes Street) can be seen in the following table, for each given return period.

Table 4 Proposed Peak Flow Rates

Return Period AEP (%)	Peak Flow Rate (m^3/s)	
	Outlet 1	Outlet 2
63% AEP (Q1)	0.011	0.010
39% AEP (Q2)	0.018	0.017
18% AEP (Q5)	0.044	0.041
10% AEP (Q10)	0.072	0.072
5% AEP (Q20)	0.123	0.147
2% AEP (Q50)	0.193	0.287
1% AEP (Q100)	0.289	0.426

2.3 Summary of Existing and Proposed Peak Flow Rates

The Peak Flow Rates determined for the existing system and proposed system have been summarised in the following table for each return period. The flow increase for each return period due to the proposed development is also seen in the following table.

Table 5 Outlet 1 Summary of Pre and Post Development Flow Rates

Return Period AEP (%)	Pre-Development Peak Flow Rate (m^3/s)	Post-Development Peak Flow Rate (m^3/s)	Increase (m^3/s)
63% AEP (Q1)	0.007	0.011	0.004
39% AEP (Q2)	0.012	0.018	0.006
18% AEP (Q5)	0.031	0.044	0.013
10% AEP (Q10)	0.055	0.072	0.017
5% AEP (Q20)	0.111	0.123	0.012
2% AEP (Q50)	0.215	0.193	-0.022
1% AEP (Q100)	0.320	0.289	-0.031

As can be seen above for Outlet 1 (Bethany Car Park), the proposed development site has extremely minimal impact to the peak flow rates in all return periods. In fact, a slight decrease in peak flow rate is apparent for a 1% AEP and 2% AEP event in the post-development scenario. The increase in all other events is extremely minimal and we believe can be catered for in the existing storage capacity of the Bethany Car Park. This Car Park currently acts as a detention facility as per the requirements of the VDM consulting report dated June 2012. The additional small increase in runoff in minor return period we believe can be adequately catered for in the Car Park area in additional to the required volume stated within the VDM report.

The following table shows pre-development and post-development peak flow rates for Outlet 2 (Agnes Street discharge).

Table 6 Outlet 2 Summary of Pre and Post Development Flow Rates

Return Period AEP (%)	Pre-Development Peak Flow Rate (m^3/s)	Post-Development Peak Flow Rate (m^3/s)	Increase (m^3/s)
63% AEP (Q1)	0.006	0.010	0.004
39% AEP (Q2)	0.009	0.017	0.008
18% AEP (Q5)	0.022	0.041	0.019
10% AEP (Q10)	0.047	0.072	0.025
5% AEP (Q20)	0.112	0.147	0.035
2% AEP (Q50)	0.218	0.287	0.069
1% AEP (Q100)	0.316	0.426	0.110

As can be seen in the table, it is evident that an increase in runoff in all return periods to Agnes Street (Outlet 2) is apparent in the proposed developed scenario. In a major 1% AEP event, this increase is in the order of 35% and in a minor 18% AEP event is around 86%. As a result, mitigation measures are proposed in order to ensure that the development proposal does not worsen or cause actionable nuisance to the downstream Agnes Street road corridor. Mitigation in the form of a detention basin is intended to be incorporated as part of the development proposal, with details found under section 2.3.1.

2.3.1 Quantity Mitigation Strategy

XP-RAFTS has been utilised to determine the optimal mitigation strategy to ensure that the peak flows reaching discharge point Outlet 2 to Agnes Street are maintained at pre-development flows or less for all return periods. To achieve mitigation of the peak flow at Outlet 2 (Agnes Street), an online detention basin system is proposed. The following Table 7 and drawing in Appendix C provides a summary of the critical basin information modelled in XP-RAFTS with the mitigated peak discharges at Outlet 2 (Agnes Street) summarised in Table 8.

Table 7 Detention Basin Summary

Basin Configuration	
Invert (Base) Level	43.650m AHD
Peak Q100 WSL	44.206m AHD
Detention Volume at Q100 WSL	$133m^3$
Max Q100 Depth	0.556m
Outlet Pipe- Low Flow	
Pipe Size	40mm dia.
Pipe Invert (Basin side)	43.650 AHD
Outlet Pipe- Intermediate	
Pipe Size	2/90mm dia.
Pipe Invert (Basin side)	43.850 AHD
Weir	
Width	3.0m
Crest Level	44.160 AHD

The above detention basin has been modelled as such that the only return period where the weir is utilised is in the 1% AEP event. This weir is only around 46mm water flow depth and we believe will have no negative impact to the Agnes Street verge as the discharge has been controlled to pre-development flow rates. The low flow and intermediate pipes convey the majority of the 1% AEP flow directly to the Agnes Street Kerb and Channel.

2.3.2 Mitigated Peak Discharge Summary

The summary below in Table 8 demonstrates the achieved peak discharges for the standard range of return periods assessed for Outlet 2 (Agnes Street). As can be seen, the proposed basin configuration detailed will be capable of mitigating the proposed development peak flows to ensure there is no adverse impacts to existing downstream infrastructure or properties as a result of the development, and in fact, reduce the peak discharge to below pre-development conditions.

Table 8 Outlet 2 (Agnes Street) Post-development Peak Discharge

Return Period AEP (%)	Pre-Development Peak Flow Rate (m^3/s)	Post-Development Peak Flow Rate (m^3/s)	% Increase (m^3/s)
63% AEP (Q1)	0.006	0.006	0.0
39% AEP (Q2)	0.009	0.009	0.0
18% AEP (Q5)	0.022	0.022	0.0
10% AEP (Q10)	0.047	0.047	0.0
5% AEP (Q20)	0.112	0.107	-4.0
2% AEP (Q50)	0.218	0.213	-2.0
1% AEP (Q100)	0.316	0.314	-1.0

3 Stormwater Quality

The stormwater quality assessment for the development has been based on the requirements listed in the State Planning Policy – July 2017 under the Water Quality section.

It is expected that the proposed development will increase the stormwater pollutants that are exported from the subject site. A treatment train of suitable Stormwater Quality Improvement Devices (SQID's) has been proposed to intercept and capture the pollutants associated with the proposed development, so that the potential impacts external to the subject site will be adequately mitigated to achieve the required Water Quality Objectives (WQO's).

This section discusses:

- The identification of key stormwater pollutants associated with the proposed development;
- The Water Quality Objectives (WQO's) identified for the catchment;
- Proposed measures to mitigate the increase in pollutant export; and
- Modelling of the proposed measures and comparison to the identified WQO's.

Water quality modelling was undertaken with Model for Urban Stormwater Improvement Conceptualisation (MUSIC), generally in accordance with the Water By Design *Music Modelling Guidelines* (2010).

3.1 Pollutants of Concern

Pollutant typically generated during the operational phase of a development are as follows:

- Litter
- Sediment
- Oxygen demanding substances (possibly present)
- Nutrients (N & P)
- Pathogens/Faecal Coliforms
- Hydrocarbons
- Heavy Metals (often associated with the fine sediment)
- Surfactants
- Organochlorines & organophosphates
- Thermal Pollution
- pH altering substances

3.2 Water Quality Objectives

The load reduction WQO's presented in below Table 9 have been extracted from Table B of the Queensland State Planning Policy (SPP) (July 2017).

Table 9: Load Reduction Water Quality Objectives.

Pollutant	Total Suspended Solids (kg/yr)	Total Phosphorus (kg/yr)	Total Nitrogen (kg/yr)	Gross Pollutants (kg/yr)
Load Reduction Target	85%	60%	45%	90%

3.3 Water Quality Management Strategy

To mitigate the increase in pollutants generated by the proposed development, the use of the existing bio-retention basin in the car park area to the east of the proposed Bethany Respite Centre is intended to be utilised. This basin will be refurbished and the existing catchment which this basin serves has been considered in this water quality assessment as per the VDM consulting report dated June 2012, where the basin was designed and modelled.

3.4 MUSIC Modelling Methodology

Water quality modelling of the proposed development has been undertaken using MUSIC Version 6, developed by eWater CRC. MUSIC enables the user to conceptualise the transfer of pollutants through a stormwater drainage system and it provides an aid in quantifying the effectiveness of the proposed stormwater quality treatment train.

3.4.1 Meteorological Data

Six minute pluviographic data was sourced from the Bureau of Meteorology (BOM) for Rockhampton Aero (Station No. 039083). Based on the mean annual rainfall over the station's entire rainfall data period and the availability of pluviograph data, from the 1st January 1939 to 31st March 2010 was selected and adopted for modelling in MUSIC.
Monthly evapotranspiration data for the period was sourced from Bureau of Meteorology and entered into the MUSIC Model.

3.4.2 Source Nodes

Source nodes utilised for the proposed catchments have been modelled based upon the same catchments adopted within the stormwater quantity analysis. A summary of the source nodes (existing and proposed) are presented below:

Table 10: Source Node Summary.

Source Node	Area (ha)	Fraction Impervious	Land Use
A-1 (Roof)	0.062	100.0	Commercial
A-2 (Road)	0.100	100.0	Commercial
A-2 (Road)	0.100	5.0	Commercial
A-3 (Roof)	0.061	100.0	Commercial
A-4 (Roof)	0.038	100.0	Commercial
A-4 (Ground)	0.020	0.0	Commercial
B-3 (Road)	0.059	100.0	Commercial
B-3 (Ground)	0.029	0.0	Commercial

3.4.3 Treatment Nodes

To represent the treatment measures proposed, the following bio-retention treatment nodes were adopted within the MUSIC model.

Basin (Existing Car Park Basin)

- Filter Area – 60m^2
- Filter Depth – 0.4m
- Extended Detention Depth – 0.3m
- Hydraulic Conductivity – 180mm/hr

Swale

- Length – 40m
- Slope – 0.5%
- Base Width – 2.0m
- Depth – 0.5m

3.4.4 Music Model

The site has been modelled as a Commercial use, and the following screenshot shows the schematic treatment train adopted for the site in the MUSIC model.

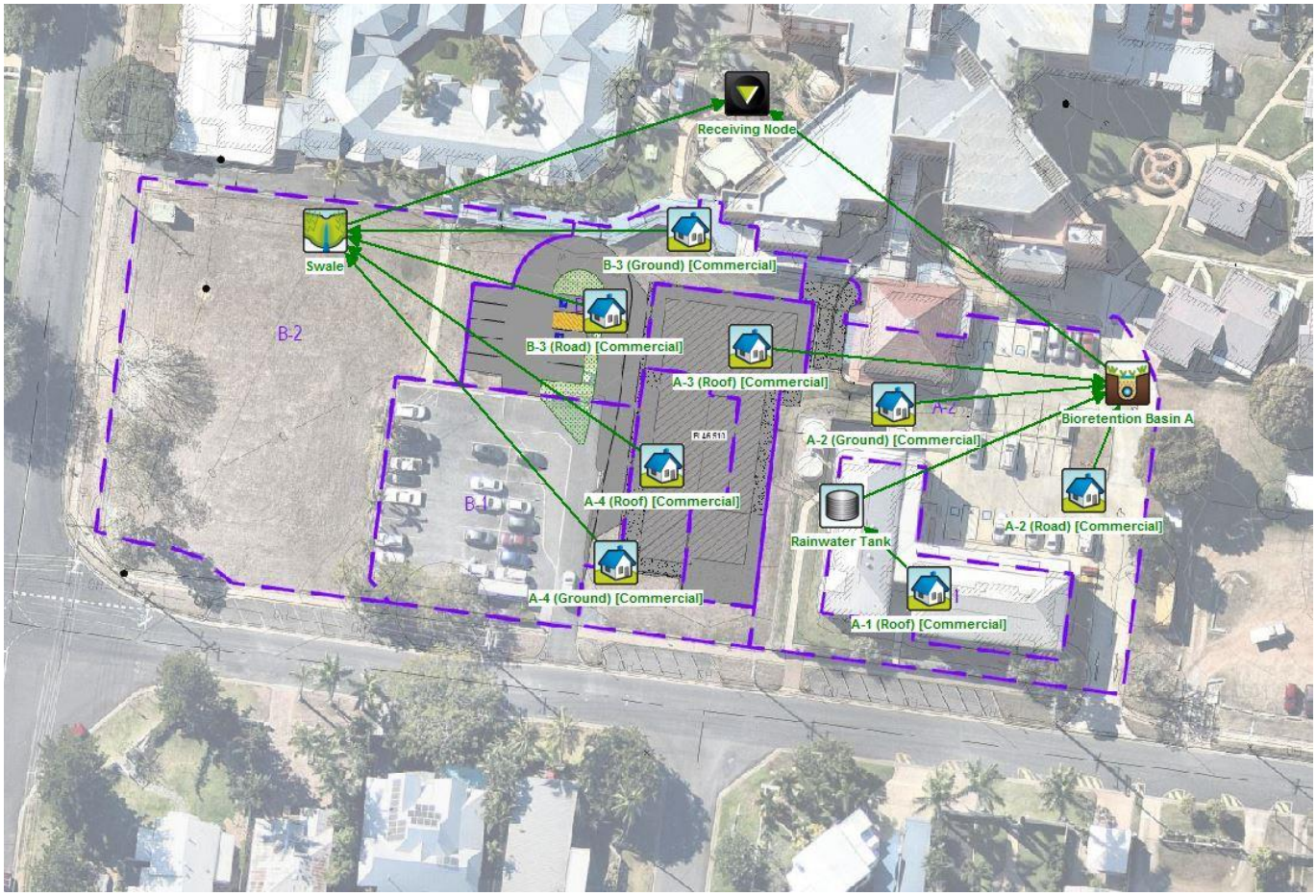

Figure 6 MUSIC Model Water Quality Treatment Train

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3.5 MUSIC Modelling Results

The development has been considered holistically for water quality analysis to ensure the development meets the required water quality objectives. The results from the MUSIC model at the receiving node, including the proposed treatment measures, are shown below.

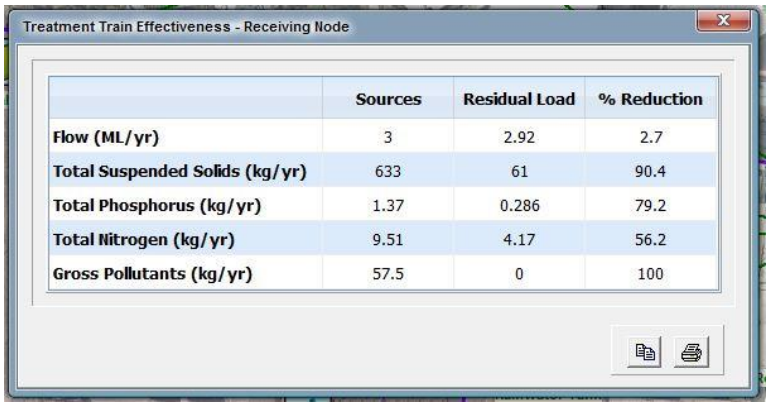


Figure 7 MUSIC Results - Receiving Node

The following summary table compares the MUSIC modelling analysis to the required reduction targets:

Table 11 Pollutant Reduction Summary (Modelled vs Target)

	Total Suspended Solids (TSS)	Total Phosphorus (TP)	Total Nitrogen (TN)	Gross Pollutants (GP)
Minimum Percentage Reductions (SSP)	85.0	60	45	90
Achieved Percentage Reductions	90.4	79.2	56.2	100
WQO's Achieved?	**Yes**	**Yes**	**Yes**	**Yes**

As can be seen within the above, the proposed treatment train can effectively mitigate the expected impacts of the proposed development.

4 Conclusion

Calibre was engaged by Mercy Health and Aged Care Central Queensland Limited to prepare this Stormwater Management Report in order to assess the stormwater scenario for the proposed respite and recreation centre on the Bethany Village site at 75 Ward Street, Rockhampton.

This report assesses and addresses the required stormwater management mechanisms necessary to ensure that the post-development scenario is equal to or better than the pre-development scenario. The stormwater management strategy detailed within this report meets the requirements of all relevant policies, guidelines and design manuals, to ensure a suitable arrangement is integrated into the detailed design for the subject site. This report also demonstrates that the proposed stormwater strategy will not diminish the stormwater immunity of the surrounding/downstream allotments and not negatively impact on existing infrastructure, if the detention basin described in Table 7 is constructed.

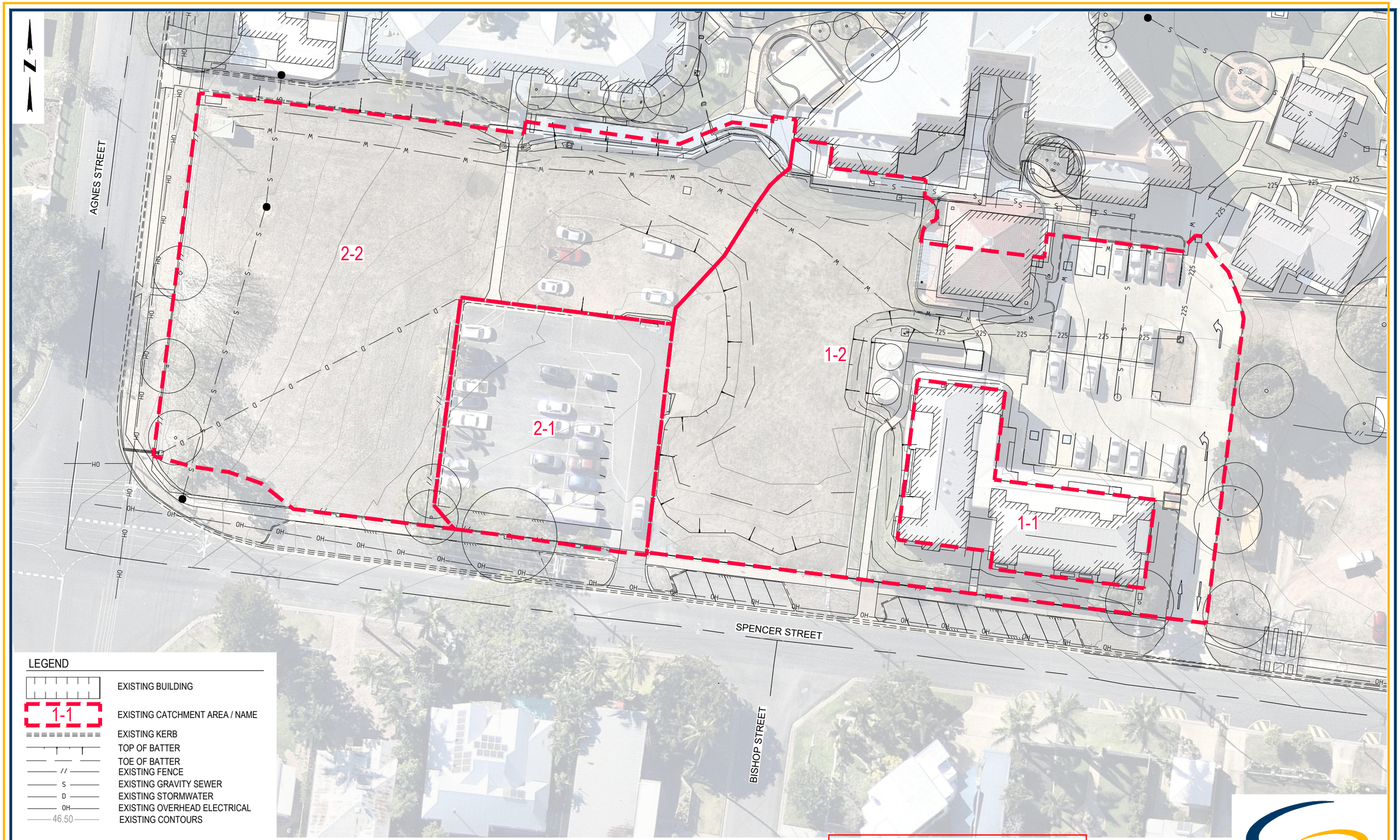
Minor alterations in details as the project progresses can be accommodated, but the fundamentals of the stormwater strategy can be readily adopted. This will ensure the stormwater can be managed on site and will not pose a serious constraint to development, or adversely affect any upstream or downstream landowners.

If you should have any questions regarding this report, please do not hesitate to contact the Calibre Office in Rockhampton on (07) 4961 4200.

BETHANY RESPITE AND REC CENTRE, 75 WARD STREET, ROCKHAMPTON

Appendix A Existing Catchment Plan

MERCY HEALTH AND AGED CARE CENTRAL QUEENSLAND LIMITED C/- BICKERTON MASTERS ARCHITECTURE



LEGEND

- EXISTING BUILDING
- 1-1 EXISTING CATCHMENT AREA / NAME
- EXISTING KERB
- TOP OF BATTER
- TOE OF BATTER
- // EXISTING FENCE
- S EXISTING GRAVITY SEWER
- D EXISTING STORMWATER
- OH EXISTING OVERHEAD ELECTRICAL
- 46.50 EXISTING CONTOURS

18-000432 BETHANY RESPITE CENTRE

SK001 EXISTING STORMWATER CATCHMENT PLAN

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0 1.25 5.0m
0 2.5 10.0m
1:250 (A1)
1:500 (A3)

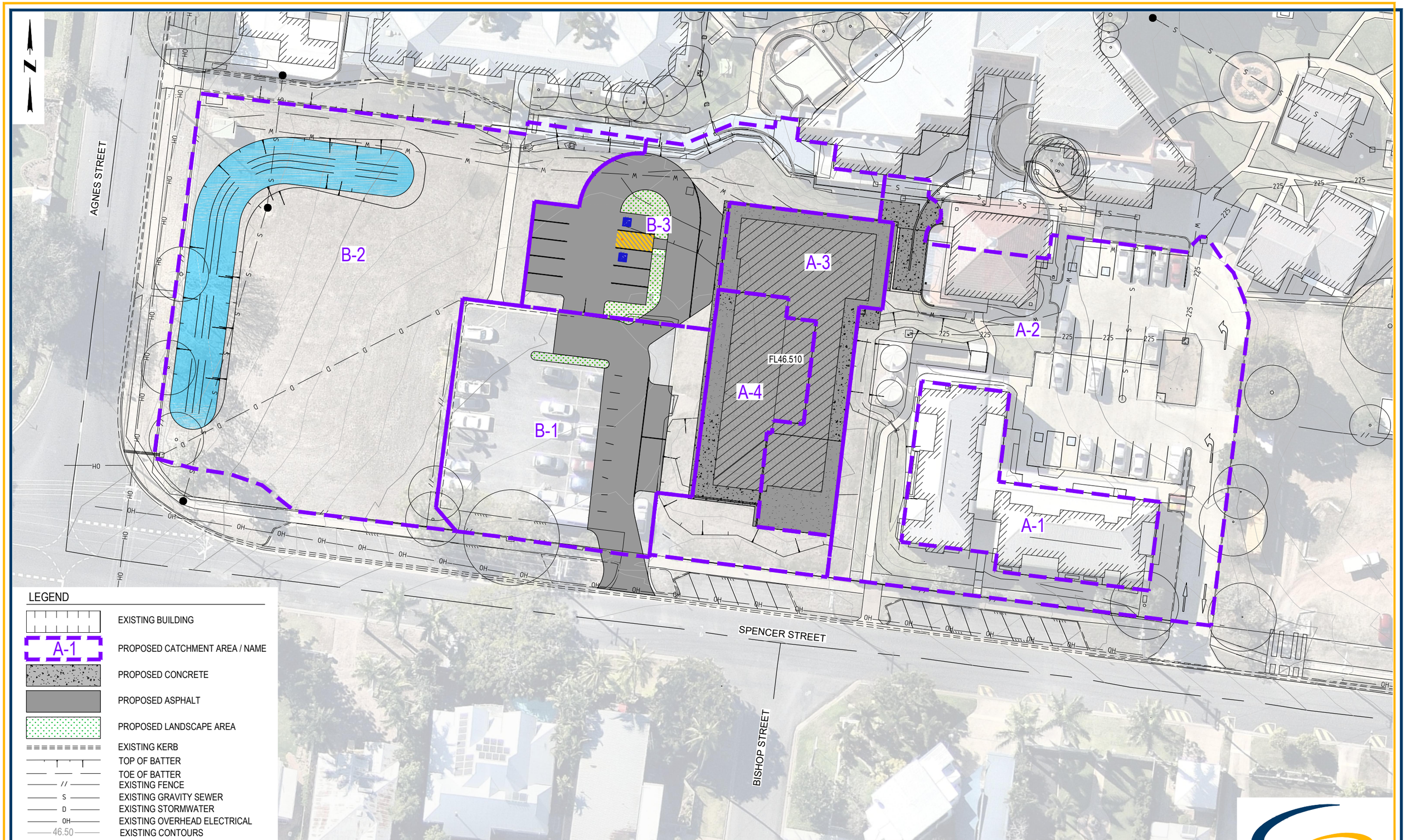
calibre

ROCKHAMPTON BRANCH
REFERENCE: 18-000432
REV: 1
DRAWN: AB

BETHANY RESPITE AND REC CENTRE, 75 WARD STREET, ROCKHAMPTON

Appendix B Proposed Catchment Plan

MERCY HEALTH AND AGED CARE CENTRAL QUEENSLAND LIMITED C/- BICKERTON MASTERS ARCHITECTURE



LEGEND

- EXISTING BUILDING
- A-1 — PROPOSED CATCHMENT AREA / NAME
- PROPOSED CONCRETE
- PROPOSED ASPHALT
- PROPOSED LANDSCAPE AREA
- EXISTING KERB
- TOP OF BATTER
- TOE OF BATTER
- EXISTING FENCE
- S — EXISTING GRAVITY SEWER
- D — EXISTING STORMWATER
- OH — EXISTING OVERHEAD ELECTRICAL
- 46.50 — EXISTING CONTOURS

18-000432 BETHANY RESPITE CENTRE

SK002 PROPOSED STORMWATER CATCHMENT PLAN

ROCKHAMPTON REGIONAL COUNCIL

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0 1.25 5.0m
0 2.5 10.0m

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

calibre

ROCKHAMPTON BRANCH
REFERENCE: 18-000432
REV: 1
DRAWN: AB

BETHANY RESPITE AND REC CENTRE, 75 WARD STREET, ROCKHAMPTON

Appendix C Stormwater Management Plan

MERCY HEALTH AND AGED CARE CENTRAL QUEENSLAND LIMITED C/- BICKERTON MASTERS ARCHITECTURE

PROPOSED BASIN OUTLET WITH SCREEN FOR DEBRIS PROTECTION.

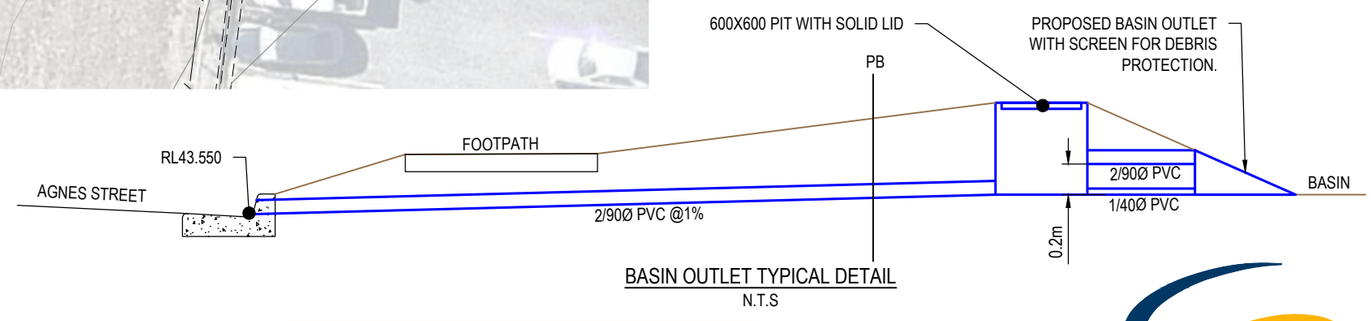
PROPOSED WEIR. RL 44.160 (0.04m DEEP)

AGNES STREET

LEGEND

- EXISTING BUILDING
- PROPOSED CONCRETE
- PROPOSED ASPHALT
- PROPOSED LANDSCAPE AREA
- PROPOSED BASIN
- EXISTING KERB
- TOP OF BATTER
- TOE OF BATTER
- EXISTING FENCE
- EXISTING WATER MAIN
- EXISTING STORMWATER
- PROPOSED STORMWATER
- PROPOSED 3.0m LONG WIER
- EXISTING OVERHEAD ELECTRICAL
- EXISTING CONTOURS

BASIN TYPICAL CROSS SECTION
N.T.S



BASIN OUTLET TYPICAL DETAIL
N.T.S

ROCKHAMPTON REGIONAL COUNCIL

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18-000432 BETHANY RESPITE CENTRE

SK003 STORMWATER MANAGEMENT PLAN

0 0.625 2.5
0 1.25 5.0m

1:125 (A1)
1:250 (A3)

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ROCKHAMPTON BRANCH
REFERENCE: 18-000432
REV: 1
DRAWN: AB

18-000432 BETHANY RESPITE CENTRE

SK004 STORMWATER QUALITY PLAN

ROCKHAMPTON REGIONAL COUNCIL

APPROVED PLANS

These plans are approved subject to the current conditions of approval associated with

Development Permit No.: D/149-2017

Dated: 10 December 2018

0 0.625 2.5
0 1.25 5.0m

1:125 (A1)
1:250 (A3)

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ROCKHAMPTON BRANCH
REFERENCE: 18-000432
REV: 1
DRAWN: AB

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