



4 January 2011

ULDA Ref No: DEV2010/056

Urban Land Development Authority
C/- Place Design Group
Attn Christie Kahukiwa
PO Box 419
FORTITUDE VALLEY QLD 4006

Dear Christie

**RE: UDA DEVELOPMENT APPROVAL FOR RECONFIGURING A LOT – STAGE 1 (1 LOT INTO 35 LOTS) AT
271 BEDFORD ROAD, ANDERGROVE DESCRIBED AS LOT 2 ON RP711645**

I am pleased to inform you that your application was approved on 22 December 2010 in accordance with the attached UDA Development Approval Package.

This application and its decision can also be viewed in the ULDA Development Approvals Register via our website www.ulda.qld.gov.au.

If you have any further questions with regard to the matter, please contact me on 3024 4166.

Yours sincerely

A handwritten signature in black ink, appearing to read "Matt Toon".

Matt Toon
PRINCIPAL PLANNER

UDA Development Approval Package

Site address	271 Bedford Rd, Andergrove
Real property descriptions	Part of Lot 2 on RP711645
Type of application	Reconfiguring a Lot
Description of proposal	Subdivision of 1 into 36 residential lots and new road with a Plan of Development
ULDA reference number	DEV2010/056
Decision	APPROVED
Decision date	22 December 2010

Drawing or Document	Number	Plan or Document Date
Lot Reconfiguration Layout for Stage 1	ULD17_SK01 Rev 5	10.12.2010
Plan of Development	ULD17_SK02 Rev 4	10.12.2010
Andergrove – Stage 1 Landscape Strategy	ULD18_SK01_A	15 December 2010
Andergrove – Stage 1 Streetscape Treatment	ULD18_SK02_C	15 December 2010
Andergrove – Stage 1 Streetscape Sections	ULD18_SK03_B	15 December 2010
Andergrove – Stage 1 Entry Treatment	ULD18_SK04_B	15 December 2010
Andergrove – Stage 1 Landscape Character	ULD18_SK05_A	15 December 2010
Earthworks Layout Plan	BM0020-CSK002 Rev A	03.08.10
Earthworks Cross Sections Sheet 1 of 2	BM0020 CSK003 Rev A	03.08.10
Earthworks Cross Sections Sheet 2 of 2	BM0020-CSK004 Rev A	03.08.10
WRM Water and Environment report Stormwater Management Plan Andergrove, Mackay	Report Number: 0678-01-C Revision No. 0	04 August, 2010.
BMD Consulting Engineering Report - ULDA Andergrove - Stage 1	Job. No. M00020 (BM0020) Revision No. A	August 2010

PROJECT TEAM

Matt Toon Principal Planner Development Assessment Urban Land Development Authority	Con de Groot Principal Engineer Development Assessment Urban Land Development Authority	Phillip Kohn Principal Environmental Planner Urban Land Development Authority
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CONDITIONS		TIMING
1	Carry out the approved development Carry out the approved development generally in accordance with the approved plans/drawing and/or documents.	Prior to survey plan endorsement
2	Complete all Operational Works Complete all operational work associated with this development	Prior to survey plan endorsement

CONDITIONS	TIMING
approval, including work required by any of the following conditions. Such operational work is to be carried out generally in accordance with the approved plans.	
3 Contaminated Land a) Land subject to contamination in Stage 1B on approved Lot Reconfiguration Layout for Stage 1 ULD17_SK01 Rev 5 dated 10.12.2010 is to be remediated in accordance with the Department of Environment and Resource Management's (DERM) <i>Draft Guidelines for the Assessment & Management of Contaminated Land in Queensland</i>. b) Submit to the ULDA a Suitability Statement obtained from DERM removing the site from the Environmental Management Register (EMR).	a) Prior to commencement of site works for each stage 1B b) Prior to survey plan endorsement for each stage 1B
4 Construction Management Plan a) Submit to the ULDA a site based construction management plan that includes but is not limited to: • provision for the management of traffic around and through the site during and outside of construction work hours • provision for parking and materials delivery during and outside of construction hours of work • management of dust generated from the site during and outside construction work hours; • management of sedimentation and erosion which complies with management of groundwater and surface water collection, treatment and disposal in accordance with <i>Mackay Regional Council's Planning Scheme Engineering Design Guidelines</i> • management of Acid Sulfate Soils in accordance with management plans prepared specifically for this site The construction management plan shall be prepared in consultation with the professionals responsible for individual site related management plans to ensure that all aspects of the construction and environmental management are included. The construction management plan shall be reviewed and approved by the principal consultant overseeing and certifying the construction works. b) All work shall be undertaken in accordance with the construction management plan which must be current and available on site at all times during the construction period.	a) Prior to commencement of site works b) At all times during site works
5 Water Supply Reticulation a) Submit and obtain approval from the ULDA of detail engineering drawings for the water reticulation system. This is to be in accordance with "<i>Mackay City Council – Water Supply Water Supply Design - 2008</i>" and certified by a Registered Professional Engineer of Queensland (RPEQ). The detail design of the water infrastructure shall be undertaken by a suitably qualified and experienced	a) Prior to the commencement of site works

CONDITIONS	TIMING
professional engineer and the design/ construction drawings checked and certified by a Registered Professional Engineer Queensland (RPEQ- Civil). b) Upon completion and certification of the works provide to the ULDA "As Constructed" plans including an asset register, checked by a Registered Professional Engineer Queensland (RPEQ-Civil), certifying that the works have been completed in accordance with commonly accepted and appropriate AUS/NZ standards. c) The development must be connected to Mackay Regional Council's reticulated water system at no cost to Council.	b) Prior to survey plan endorsement c) Prior to commencement of use
6 Service, meter assembly & meter box Provide a water service, approved meter assembly and meter box to the boundary of all proposed lots in accordance with the <i>Mackay Regional Council's Planning Scheme Engineering Design Guidelines</i>.	Prior to survey plan endorsement
7 Sewerage reticulation a) Submit to ULDA for approval detailed engineering drawings for the sewer reticulation system. This is to be in accordance with <i>Mackay City Council - Sewerage System -2008</i> and certified by a Registered Professional Engineer of Queensland (RPEQ). b) Upon completion and certification of the works the developer shall prepare and provide to the ULDA "As Constructed" plans including an asset register, checked by a Registered Professional Engineer Queensland (RPEQ-Civil), certifying that the works have been completed in accordance with commonly accepted and appropriate AUS/NZ standards. c) The development must be connected to Mackay City Council's reticulated sewerage system, and at no cost to Council.	a) Prior to the commencement of site works b) Prior to survey plan endorsement c) Prior to the commencement of use
8 Stormwater Quality a) Submit to the ULDA for approval detailed plans demonstrating the stormwater quality works for Stage1 are generally in accordance with the approved <i>WRM Water and Environment report Stormwater Management Plan Andergrove, Mackay dated 4th August, 2010</i>. b) Construct works generally in accordance with part a) of this condition. These works are to be certified by Registered Professional Engineer Queensland (RPEQ). c) Upon completion of the works submit to the ULDA "As Constructed" plans including an asset register in accordance with <i>Mackay Regional Council's Planning Scheme Engineering Design Guidelines</i>, certified by a Registered Professional Engineer Queensland (RPEQ-Civil).	a) Prior to the commencement of site works b) Prior to survey plan endorsement c) As indicated

CONDITIONS	TIMING
9 Stormwater System a) Submit to ULDA for approval designs and hydraulic calculations for the proposed stormwater drainage system checked and certified by a Registered Professional Engineer Queensland (RPEQ) in accordance with <i>Mackay Regional Council's Planning Scheme Engineering Design Guidelines</i>. The application and design needs to demonstrate the following. • The underground stormwater pipe system is to take the minor storm flow for a minimum ARI 5 year rainfall event without surcharge and demonstrate that overland flow paths are provided for up to ARI 100 year runoff events clear of allotments and with suitable depth and velocity so as not to be a hazard to people or property. • The proposed and constructed stormwater and flood management works downstream of the outlets and any hydraulic effects these may have on the stormwater system. • Stormwater drainage system within Bedford Road adjoining the estate shall fully contain the Q5 event. Critical flows between Q5-Q100 are to be assessed and adequate flow corridors determined. All proposed and existing lots in Bedford Road in the region of the proposed development to have flood immunity in the Q100 event. b) Connect the development to the Mackay Regional Council's stormwater system. Upon completion of the works provide to the ULDA "As Constructed" plans including an asset register, checked by a Registered Professional Engineer Queensland (RPEQ-Civil), certifying that the works have been completed in accordance with Mackay Regional Council's <i>Planning Scheme Engineering Design Guidelines</i> and in accordance with part (a) of this condition.	a) Prior to the commencement of site works b) Prior to survey plan endorsement
10 Flood Management a) Submit to the ULDA for approval detailed plans showing works for Stage1 as detailed in <i>WRM Water and Environment report Stormwater Management Plan Andergrove, Mackay dated 4th August, 2010</i>. b) Construct works as detailed on the approved plans. These works are to be certified by Registered Professional Engineer Queensland (RPEQ). c) Upon completion of the works submit to the ULDA "As Constructed" plans including an asset register in accordance with Mackay Regional Council's Planning Scheme Engineering Design Guidelines, certified by a Registered Professional Engineer Queensland (RPEQ-Civil).	a) Prior to the commencement of works on site b) Upon approval of part a) of this condition c) Prior to survey plan endorsement

CONDITIONS	TIMING
11 Filling and Excavation a) Earthworks are to be undertaken generally in accordance with approved BMD Consulting • Earthworks Layout Plan No. BM0020-CSK002 Rev A dated 03.08.10 • Earthworks Cross Sections Sheet 1 of 2 Plan No. BM0020 CSK003 Rev A dated 03.08.10 and • Earthworks Cross Sections Sheet 2 of 2 BM0020-CSK004 Rev A dated 03.08.10 b) Submit certification from a Registered Professional Engineer Queensland (RPEQ) specialising in geotechnical engineering stating that all constructed cut/fill batters and/or retaining structures have achieved adequate stability with a factor of safety greater than 1.5 and that all cut and fill operations have been carried out in accordance with AS3798 and any unsuitable material encountered has been treated or replaced with suitable replacement material.	a) At all times during earthworks b) Prior to survey plan endorsement
12 Road works a) Submit for approval to the ULDA engineering design/ construction drawings, checked and certified by a Registered Professional Engineer of Queensland (RPEQ-Civil). This is to be in accordance with Mackay Regional Council's <i>Geometric Road Design</i> and <i>Cycleway and Pathway Design</i> and BMD Consulting <i>Engineering Report - ULDA Andergrove - Stage 1 dated August 2010</i>. The designs are to include but not limited to the following. • Single lane roundabout at the existing Monique Court intersection. • Bedford Road as a Major Collector Road. • Unless endorsed by the Mackay Regional Council, the use of permeable pavement must be removed from any engineering reports and engineering and landscape drawings. b) Construct the road works generally in accordance with part a) of this condition c) Submit to the ULDA certification from an RPEQ (Civil) that all roads and associated works (e.g. stormwater drainage, kerb and channel, concrete footpaths, signage, traffic islands) have been constructed in accordance with part a) of this condition.	a) Prior to the commencement of road works b) Prior to survey plan endorsement c) Prior to the commencement of use
12 Street lighting Design and install a street lighting system (including connections and energising) to all roads within and bounding the subdivision and to all footpaths/bikeways within road reserves and parks associated with the subdivision at no cost to Council. The design and construction of the street lighting system must:	Prior to survey plan endorsement

CONDITIONS	TIMING
• be in accordance with Mackay Regional Council's <i>Planning Scheme Engineering Design Guidelines</i>. • meet the relevant requirements of the electricity supplier • be acceptable to the electricity supplier as 'Rate 2 Public Lighting'	
14 Footpaths a) Construct footpaths in accordance with BMD Consulting report <i>Engineering Report ULDA Andergrove - Stage 1 dated August 2010</i> and Mackay Regional Council's <i>Planning Scheme Engineering Design Guidelines</i>. b) Upon completion of the works submit to the ULDA "As Constructed" plans including an asset register in accordance with Mackay Regional Council's <i>Planning Scheme Engineering Design Guidelines</i> and certified by a Registered Professional Engineer Queensland (RPEQ-Civil).	a) Prior to survey plan endorsement b) Upon completion of the works
15 Electricity Submit to the ULDA either: a) written evidence from Ergon demonstrating that existing underground low-voltage electricity supply is available to the newly created lots or b) written evidence from Ergon that the applicant has entered into an agreement with an authorised electricity supplier (e.g. Ergon) to provide underground electricity services.	Prior to survey plan endorsement
16 Telecommunications Enter into an agreement with a telecommunication carrier to provide underground telecommunication services to each new lot within proposed subdivision.	Prior to survey plan endorsement
17 Service Conduits & Mains Supply and install all service conduits and meet the cost of any alterations to public utility mains, existing mains, services or installations required in association with the approved development in accordance with Mackay Regional Council's <i>Planning Scheme Engineering Design Guidelines</i>.	Prior to survey plan endorsement
18 Install Fire hydrants Install fire hydrants in the perimeter Road 2 between housing and retained bushland in accordance with Mackay Regional Council's <i>Planning Scheme Engineering Design Guidelines</i>.	Prior to survey plan endorsement
19 Streetscape Works a) Provide public streetscape works including street trees and landscaping generally in accordance with the approved Andergrove – Stage 1 Landscape Strategy ULD18_SK01_A, Andergrove – Stage 1 Streetscape Treatment ULD18_SK02_C, Andergrove – Stage 1 Streetscape Sections ULD18_SK03_B, Andergrove – Stage 1 Entry Treatment ULD18_SK04_B and Andergrove – Stage 1	a) Prior to endorsement of survey plan

CONDITIONS	TIMING
Landscape Character ULD18_SK05_A dated 15 December 2010. b) Provide 12 months maintenance to the landscaping and street trees commencing on receipt of written confirmation from the ULDA that planting is satisfactory. c) Obtain from the ULDA written confirmation that the landscaping has been maintained to a satisfactory standard.	b) As indicated c) At the conclusion of the 12 months maintenance period
20 Dedication of Land fronting Bedford Road - Mackay Regional Council as a Nominated Assessing Authority Dedicate to Mackay Regional Council a 4 meter wide land strip along the eastern boundary, fronting Bedford Road to increase the existing Bedford Road reserve from 20m to 24m.	Prior to endorsement of survey plan
21 Infrastructure Contributions Pay to the Urban Land Development Authority a monetary contribution towards the cost of the provision of essential infrastructure. The contribution will be calculated at the time of payment as follows: The contribution will be equivalent to the charge that would have applied to the development under the Mackay Regional Council's <i>Contribution Policies Indexed Contribution Rates (ICR)</i> in place and at the time of declaration of the Urban Development Area (UDA), reviewed on 1 July each year and increased by the amount calculated by multiplying the Infrastructure Contribution applying immediately preceding the relevant Review Date by the annual compounding average for the Queensland Roads and Bridges Construction Index for the preceding five (5) calendar years.	Prior to endorsement of survey plan

Standard Advice

Mackay Regional Council (MRC)

For any conditions in this package that require the consideration of MRC, you will need to submit the relevant forms, plans and/or reports and fee to the MRC. When satisfied that the condition has been met, the MRC will issue a response in the manner required by the condition/s (e.g. a letter of endorsement or authorisation or a permit).

Noise and Dust Emissions

You are advised that all development involving the emission of noise and dust from building/construction activities requires that such emissions be in accordance with the requirements of the *Environmental Protection Act 1994*.

Pursuant to Division 3 Section 440R of the Act, a builder or building contractor must not carry out building work on a building site in a way that makes or causes audible noise to be made from the building work:

- (a) on a Sunday or public holiday, at any time or
- (b) on a Saturday or business day, before 6.30 a.m. or after 6.30 p.m.

Urban Land Development Authority

DEV2010/056

Subdivision of 1 into 36 residential lots and road

Please note: The above information has been provided to the applicant as an advice only, and does not form part of the development approval conditions. This advice has been provided to the applicant to inform them of other obligations they may have to comply with (under state legislation or local laws) prior to their activity commencing.

**** End of Package ****



PLACE
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ENVIRONMENT

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PROJECT
STAGE 1
ANDERGROVE UDA
MACKAY

CLIENT
URBAN LAND
DEVELOPMENT
AUTHORITY

NOTES

ISSUE CODE	ISSUE DESCRIPTION	BY	CHK	DATE
1	PRELIMINARY LOT RECONFIGURATION	TW	CA	24.08.2016
2	PRELIMINARY LOT RECONFIGURATION	TW	CA	28.08.2016
3	PRELIMINARY LOT RECONFIGURATION	TW	CA	22.11.2016
4	PRELIMINARY LOT RECONFIGURATION	TW	TS	03.12.2016
5	PRELIMINARY LOT RECONFIGURATION	TW	TS	10.12.2016

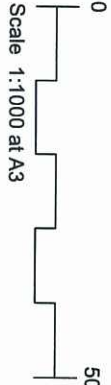
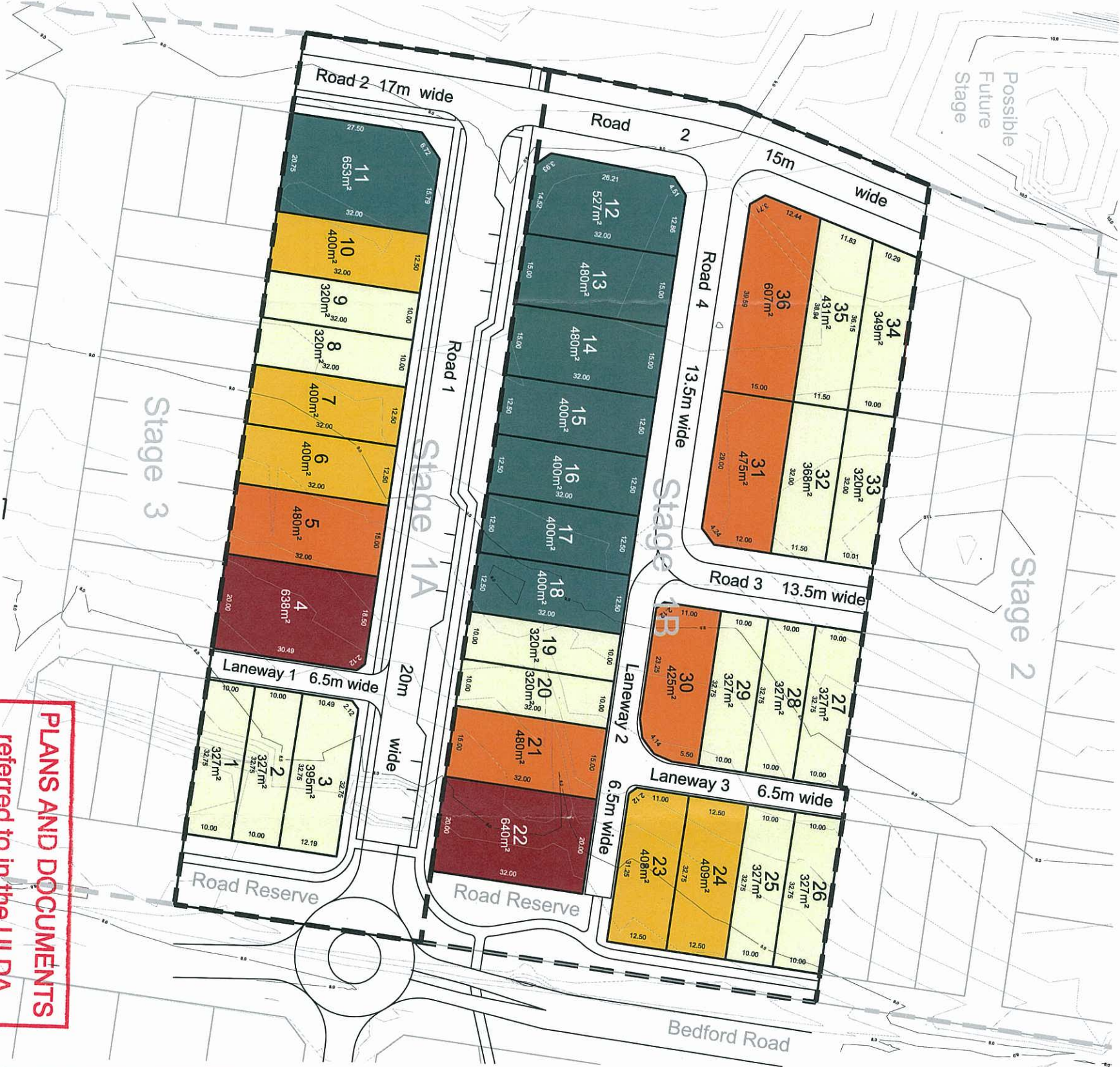
DRAWING TITLE
LOT RECONFIGURATION
LAYOUT FOR STAGE 1

DESIGN : CA
DOCUMENT : ULD17
PROJECT : ULD17
SCALE : 1:1000@A3



SHEET NUMBER : ULD17_SK01
REVISION : 5

Development Statistics		
Area	Stage 1A	Stage 1B
Additional Road Reserve	479m ²	848m ²
Open Space	-	-
Total Area	0.96ha	1.48ha
Area of Lots	0.46ha (48%)	1.03ha (68%)
Net Density	26 dw / ha	24 dw/ha
Lot Mix and Yield		
Traditional (20m + frontage)	1	1
Courtyard (15m frontage)	1	4
Villa (12.5 - 14.9m frontage)	3	2
Villa (10m-12.4m frontage)	5	11
Multi Family Dwellings	1 lot / 2 dw	7 lot / 2dw
Total	11 lots / 12 dwellings	25 lots / 32 dwellings
Roads		
6.5m Laneway	37m	118m
13.5m Wide	-	122m
15m Wide	-	50m
17m Wide	52m	32m
20m Wide	167m	-





PLACE
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Approved dimensions state procedures over any measures of scale. Verify all dimensions on site prior to construction.
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PROJECT
STAGE 1
ANDERGROVE UDA
MACKAY

CLIENT
URBAN LAND
DEVELOPMENT
AUTHORITY

NOTES

ISSUE	DATE	BY	CHK	DATE
1. PRELIMINARY PLAN OF DEVELOPMENT	TW 24.02.2010			
2. PRELIMINARY PLAN OF DEVELOPMENT	TW 24.02.2010			
3. PRELIMINARY PLAN OF DEVELOPMENT	TW 24.02.2010			
4. PRELIMINARY PLAN OF DEVELOPMENT	TW 10.12.2010			

DRAWING TITLE

PLAN OF
DEVELOPMENT

DESIGN : CA
DOCUMENT : ULDT7
PROJECT : ULDT7
SCALE : 1:1000@A3



SHEET NUMBER : 4
ULDT7_SK02



BUILDING SETBACK TABLE											
Lots without lane	Width of lot frontage										
	Villa Allotments		Villa Allotments		Courtyard Allotments		Traditional Allotments		Multi-Family Dwellings		
	10m-12.4m	Ground floor	12.5m-14.9m	Ground floor	15m-19.9m	Ground floor	20m+	Ground floor	Ground floor	Ground floor	
Front (Primary)	2.4*	2.4	2.4*	2.4	2.4*	2.4	2.4*	2.4	2.4*	2.4	
Side											
- build to boundary	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	0.0	1.0	
- not build to boundary line	0.9	0.9	1.0	1.0	1.0	1.5	1.2	2.0	1.2	2.0	
Rear	0.9	1.0	0.9	1.0	0.9	1.0	1.0	2.0	1.0	2.0	
Secondary frontage											1.5
Park											
- side / rear to lane											1.0 metre or minimum 0.0 metre to verandah / balcony and 2.4 metres to wall
Lots with lane											
Primary frontage											2.4
Side / rear to lane											1.0
Side / rear to park											1.0 metre or minimum 0.0 metre to verandah / balcony and 2.4 metres to wall
Secondary frontage											1.2
*4.5m to garage or carport door											

Car Parking & Driveways

16. No vehicular access to Bedford Road
17. Minimum of 1 covered on-site car parking space is to be provided for each dwelling.
18. Garages are to be recessed behind the main building line except where on laneways.
19. For Conventional allotments (not Laneway Allotments) the following applies:
 - Double garages will not be permitted on single-story dwellings on a lot less than 12.5m wide
 - Double garages will not be permitted on any lot less than 10.0m wide
 - Double garages may be permitted on a lot 10.0m, + wide and less than 12.5m wide where the dwellings is more than one storey in height, and where:
 - The garage is setback at least 1m behind the main face, excluding balconies, of the dwelling AND
 - The maximum width of a driveway, comprising a mix of materials and colours, or are staggered
 - Serving a single garage shall be 4.8m at the lot boundary
 - Serving a double garage shall be 9.6m at the lot boundary
 - On lots with a frontage of less than 12.5 metres:
 - The maximum width of a garage shall be no more than 40% of the lot frontage, except on northern boundary of lots 12-17 - 17 where the maximum width of a garage shall be no more than 50% of the lot frontage
 - Double garages are not permitted.
 - Double width garages are not permitted.
20. A maximum of one driveway per dwelling is permitted, except in the case of lots 12 - 17 where an additional driveway may be permitted to access an additional dwelling.
21. Driveways should avoid on-street works such as dedicated on-street parking bays, drainage pits and service pillars
22. The minimum distance of a driveway from an intersection of one street with another street shall be 6.0 metres
23. The minimum distance between driveways on the same lot shall be 3.0 metres at the boundary, except in the case of Laneway Allotments where driveways to Lot Homes can be combined with driveways to parking spaces for other dwellings on the site lot, or in the case of lots 12 - 17 where an additional driveway may be permitted to access an additional dwelling.
24. Garages served off a laneway must be built to meet the minimum 1.0 metre Rear Setback.

Site Cover and Amenity

25. Site cover of each lot is not to exceed 60% at ground level and 50% at the second level, except for where lot apartments are proposed and MFD lots where site cover should not exceed 75% of the lot area.
26. Private open space at ground level must not be less than 12m² and minimum dimension of 2.4m and with a maximum gradient not exceeding 1 in 10. Private amenity space for apartments/units above ground level must not be less than 5m² which may be in the form of a balcony with a minimum dimension of 1.2m.
27. Second storey verandas and windows are screened or obscured to a side boundary

Fencing & Landscaping

28. Private Open Space on each lot is located for access to northern, north-easterly or eastern sunlight
29. Fencing of primary frontage is to be partially transparent with a maximum height of 1.5m; OR solid fencing with a maximum height of 1.2m.
30. Fencing of lots adjoining Bedford Road and Road 1 are to be partially transparent with a maximum height of 1.5m; OR solid fencing with a maximum height of 1.2m; AND shall provide pedestrian gate/ access to public pathways on Bedford Road.
31. Fence on corner lots should be designed as front fences addressing both streets (rather than a front and a side fence).

Buildings

32. Buildings with a width of more than 10 metres that are visible from a street or a park should be articulated to reduce the mass of the building by:
 - windows recessed into the facade
 - balconies, porches or verandas provided
 - window hoods provided
 - shadow lines created on the building through minor changes in the facade (100 millimetres minimum)

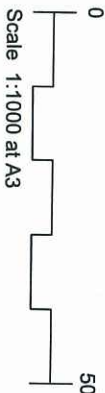
33. Left apartments should:

- have a clearly identifiable and addressed front door and undercover point of entry
- incorporate in all walls adjoining the main dwelling and private open space areas of the main dwelling:
 - windows with a minimum sill height of 1500 millimetres or privacy screening
 - low maintenance building materials and non-reflective finishes
 - no external drainage or other pipes

34. Multi-family dwellings should:

- have a maximum of two storeys in height
- have a clearly identifiable and addressed front door and undercover point of entry
- incorporate an area of private open space such as a balcony or veranda with a minimum depth of 1.2 metres and a minimum area of 5.0 sqm, preferably overlooking the street or an area of public open space
- have screened drying and rubbish bin areas behind the main face of the dwelling
- incorporate at least two openings to all habitable rooms, including internal windows and lowered windows to facilitate cross ventilation

PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 22 / 12 / 10



0 50

Scale 1:1000 at A3

Introduction

Project aim

The ULDA will work in partnership with the Mackay Regional Council to bring the Mackay Depot site at Andergrove into the urban fabric of the City. A diverse residential neighbourhood will be created which is affordable, sustainable, interconnected and demonstrates best practice principles in housing estate design, water sensitive design, landscape design and tropical architecture.

Vision for the site

“Newton Park” will become an exemplar residential neighbourhood which is distinguished by its natural core and leafy green character, is connected to surrounding schools, shops, community facilities and adjacent parks by comfortable, attractive and safe pedestrian and cycle networks and provides a range of housing options for the future.

Guiding Principles

Housing the future

- Provide a range of housing choices with different lot sizes, building forms, tenures and intensities to accommodate the needs and aspirations of the local community whilst demonstrating new forms of housing for the future.
- Promote tropical architecture.

A connected place

- Make new connections east-west across the site through multi-purpose greenways which accommodate vehicle, pedestrian and cycle movements, opening new vistas which visually as well as physically connect this new neighbourhood to the surrounding urban fabric.
- Utilise street tree planting and detailing to create a strong connecting landscape character.
- Use the treatment of streets to reinforce a clear hierarchy of pedestrian and cycle routes and spaces.
- Enhance pedestrian and cycle facilities on Bedford Road to support local trips to nearby schools, shops and open spaces.

A green heart

- Retain significant vegetation in core areas and define use and movement patterns to minimize impacts while making the natural values of the site accessible.
- Apply water sensitive urban design to heal the western edge of the site to Broomdykes Park and create a new north-south greenway which could link beyond the site to significant natural areas to the north.
- Strike a balance between natural and built elements considering land form, climate, landscape and ecology to maximise environmental conservation and amenity and contribute to the desired landscape character.

A distinctive neighbourhood

- Draw on the site's landscape features and vegetation to create a distinctive residential environment with a green living heart which provides ecological, amenity and recreation benefits for its residents and surrounding residents.
- Create a strong gateway entrance on Bedford Road.
- Explore new expressions of tropical architecture appropriate for the Mackay context.
- Develop a materials palette for public spaces which will compliment the desired leafy green character.

A good neighbour

- Consider interfaces between existing residences and open spaces and weave the new urban fabric in at these edges.
- Stage implementation to ensure the amenity of new residents is not impacted upon by existing uses.

A safe place to live

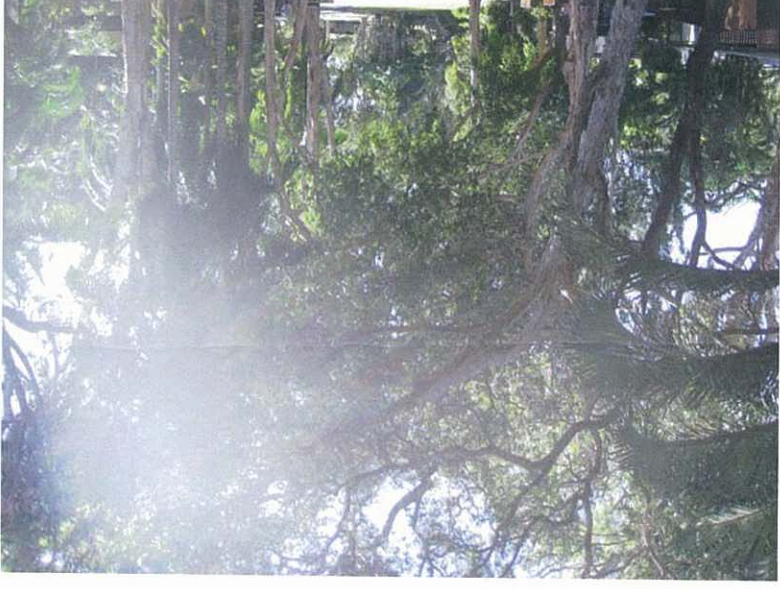
- Minimise bushfire risk through the location of public roads between natural areas and housing to create fire breaks.
- Locate higher order roads adjacent to natural areas to improve surveillance and personal safety.
- Ensure the purpose of public spaces is clear and avoid dead end parkland.



EXISTING PALM GROVES IN AREAS TO BE DEVELOPED WILL BE ROLOCATED TO KEY AREAS ON SITE.



THE SITE VEGETATION IS AN ATTRACTIVE AND UNUSUAL MIX OF PALMS, PAPERBARK AND GUMS.



INFORMAL STREET TREE CHARACTER OF A LOCAL STREET.

Landscape Guidelines

Landscape Character

The existing character of the site is characterised by the remnant vegetation community, which has an unusual mix of cabbage palms, paperbarks and gums (Livistona decora, Melaleuca leucadendra, Corymbia tessellaris and Eucalyptus tereticornis). The bushy nature of the site and the mix of vegetation type will be used as a strong identifiable element that defines a distinctive neighbourhood. The existing bushland character of the site will be preserved in streetscapes by:

- Retaining views to the bush along streets wherever possible
- Retaining significant trees in streets where possible
- Relocating existing cabbage palms in areas to be developed to key locations in streets where space permits
- Using species endemic to the site where appropriate
- Adopting an informal street tree planting through irregular spacing and a mix of species
- Introducing areas of low maintenance groundcover planting in key locations in streets

Tropical streets

A hierarchy of street treatments will be used on main access streets, minor access streets and laneways. Street treatments will be appropriate for a tropical residential area and allow for:

- The minimum widths of carriageways
- Generous width of footpaths to encourage walking and provide good connectivity
- Maximum shade along footpaths and roads wherever possible
- Safety and CPTED principles by maintaining good visibility and low planting

Entry treatment

The entry treatment will be a strong gateway and provide an identity for the estate, reinforcing the sense of community and local natural values. Cabbage palms will be a major theme for the estate entry:

- Existing mature cabbage palms will be relocated in groves at the entrance and roundabout to create an instant and dramatic landscape
- A bold sculptural sign in laser cut Corten steel will preserve the silhouette of the grove of palms to be removed
- The entry and roundabout will feature areas of mass groundcover planting of decorative, hardy and low-maintenance species to compliment the palms
- A small grove of mature cabbage palms will be relocated to terminate the vista of the entry road

Stormwater treatment

Water sensitive design will be incorporated into streets to minimise and clean storm water run-off from road reserves. Bio-filtration areas will be:

- An attractive element of the streetscape on Bedford Road
- Use native plant species
- Reinforce the bushy character

Street Trees

Street trees will be:

- Provided at a minimum of one tree per lot
- A minimum of 1m from the front of kerb, 3m from a driveway and 7.5m from a street light
- Planted as 45lt stock
- Native species selected for their performance criteria in each street location

Footpaths

Concrete footpaths vary in width depending on their location:

- 2m wide to allow for bicycles and pedestrians on main routes
- 1.5m wide to allow prams and wheelchairs to comfortably pass each other on most streets
- 1.2m wide on minor streets

Footpaths are on one side of the street only, except on main access routes that will be highly trafficked, which will have paths on both sides of the street.

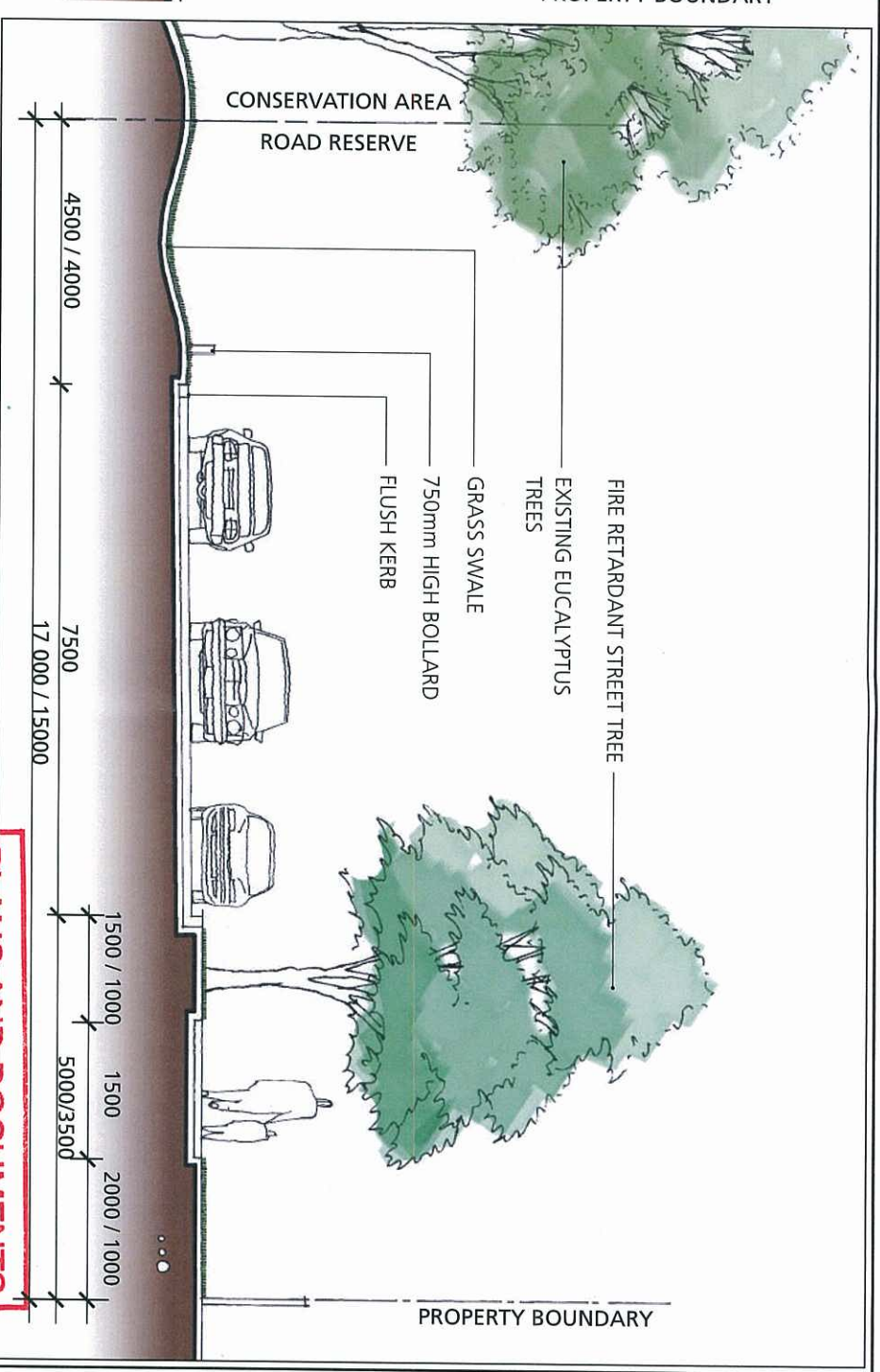
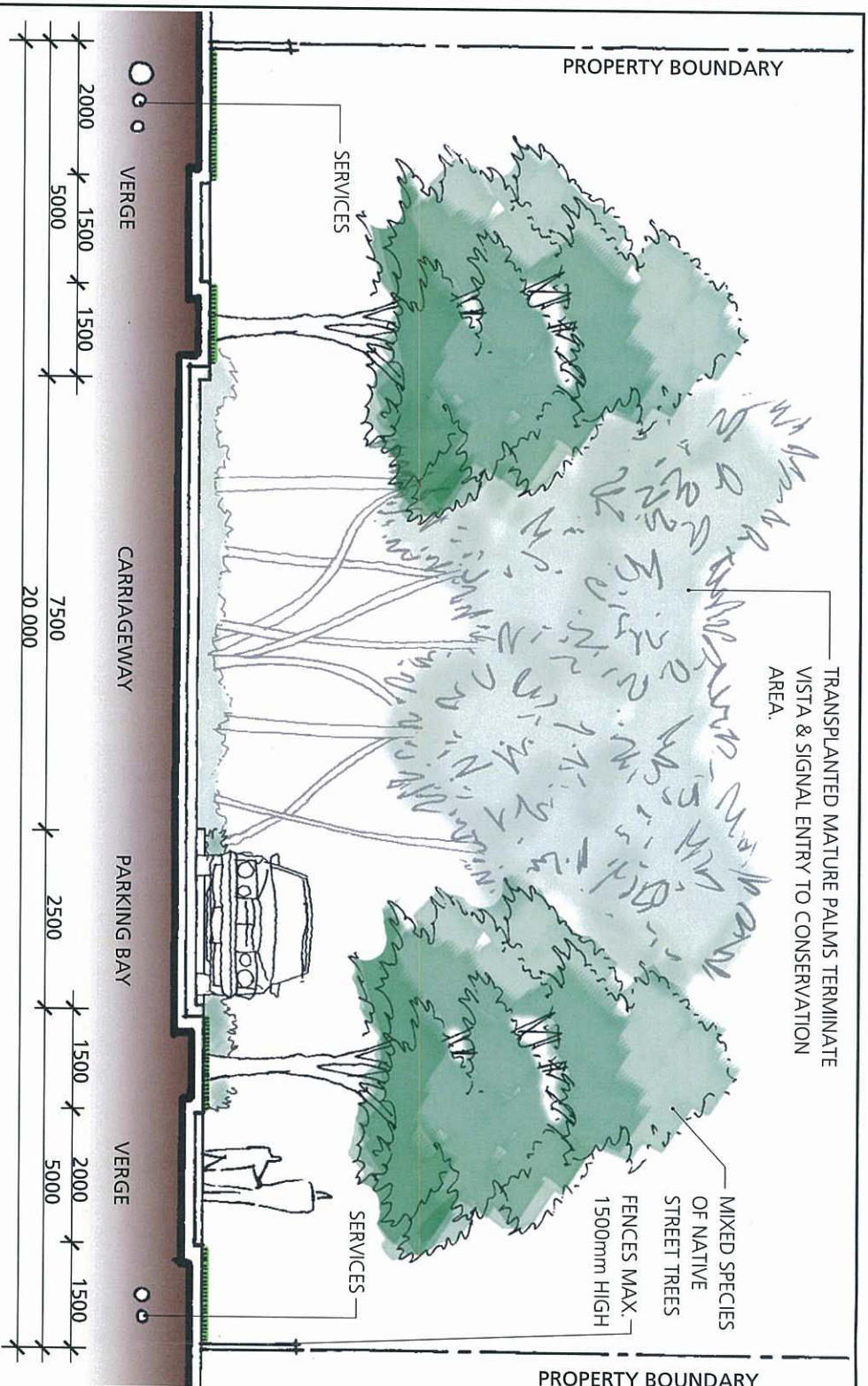
Fences

Fences will be partially transparent:

- Front boundaries - maximum 1.5m high and partially transparent OR 1.2m high and solid
 - Side boundaries - maximum 1.8 high and partially transparent OR 1.5m high and solid
- All fences on Bedford Road or Road 1 will be treated as for front boundaries

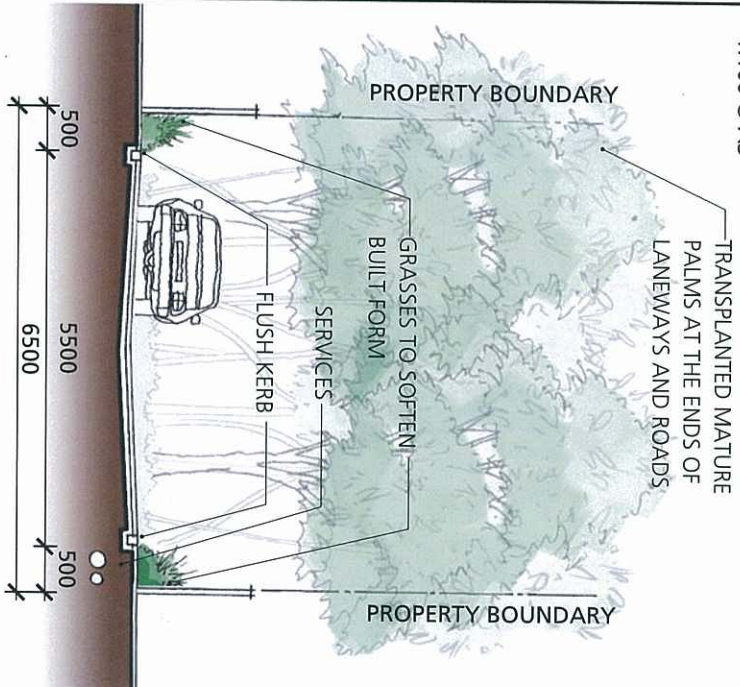
PLANS AND DOCUMENTS referred to in the ULDA APPROVAL dated 22/12/16



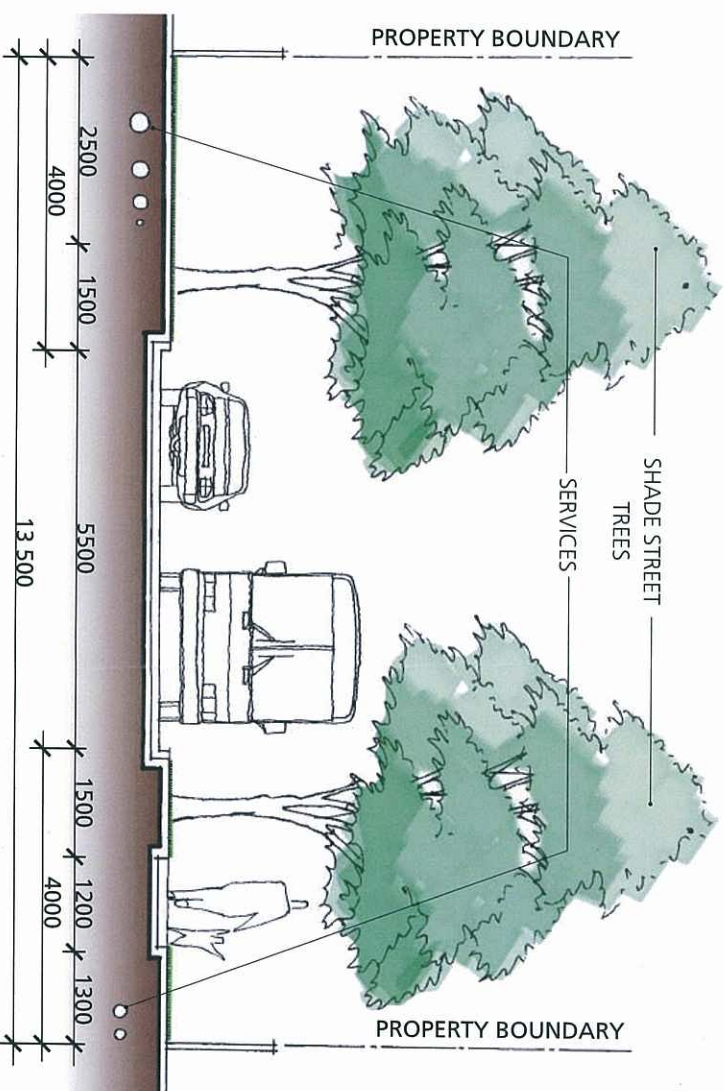


SECTION A - ROAD 1
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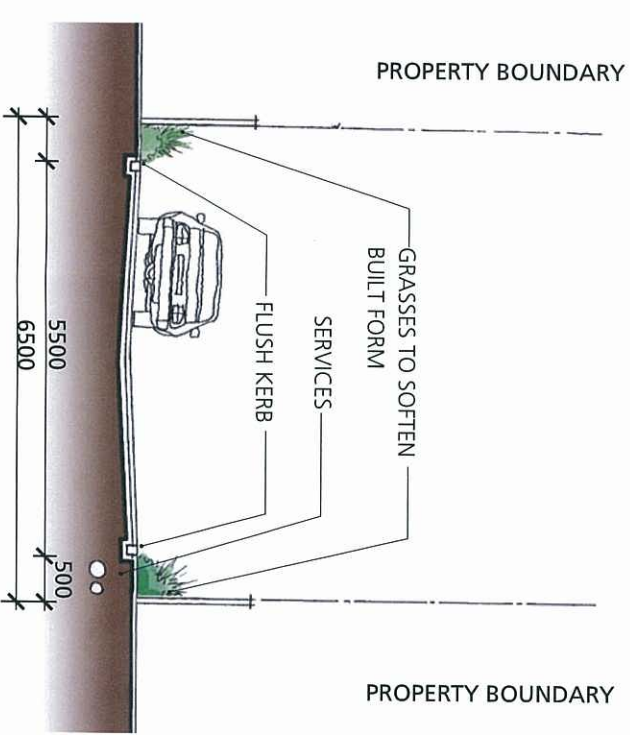
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SECTION C - LANEWAY 2
1:100 @ A3

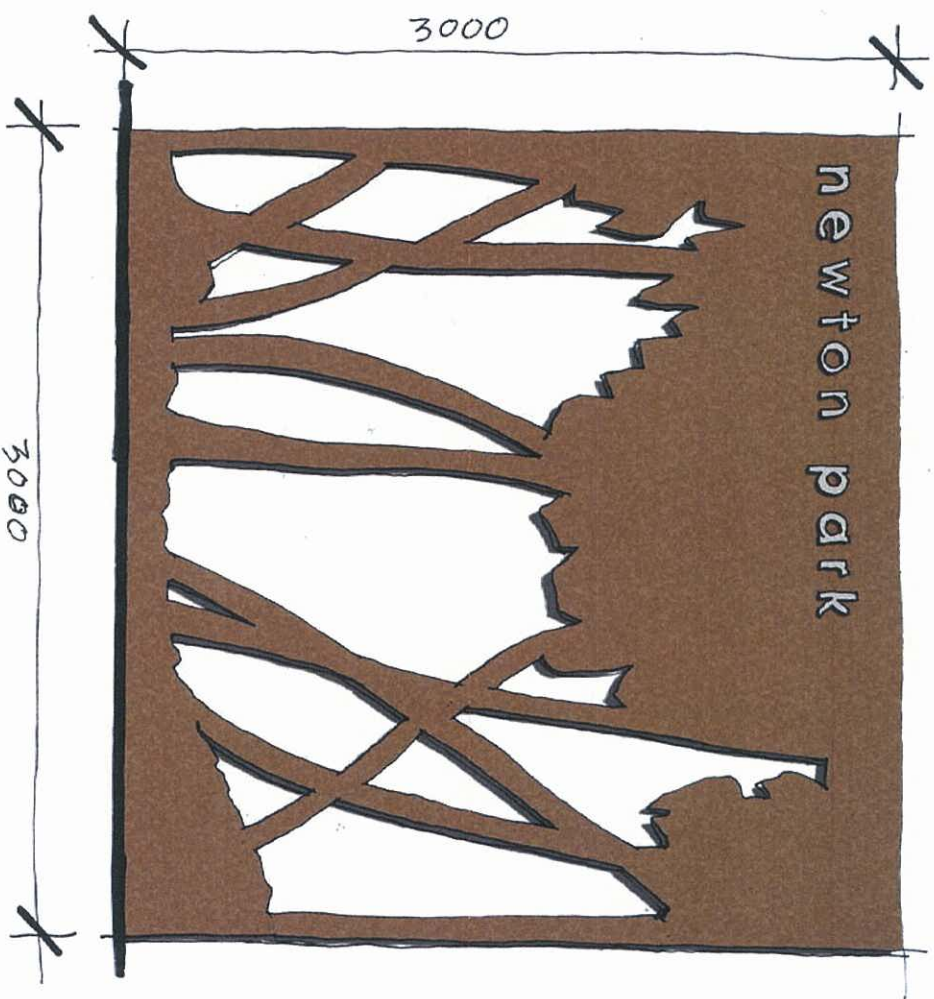


SECTION D - ROAD 3 AND 4
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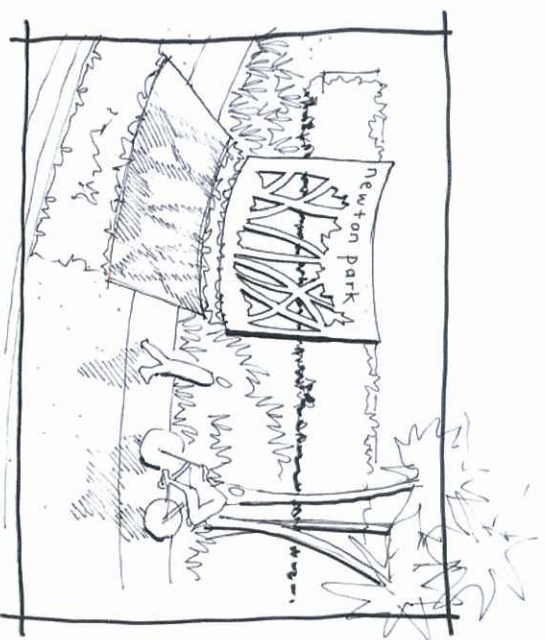


SECTION E - LANEWAY 1 AND 3
1:100 @ A3

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LASER CUT CORTEN STEEL SIGN



EXAMPLE OF CUT CORTEN STEEL



IMAGERY FOR SIGN DERIVED FROM CABBAGE PALM GROVE



INDICATIVE AREA FOR BIO-FILTRATION,
DETAIL DESIGN AT OP WORKS

NEW PALMS

FEATURE TIMBER FENCE TO FORM
ATTRACTIVE BACKDROP TO ENTRY

TRANSPLANTED MATURE PALMS

2M WIDE PEDESTRIAN AND
CYCLE PATH

MASS FEATURE GROUNDCOVER
PLANTING

CORTEN STEEL ENTRY SIGN AND
SCULPTURE (REFER SKETCH DETAIL)

PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 22/12/10

TRANSPLANTED MATURE PALMS WITH
LOW UNDERSTOREY PLANTING (MAX
700MM HIGH)

NEW PALMS

FRONT FENCES ARTICULATED AT
ENTRIES

TRANSPLANTED MATURE PALMS

2M WIDE PEDESTRIAN AND
CYCLE PATH

INDICATIVE AREA FOR 600M² OF
BIO-FILTRATION, DETAIL DESIGN AT
OP WORKS

LARGE EUCALYPTS AND SHADE TREES
ALONG BEDFORD ROAD FRONTAGE

DETAIL PLAN A -
ENTRY TREATMENT

0 5 10 15 20M
SCALE 1:200 @ A1



Street Trees	
Ayteria divaricata	Rose Tamarind
Brachychiton acerifolius	Illawarra Flame Tree
Callistemon viminalis	Weeping bottlebrush
Cassia brewsteri var tomentella	Velvet Bean
Corymbia ptychocarpa	Swamp bloodwood
Corymbia tessellaris # *	Moreton Bay Ash
Cupaniopsis anacardioides #	Tuckeroo
Eucalyptus tereicornis # *	Old Blue Gum
Euroschinus falcatus	Ribbonwood
Ficus virens # *	White Fig
Flindersia australis	Crows Ash
Livistona decora #	Weeping Cabbage Palm
Lophostemon suaveolens # *	Swamp Box
Melaleuca leucadendra # *	Weeping Paperbark
Pittosporum ferrugineum	Rusty Pittosporum
Pongamia Pinnata	Native Wisteria
Waterhousia floribunda	Weeping Lilly Pilly
Xanthostemon chrysanthus	Golden Penda

Local species found on site * Bedford road frontage only

Shrubs	
Alpinea caerulea	Native Ginger
Atractocarpus fitzalanii	Native Gardenia
Cordyline canifolia	Palm Lily
Gossia inophloia	Blushing beauty
Melaleuca 'Little John'	
Melaleuca linariifolia 'Claret Tops'	Claret Tops
Melaleuca linariifolia 'Dwarf Snow'	Dwarf Snow in Summer
Murraya ovatifoliolata	Native Mock Orange
Vitex trifolia 'Purpurea'	Purple Vitex

Groundcovers	
Babingtonia virgata "Dwarf"	Miniature Baeckea
Baloskion pallens	Didgery Sticks
Dianella caerulea	Flax Lily
Dianella caerulea	Flax Lily
Dietes bicolor	Spanish Iris
Lomandra longifolia 'Bunyip'	Mattrush
Molinera capitulata	Palm Lily

Bio-filtration	
Crinum pedunculatum	Swamp Lily
Dianella caerulea	Flax Lily
Hymenocallis littoralis	Spider Lily
Hymenocallis littoralis Thai Spider	Variagated Spider Lily
Gahnia sieberiana	Swamp Gahnia
Isolepis nodosa	Knobby Club Rush
Lepidosperma laterale	Variable Sword Sedge
Lomandra hystrix	Creek Matt Rush
Lomandra longifolia	Matt Rush



FIG TO BE RETAINED



ROAD 2 - PARK EDGE

DOCUMENTS
referred to in the ULDA
APPROVAL dated 22/12/10



PERMEABLE FENCE 1800



PERMEABLE FENCE 1500



Brachychiton acerifolius



Corymbia tessellaris



Cupaniopsis anacardioides



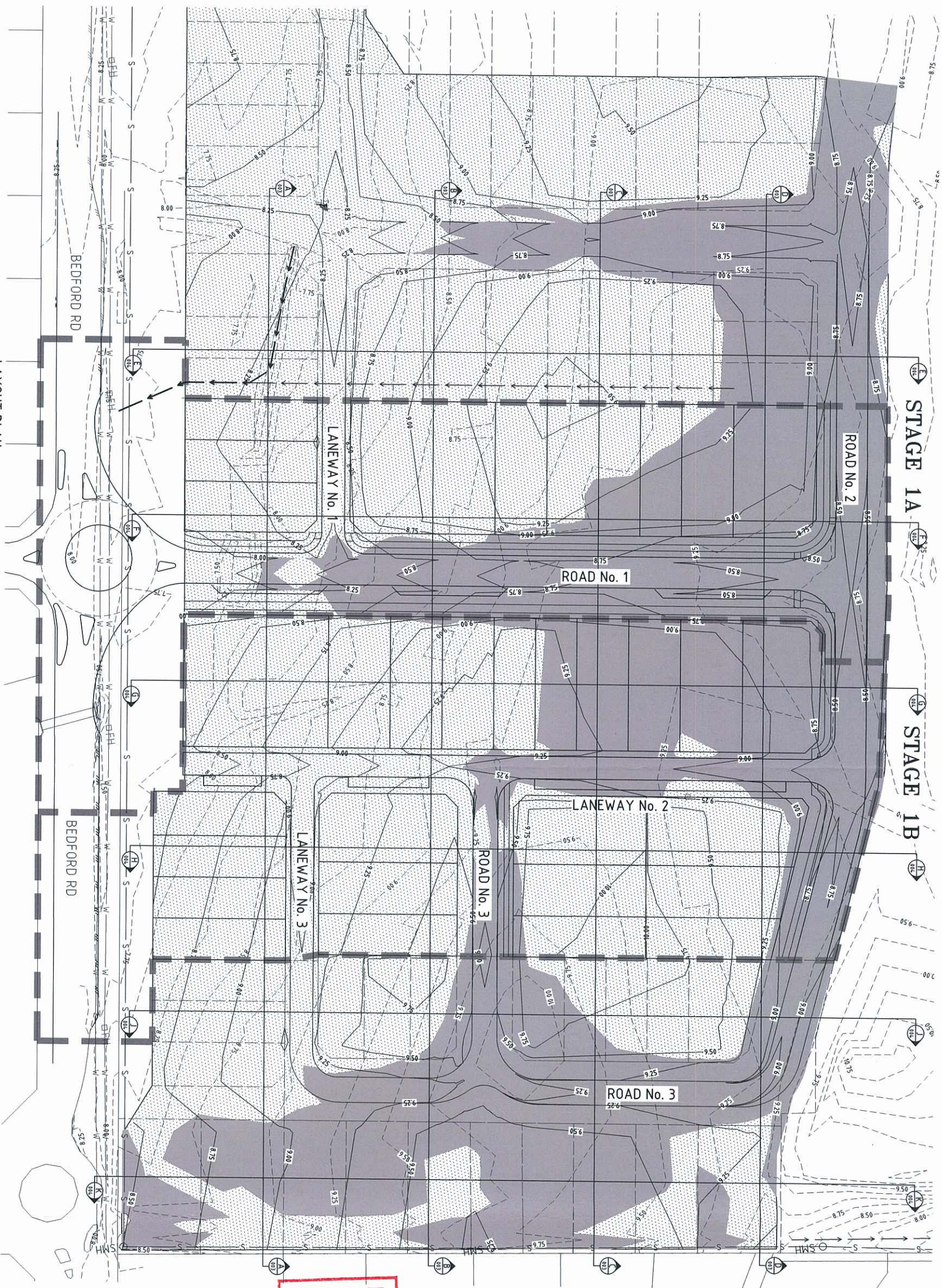
Livistona decora



Xanthostemon chrysanthus



LAYOUT PLAN
SCALE 1500



- LEGEND**
- STAGE BOUNDARY
 - EXISTING CONTOURS (0.25m INTERVAL)
 - DESIGN CONTOURS (0.25m INTERVAL)
 - TEMPORARY DIVERSION DRAIN
 - CUT
 - FILL

PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 22/12/10

No.	Revisions	Drawn/Design	Appd	Registered Engineer	Reg No.	Date
A	ORIGINAL ISSUE	NP	NP	PC		03.08.10

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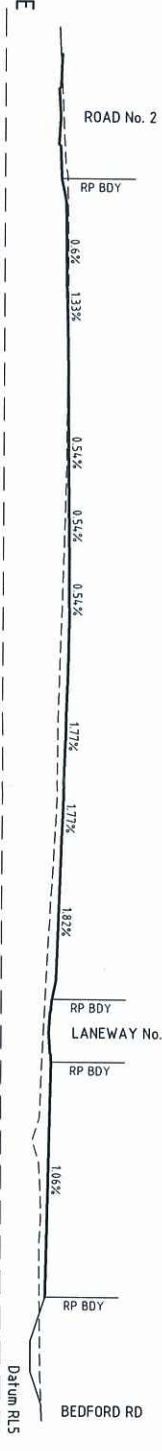
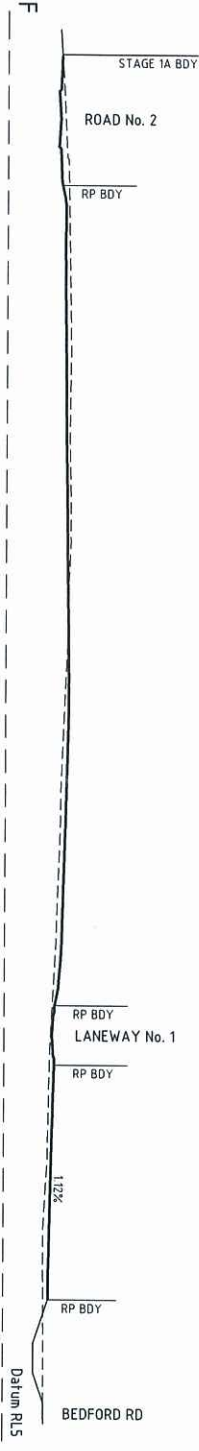
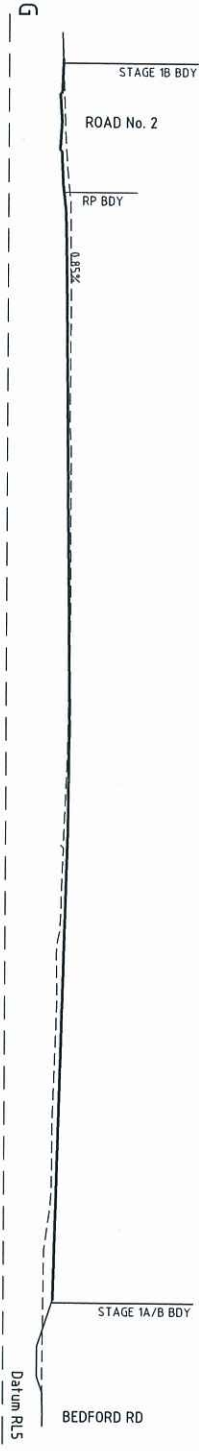
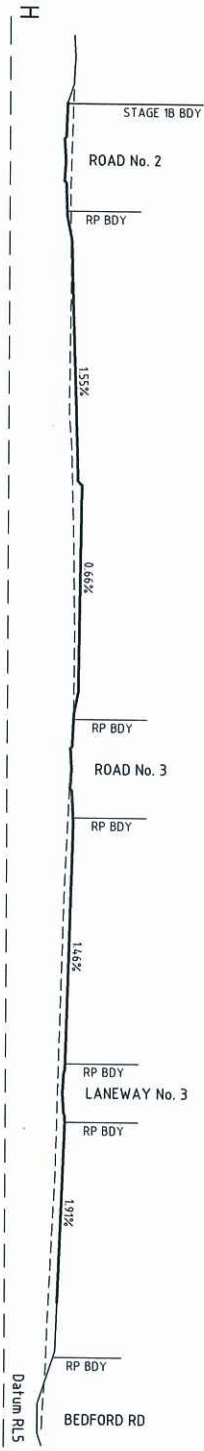
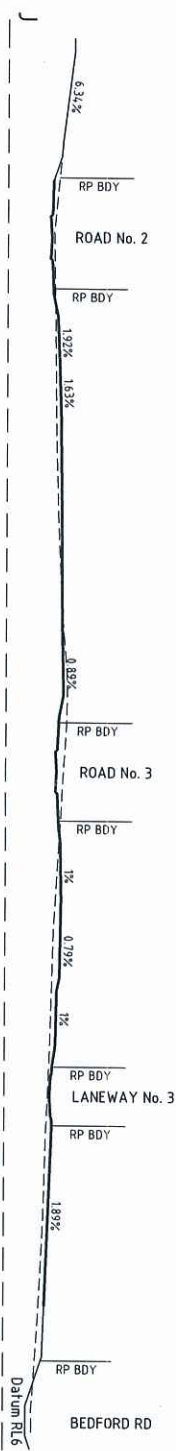
Civil Engineers • Structural Engineers • Project Managers • Water Sampling Co-ordinators
brisbane • canberra • gladesville • gold coast • melbourne • sydney • townsville

Client	Project	Title	Datum	Project No.	Drawing No.	Rev
URBAN LAND DEVELOPMENT AUTHORITY	ANDERGROVE STAGE 1	EARTHWORKS LAYOUT PLAN	PSM RL (INGA) COORD	BM0020-CSK002		A



APPROVAL dated 22/12/19

[illegible]



EARTHWORKS CROSS SECTIONS

SCALE 1:500H 1:250V

[illegible]

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20 YEARS OF
EXPERIENCE

Client	URBAN LAND DEVELOPMENT AUTHORITY		
Project	ANDERGROVE STAGE 1		
Title	EARTHWORKS CROSS SECTIONS SHEET 2 OF 2		
	Datum AHD PSM RL (MGA) COORD	NOT FOR CONSTRUCTION	
	Project No.	Drawing No.	Rev
	BM0020-CSK004	A	

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referred to in the ULDA
APPROVAL dated 22/12/10



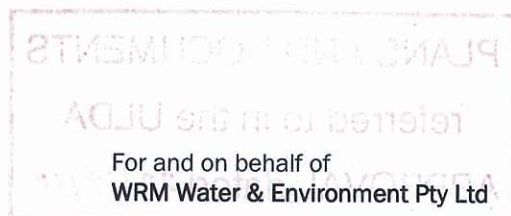
STORMWATER MANAGEMENT PLAN ANDERGROVE, MACKAY

Urban Land Development Authority
04 August 2010

PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 22/12/10

REPORT TITLE: Stormwater Management Plan, Andergrove Mackay
CLIENT: Urban Land Development Authority
REPORT NUMBER: 0678-01-C

Revision Number	Report Date	Report Author	Reviewer
DRAFT 1	15 July 2010	EJ	DN
0	04 August 2010	EJ	DN



For and on behalf of
WRM Water & Environment Pty Ltd



David Newton
Director

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1 INTRODUCTION

WRM Water & Environment has been commissioned by the Urban Land Development Authority (ULDA) to prepare a Stormwater Management Plan (SMP) for a proposed residential development on Bedford Road, Andergrove (the subject site). The development is proposed to be developed in seven stages.

This report provides methodology and results of investigations undertaken to develop concept designs of the proposed stormwater quantity and quality management measures for the ultimate developed masterplan.

The objective of this SMP is to ensure that the quality of stormwater runoff from the developed site meets Council's water quality objectives. In addition, there will be no increase in peak discharge flow rates from the development site to ensure that flooding of downstream property is not adversely impacted.

2 SITE CHARACTERISTICS

2.1 LOCATION

The subject site is located in Andergrove, which is in Mackay Regional Council's Local Government Area, 6km north of Mackay's CBD.

The subject site is bounded by Bedford Road to the east, Newton Street to the south, Emperor Drive to the north and Broomdykes Drive to the west. Access from the site is from Bedford Road.

A map extract has been included as Figure 2.1 to identify the location of the subject site.



Figure 2.1 Locality Plan (Source: Google Earth)

2.2 EXISTING CATCHMENT CONDITIONS

Figure 2.2 shows the existing drainage features of the subject site. The majority of the development site consists of open space. The site also includes the Council's depot facilities. Runoff currently drains to two points of discharge;

- Site Discharge Point 1 (SDP1) – Bedford Road (900X600mm box culvert)
- Site Discharge Point 2 (SDP2) – Western boundary (600x300mm box culvert)

A description of each sub catchment is given below and the catchment areas are shown in Table 2.1:

- Subcatchment A is located in the south-eastern corner of the development site and comprises buildings and hard stand areas of the Council depot. This catchment currently drains into sub catchment B.
- Subcatchment B is located along the north-eastern boundary and comprises car parks, hard stand areas of the depot site and grassed farm land. There is a drainage channel through the farm land which drains overland flow to a box culvert (900X600mm) under Bedford Road (SDP1).
- Subcatchment C is in the south-western corner, which comprises dense significant vegetation and a portion of the Council's depot hard standing area. A drainage channel conveys flow from residential lots south of Newton Street through to Sub catchment D.
- Subcatchment D covers the north-western corner of the site and comprises dense significant vegetation and cleared farmland. There is a natural depression in the north-western corner, which ponds water before draining via a small box culvert (600 x300mm) located under a pathway along the western boundary (SDP2) to an existing lake near Caledonian Drive.
- External catchment 1 comprises of urban residential to the south of Newton Street. Runoff from this area drains into the site via a 900mm pipe culvert without treatment.

Table 2.1 Catchment Areas

Sub catchment	Existing (ha)	Proposed (ha)
A	2.24	3.5
B	5.39	4.01
C	3.18	2.17
D1	11.27	7.8
D2	-	2.64
D3	-	1.96
Ext 1	9.97	9.97
Total	32.05	32.05
Contributing area to:		
SDP1	7.63	4.01
SDP2	24.42	28.04

2.3 PROPOSED CATCHMENT CONDITIONS

Figure 2.3 shows the proposed development site configuration and the proposed stormwater management measures. The catchments have been delineated based on the development layout. A description of the proposed development site and drainage characteristics of the various sub catchments is given below and the catchment areas are shown in Table 2.1:

- Subcatchment A will be developed into urban residential and all runoff will be redirected into a wetland in subcatchment C.
- Subcatchment B has been reduced by earthworks to modify the catchment boundaries which will minimise the runoff draining to Bedford Road (SDP1). Runoff from the allotments will drain to bio-filtration pods that will be built into the landscape before exiting the site under Bedford Road.
- Subcatchment C will be partially developed into urban residential, however most of the area will be occupied by the proposed wetland. The residential area and wetland will be designed not to disturb the existing significant vegetation.
- The External catchment 1 will remain urban residential. The runoff currently discharges into the dense significant vegetation on site without treatment. The proposed wetland will provide stormwater quality treatment to this runoff from the external catchment.
- Subcatchment D has been split into three catchments;
 - Subcatchment D1 will remain as dense significant vegetation;
 - Subcatchment D2 will be developed into urban residential and all runoff will drain to a bio-filtration basin and ultimately to SDP2. This catchment includes additional catchment area from existing Subcatchment B.
 - Subcatchment D3 will be developed into urban residential and all runoff will drain to a wetland and ultimately to SDP2. This catchment includes additional catchment area from existing Subcatchment B.

2.4 MASTERPLAN OF DEVELOPMENT

Mackay Regional Council have proposed a regional wetland system south of Caledonian Drive. The western subcatchments of the development will drain to this wetland before entering McCreadys Creek. Council have agreed that this wetland system can be incorporated into the treatment train for runoff discharging to the west. However they cannot confirm the construction date of this system, so to avoid delay to this development, onsite treatment has been proposed. The following stormwater management measures will be included into the overall masterplan;

Stormwater Quality Measures

- All developed runoff discharging east to Bedford Road will be treated via a series of bio-filtration pods (B1). This bio-filtration system will be constructed in Stage 1.
- All developed runoff from Stage 1 and 2 flowing west will be directed to a bio filtration basin (B2) located on the western boundary of Stage 1. This basin has been sized to account for future development west of Stage 2.
- A vegetated buffer will constructed along the road running north-south along the western boundary of Stage 1 and 2, to deliver part of the road runoff to Basin B2. This bio-filtration system will be constructed in Stage 1.
- A wetland (W1) is proposed in the south end of the development, to treat all runoff from Stages 3, 4 5, 6 and 7.
- Currently runoff from the existing residential area along Newton Street (External catchment 1) flows into the significant vegetation area on site without treatment.
- The wetland is proposed to also treat the runoff from this external residential area, in order provide greater protection to the significant vegetation on site. This goes above and beyond the standard requirements for the proposed development.
- A vegetated buffer will be constructed along the road fronting the significant vegetation area, running north-south along the western boundary of Stages 3, 4 and 5 allow part of the road runoff to drain to a vegetated buffer and deliver them to the wetland (W1). The remaining runoff will be directed to the wetland via pipes and surcharge flow paths.

Stormwater Quantity Measures

- Onsite detention is not required at SDP1, as the proposed catchment areas have decreased, therefore conveying less flow to the east and maintaining the existing flow rates.
- The wetland in the south will sit within the base of a detention basin to provide the onsite detention requirements for all runoff discharging west (SDP2).
- This wetland/detention basin is proposed to be constructed in Stage 3.

Stage 1 will be cut and filled to form up to 35 allotments ranging in size from 245m² to 495 m². The following proposed stormwater management measures will be included in Stage 1 only;

- A number of bio-filtration pods (B1) will be designed into the landscape along the entry road of Stage 1 and the upgraded road reserve of Bedford Road.
- The proposed earthworks for Stage 1 has decreased the runoff draining to the east, so that on-site detention is not required to ensure that the existing flow rates are maintained at Bedford Road.

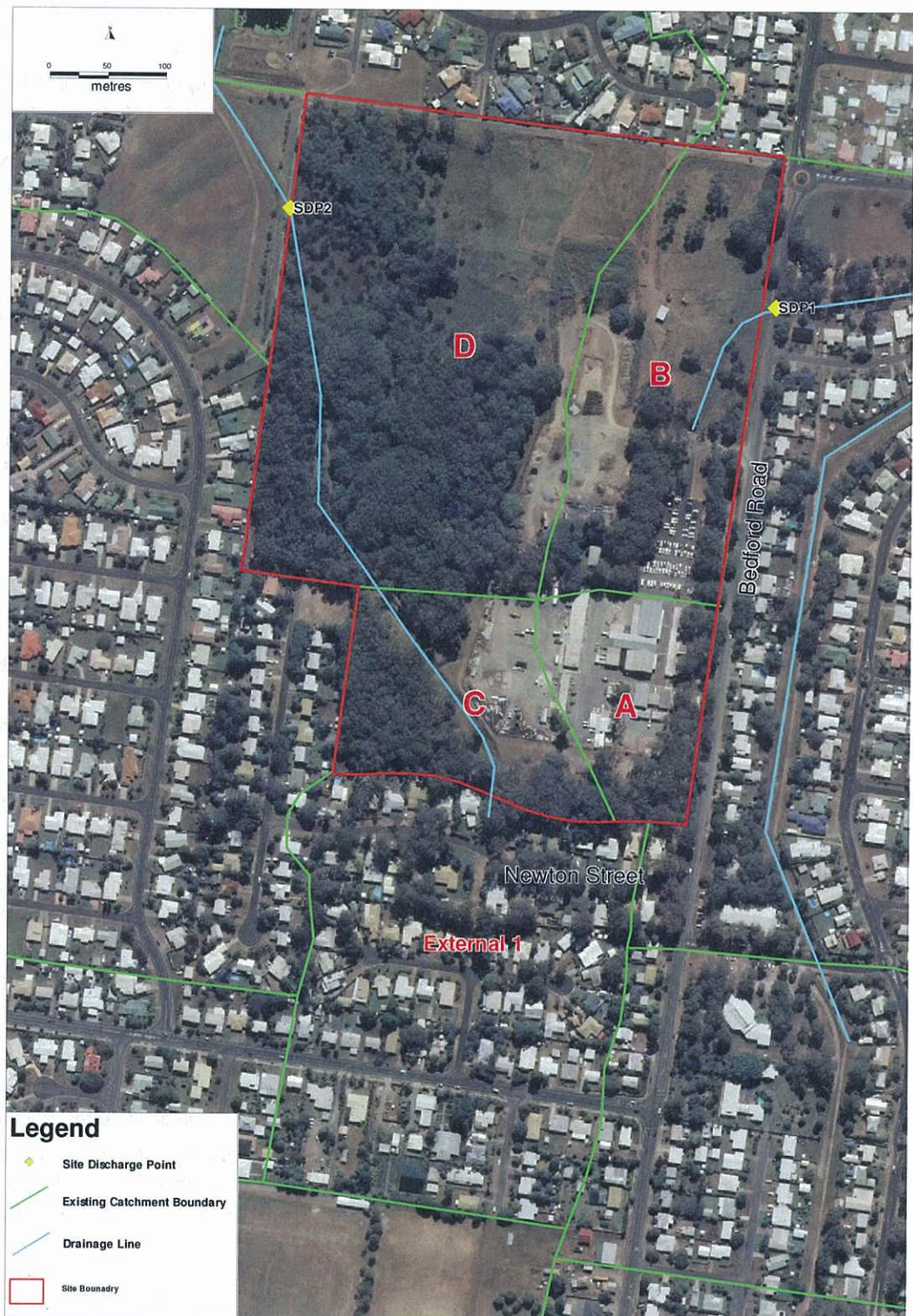


Figure 2.2 Existing Catchment Characteristics



Figure 2.3 Proposed Developed Conditions and Stormwater Management Measures

3 ESTIMATION OF DISCHARGES

3.1 OVERVIEW

The 'RAFTS' runoff-routing model (XP Software, 2001) was used to estimate design discharges from the existing and developed site and to design the proposed detention basin on site.

Separate models were developed for existing and developed conditions to reflect the changes in catchment associated with the development.

The Rational Method was used to calibrate discharges estimated by the RAFTS model.

3.2 ADOPTED DESIGN RAINFALLS

Design rainfall patterns and intensities for the area were determined using standard procedures in Australian Rainfall and Runoff (IEAust, 1998).

3.3 RAFTS HYDROLOGIC MODEL

3.3.1 Configuration

For the existing catchment conditions, four subcatchments have been used to represent runoff from the catchment, plus an additional sub catchment to represent runoff from the external catchment to the south of Newton Street.

For the developed catchment conditions, six subcatchments have been used to represent runoff from the development, plus one external catchment to represent runoff from the external catchment to the south of Newton Street. Figure 3.1 shows the configuration of the RAFTS model for the developed catchment conditions.

3.3.2 Existing Conditions Parameters

Table 3.1 shows the RAFTS parameters adopted for the pre-developed catchment.

Table 3.1 RAFTS Model Parameters, Existing Conditions

Sub catchment	Catchment Area (ha)	Catchment Slope (%)	Percentage Impervious (%)	Mannings 'n'
A	2.24	0.5	80	0.04
B	5.39	0.5	12	0.04
C	3.18	1.1	22	0.04
D	11.27	0.5	0	0.06
Ext A	9.97	1.3	70	0.045

3.3.3 Development Conditions Parameters

For the developed catchment conditions, the RAFTS model was reconfigured to reflect the proposed changes to catchment areas.

Table 3.2 shows the revised catchment areas and RAFTS parameters adopted for the proposed Ultimate Development Catchment conditions:

Table 3.2 RAFTS Model Parameters, Developed Conditions

Sub Catchment	Catchment Area (ha)	Catchment Slope (%)	Percentage Impervious (%)	Mannings 'n'
A	3.5	1	70	0.04
B	4.01	1	70	0.04
C	2.17	1	0	0.06
D1	7.8	1	0	0.06
D2	2.64	1	70	0.04
D3	1.96	1.3	70	0.04
Ext A	9.97	1.3	70	0.045

3.4 MODEL CALIBRATION

The Rational Method was used to estimate design flood discharges for existing and developed conditions at each site discharge point. A C10 value of 0.7 was adopted for undeveloped conditions assuming medium density bush and medium soil permeability (QUDM, 2007), and 0.86 was used for the existing industrial areas on the site. A C10 value of 0.84 was adopted for urban residential development. These runoff coefficients were based on the expected percent impervious areas in accordance with QUDM (2007). The Rational Method Calculations are shown in Appendix A.

Table 3.3 shows a comparison of existing and developed Rational Method and RAFTS model discharges at each site discharge point.

The RAFTS discharges generally correspond well to the Rational Method discharges and have been adopted for this study. RAFTS model calibration was achieved using:

- Initial and continuing rainfall losses of 15 mm and 2.5mm/hr for all agricultural land for all storms;
- Initial and continuing rainfall losses of 0 mm and 1 mm/hr for all industrial land for all storms; and,
- A BX factor of 1 has been adopted

For existing and developed conditions, the critical storm duration is 60 minutes for all ARI design discharges.

Table 3.3 Rational Method and RAFTS Model Discharges at Bedford Road (SDP1)

Event ARI (Years)	Existing Discharge (m ³ /s)		Developed Discharge (m ³ /s)	
	Rational Method	RAFTS	Rational Method	RAFTS
1	1.03	0.95	0.72	1.00
2	1.43	1.35	0.99	1.40
5	2.08	1.94	1.44	1.92
20	3.06	2.83	2.09	2.54
50	4.00	3.36	2.72	2.86
100	4.71	3.99	3.20	3.23

Table 3.4 Rational Method and RAFTS Model Discharges on western boundary (SDP2)

Event ARI (Years)	Existing Discharge (m ³ /s)		Developed Discharge (m ³ /s)	
	Rational Method	RAFTS	Rational Method	RAFTS
1	2.52	2.99	2.98	3.75
2	3.53	4.17	4.17	4.94
5	5.18	5.71	6.14	6.85
20	7.69	7.70	9.15	9.38
50	10.12	9.06	12.07	10.85
100	11.91	10.38	14.22	12.43



Figure 3.1 Proposed RAFTS Model Configuration

4 WATER QUANTITY MANAGEMENT

4.1 GENERAL

The objective of the stormwater quantity management measures proposed for the site is to ensure that the proposed development does not increase downstream discharges. There are two discharge points from the site.

1. SDP1 - To the east, via culverts under Bedford Road; and,
2. SDP2 - To the west via culverts along the western boundary.

The earthworks during Stage 1 will direct more flow to the west. Therefore the existing flow rate at SDP1 can be maintained without any detention measures for all storm events greater than a 5yr ARI. The increase in developed flow rates for 1yr and 2yr ARI storm event is negligible.

To mitigate the increased runoff to the west (SDP2), a detention basin is proposed in the south-west corner of the developed area. The detention area will utilise storage above the standing water level of the proposed wetland.

The wetland will be adjacent to the existing drainage channel. Low flows will be diverted into the wetland for treatment. The proposed wetland will have two inlet ponds, one at the northern end of the wetland and the other at the southern end just downstream of the existing discharge point from the external catchment. All runoff from Stage 3, 4 and 5 will enter the wetland from the northern inlet pond and all runoff from Stage 6 and 7 and southern external catchment via the southern inlet pond. Conceptual details of the wetland are provided in Section 6. The detail design of the wetland/detention basin will be undertaken at Operational Works Stage.

The 'RAFTS' runoff routing model (XP Software, 2001) described in Section 3 was used to determine the required size of the detention basin.

4.2 DETENTION BASIN

The proposed detention basin will mitigate the potential increased discharges due to the proposed development at the western site discharge point (SPD2).

Figure 4.2 shows the approximate location and configuration of the detention basin. Concept design details are given in Table 4.1. The basin flows will be discharged either by the spillway or by the proposed pipe outlet to the existing downstream channel. The base level of the basin has been assumed to be the standing water level in the wetland.

Figure 4.1 shows simulated water levels hydrographs in the basin for various ARI storm events. That the maximum water in the basin reaches 8.0m and the basin has returned to the standing water in the wetland (6m) within approximately six hours. This short ponding time should not impact of the vegetation of the wetland.

Table 4.1 Detention Basin Parameters

Base Level	6.0m AHD
Base Surface Area	1750m ²
Q100 Peak Water Level	8m AHD
Detention Volume	6000m ³ (at 8.0m AHD)
Total Basin Area	4400m ²
Basin Depth*	2.0 m
Outlet Configuration	3 x 750mm pipe, 0.2%
Spillway*	10m wide (at 7.7m AHD)
Internal Batters	1V:6H on three sides,

* From standing water level in the wetland

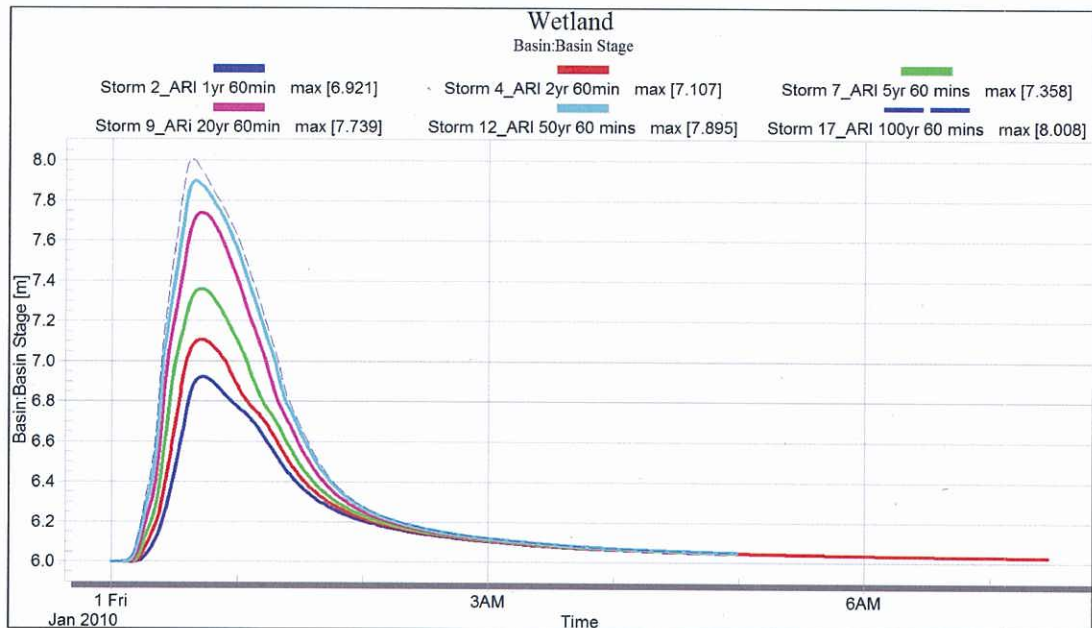


Figure 4.1 Stage Hydrograph in the proposed wetland

4.2.1 Proposed Detention Stage Storage Curves

Table 4.2 shows the adopted stage storage relationship for the proposed detention basin.

Table 4.2 Adopted Stage Surface Area- Storage Relationship

Stage (m AHD)	Detention Basin	
	Surface Area (m ²)	Storage (m ³)
6	1750	0
6.1	1750	175
7	2700	2177.5
8	4440	5747.5

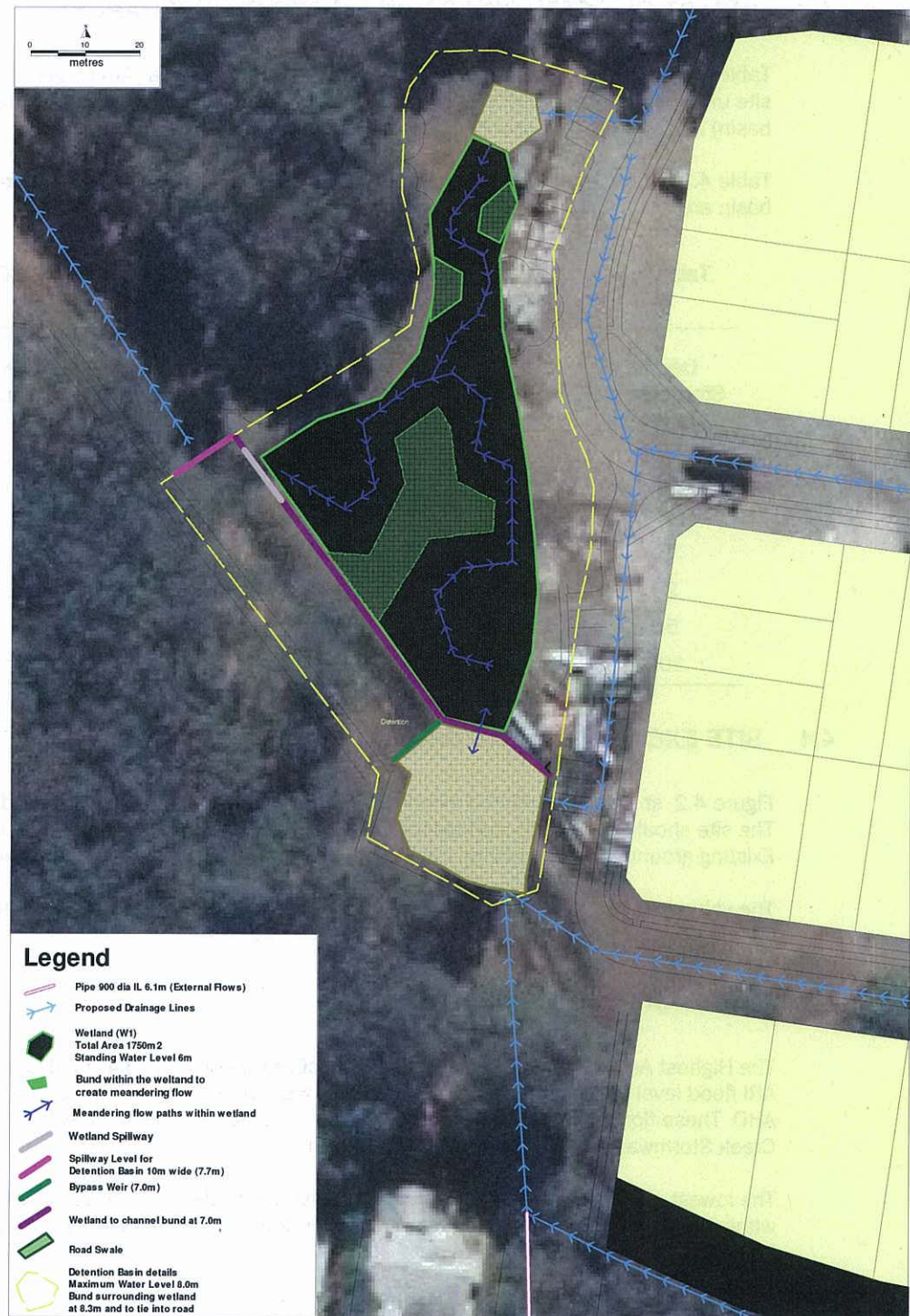


Figure 4.2 Wetland/Detention Basin Details

4.3 IMPACT OF DETENTION BASIN ON DESIGN DISCHARGES

Table 4.3 shows the calculated 1, 2, 5, 10, 20, 50 and 100 year ARI design discharges for the site under existing and developed site conditions (with and without the proposed detention basin) as determined by the RAFTS model.

Table 4.3 shows that the developed site conditions discharges with the proposed detention basin are less than or equal to existing site conditions discharges at SDP2.

Table 4.3 Design Discharges at SDP2 with and without Detention Basin

Design Storm Event (ARI years)	SDP 2 Discharge (m ³ /s)			Peak Water Level in Basin (m)
	Existing Site Conditions	Developed Site Conditions		
		Without basin	With Basin	
1	2.99	3.75	2.37	6.92
2	4.17	4.94	3.29	7.11
5	5.71	6.85	4.35	7.35
20	7.70	9.38	5.86	7.74
50	9.06	10.85	7.84	7.89
100	10.38	12.43	9.85	8.00

4.4 SITE EXCAVATION FOR DRAINAGE

Figure 4.2 shows the expected extent of disturbance for the proposed wetland/detention basin. The site should be cut with sufficient grade such that the runoff drains overland to the wetland. Existing ground levels should be maintained downstream of the detention basin.

The volume of earthworks and its suitability for use as fill on site will be assessed at detail design stage.

4.5 REGIONAL FLOOD IMPACTS

The Highest Astronomical Tide (HAT) level in McCrearys Creek is 3.47m AHD, and the 100 year ARI flood level in downstream of the site to the west is 4.29 m AHD and to the east is 7.24 m AHD. These flood levels have been sourced from the HEC RAS model created for the 'McCrearys Creek Stormwater Drainage Study' (KBR, 2006).

The lowest ground level on the subject site within the western catchment is 4.4m AHD and within the eastern catchment is 7.4m AHD. Therefore backwater flooding onto the subject site from McCrearys Creek will not occur.

5 WATER QUALITY OBJECTIVES

5.1 OVERVIEW

The stormwater quality management plan (SQMP) includes the following:

- An outline of the design objectives that must be met by the proposed stormwater treatment system;
- Descriptions and preliminary sizing of Stormwater Treatment Measures (STMs) proposed for the operational phase of the development; and
- Quantitative modelling to demonstrate that the treatment system will meet relevant performance criteria.

The proposed development can be classified as urban residential. The 'MUSIC' model for urban stormwater improvement conceptualisation (CRCCH, 2005) was used to assess the mitigated developed site runoff quality, and determine the performance of the proposed stormwater treatment system.

The design objectives set out in the 'Stormwater Quality Performance Curves and Stormwater Quality Objectives for Mackay' have been adopted as the water quality objectives (WQO's) for the proposed development.

5.2 WATER QUALITY OBJECTIVES

Table 5.1 gives the best practice load-based design objectives set out in 'Stormwater Quality Performance Curves and Stormwater Quality Objectives for Mackay' (MRC 2009) for site runoff in the operational phase of a development. The design objectives have been adopted as the WQO's for the proposed development.

Table 5.1 Operational Phase Water Quality Objectives

Parameter	Percent Reduction (%)
Suspended Solids	75
Total Nitrogen	40
Total Phosphorous	60
Gross Pollutants	90

The percent reductions given in Table 5.1 are target reductions for comparing mitigated site annual pollutant loads with unmitigated site annual pollutant loads. The treatment train selected for the proposed development will ensure design objectives are met for all pollutants.

The Mackay Stormwater Quality Management Plan (2006) lists pollutants that are generally of concern during the operational phase of a residential development. These include:

- Litter
- Sediment
- Nutrients (Total Nitrogen & Total Phosphorus)
- Hydrocarbons
- Heavy Metals

Current WQOs for all pollutants other than litter, total N, total P and suspended solids are either not available or not comparable with the output of water quality models. Therefore, until more appropriate WQOs are available for these pollutants, the maximum possible reduction must be achieved, given the site topography and other constraints.

6

STORMWATER QUALITY MANAGEMENT MEASURES

6.1 ASSUMPTIONS

The objective of the water quality management measures proposed for the site is to ensure the runoff from the development site meets Mackay Quality Objectives at the two site discharge points.

1. SDP 1 - To the east, via culverts under Bedford Road; and,
2. SDP 2 - To the west via culverts along the western boundary.

A bio-filtration basin is proposed to be built into the landscape of the entry road of Stage 1. This bio-filtration will be designed to treat all runoff discharging east to the Bedford Road culverts (SDP1). A bio-filtration basin to the north and a wetland to the south are proposed to treat all runoff discharging to the west (SDP2).

If the Caledonian Drive regional wetland downstream of the site is constructed prior to this development, then the treatment train for all runoff discharging to the west may not be required. In the absence of a known completion date of the regional wetland, the following sections detail the treatment measures required to meet water quality objectives for both site discharge points.

6.2 ADOPTED MEASURES

The proposed stormwater quality management measures for the site, includes the following:

- All dwellings will install a minimum 5kL rainwater tank to collect roof water from a minimum of 50% of the total dwelling roof area. The collected water will be used for gardening purposes, the cold water washing machine tap and toilet flushing.
- Overflow from the rainwater tanks will be directed to the biofiltration areas for treatment prior to discharge from the development site.
- Stormwater from lots, roads and overflows from rainwater tanks will be directed to the kerb and channel within the roadways.
- Two bio-filtration basins and one wetland will be constructed on site. See Figure 2.1 for their location.
- Bio-filtration Basin B1 is to be built into the landscape of the entry road of Stage 1 and designed treat all runoff discharging to the east for all stages.
- Bio filtration Basin B2 is to the west of Stage 1. This basin will treat the runoff flowing to the west in Stage 1 and 2.
- Wetland (W1) will treat runoff flowing to the west for Stages 3,4,5,6 and 7.
- A vegetated swale is proposed along the road fronting the significant vegetation area in Stages 3 to 6, to assist in directing part of the runoff to the wetland. All other runoff from these stages will be directed to W1 by underground drainage and surcharge flow paths.

6.2.1 Bio-filtration Details

- The bio-filtration system will include appropriate pre-treatment measures, such as a GPT or sediment forebay, to protect the filter media surface from inflows of coarse sediment.
- The bio-filtration basins will be used as the tertiary stormwater treatment measure for stormwater discharging from the site. They will be constructed with a 600mm deep filter media of sandy loam and have a 300 mm extended detention depth above the filter media.
- Runoff entering the basin will percolate through the filter media, with sediment and nutrients being removed in the process. It was assumed that the bed below the bio-filtration area is impermeable when undertaking the water quality modelling. Slotted PVC pipe will be placed in the base to drain the filtered water.
- The bio-filtration system will treat runoff up to the 2yr ARI event.
- The required surface area of the bio-filtration filter media is;
 - Basin B1 - 600 m²
 - Basin B2 - 380 m²

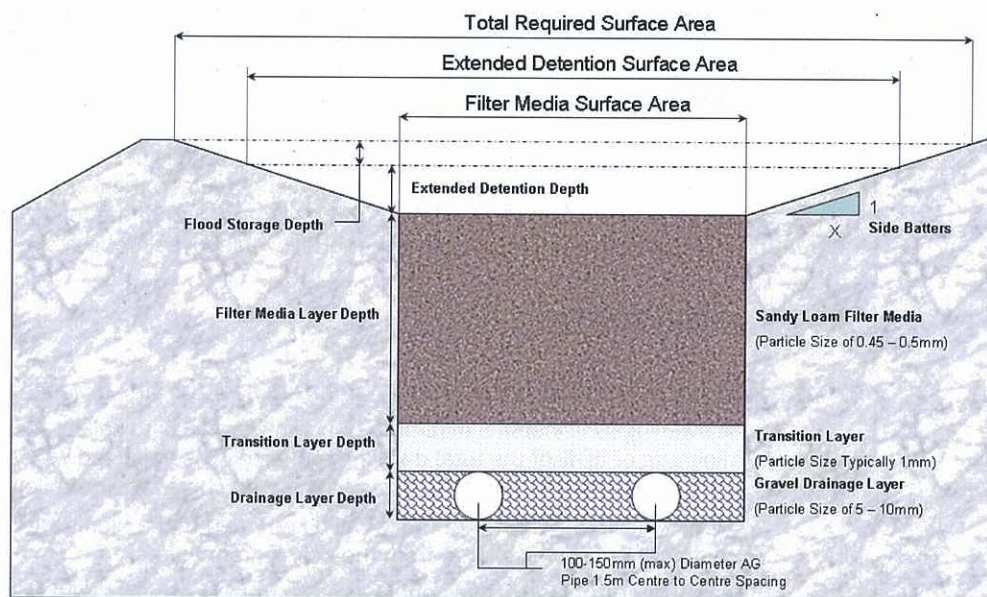


Figure 6.1 Typical Cross Section of a Bio-filtration system

6.2.2 Constructed Wetland Details

The constructed wetland will have the following features:

- A surface area of 1750m².
- Two inlet sediment ponds. The northern inlet pond will receive runoff from Stage 3, 4, 5 and southern inlet pond will receive runoff from Stage 6, 7 and External catchment 1.
- A riser outlet pit will be used to maintain the permanent water level at 6.0m AHD.
- The overflow level for the wetland will be about 6.5m AHD.

- The crest of the bund containing the wetland will be at an elevation of 8.3m AHD, with a spillway at 7.7m AHD and the 100yr ARI water level in the basin is 8m AHD.
- A minimum aspect ratio of 1W:5L within the macrophyte zone.

A diverse range of habitat areas will be constructed within the macrophyte zone, ie, ephemeral marsh, shallow marsh, marsh and deep marsh. These areas will be planted with an appropriate selection of species that are suited to the climate of Mackay. Additional permanent pool zones will be included to provide refuge for mosquito predators during extended dry periods.

The wetland will be designed to take flows up to the 1 year ARI design flood. Higher flows will be diverted to the bypass channel, which will utilise the existing drainage channel along the south side of the wetland. Refer section 4 for details on the detention measures.

Final levels of the various weirs and embankments will be determined as part of detailed design which will ensure that flood levels upstream of the wetland will not be impacted.

7 WATER QUALITY MODELLING

7.1 GENERAL

Assessment of mitigated and unmitigated developed site runoff water quality was undertaken using the 'MUSIC' water quality model (CRCCH, 2005) for proposed ultimate developed site conditions.

Mackay Regional Council's MUSIC Guidelines for Pollutant Export Modelling (2008) were used in the configuration of the MUSIC model. Suspended solids, total nitrogen, total phosphorus and litter concentrations were estimated with the MUSIC model runoff generation parameters.

7.2 AVAILABLE DATA

7.2.1 Rainfall

Six minute rainfall data for Mackay MO (Station 33119) has been adopted. A rainfall period of ten years was used for all MUSIC modelling, recommended by the Mackay Regional Council (2008). The adopted period of analysis was January 1, 1990 to 31 December, 1999.

7.2.2 Evapo-transpiration

Monthly average areal potential evapo-transpiration estimates were obtained from the Climatic Atlas of Australia – Evapo-transpiration (BOM, 2001). Table 7.1 shows the adopted monthly evapo-transpiration rates.

Table 7.1 Adopted Average Monthly Evapo-transpiration Rates

Month	Monthly Evapo-transpiration	
	(mm/day)	(mm/month)
Jan	6.1	190
Feb	5.4	152
Mar	4.8	150
Apr	3.5	105
May	2.4	75
Jun	2.0	60
Jul	2.1	65
Aug	2.6	80
Sep	3.6	107
Oct	4.8	150
Nov	5.8	175
Dec	6.1	190

7.2.3 Source Node Parameters

In order to accurately model developed conditions water quality, the site was split into roof, yard and road areas. Mean stormwater flow pollutant concentrations for roof, road and other impervious/pervious areas within an urban residential area were adopted from the Mackay MUSIC modelling Guidelines (MRC, 2008). Mean base flow pollutant concentrations and standard deviations given for residential use areas (MRC, 2008) were applied to roof, yard and road areas. Routing was not used in any drainage links.

7.3 MODEL CONFIGURATION

The MUSIC model was configured on the basis of the following assumptions:

- Equivalent of 214 total lots on site (including the 29 future dwellings to the north);
- Each lot has a 5 kL tank that collects roof water. A daily reuse demand of 0.326kL/day/lot was assumed.
- 50% of roof area was connected to rainwater tanks.

Figure 7.1 shows the MUSIC model configuration used to assess the mitigated developed site runoff quality and Table 7.2 shows the adopted source nodes.

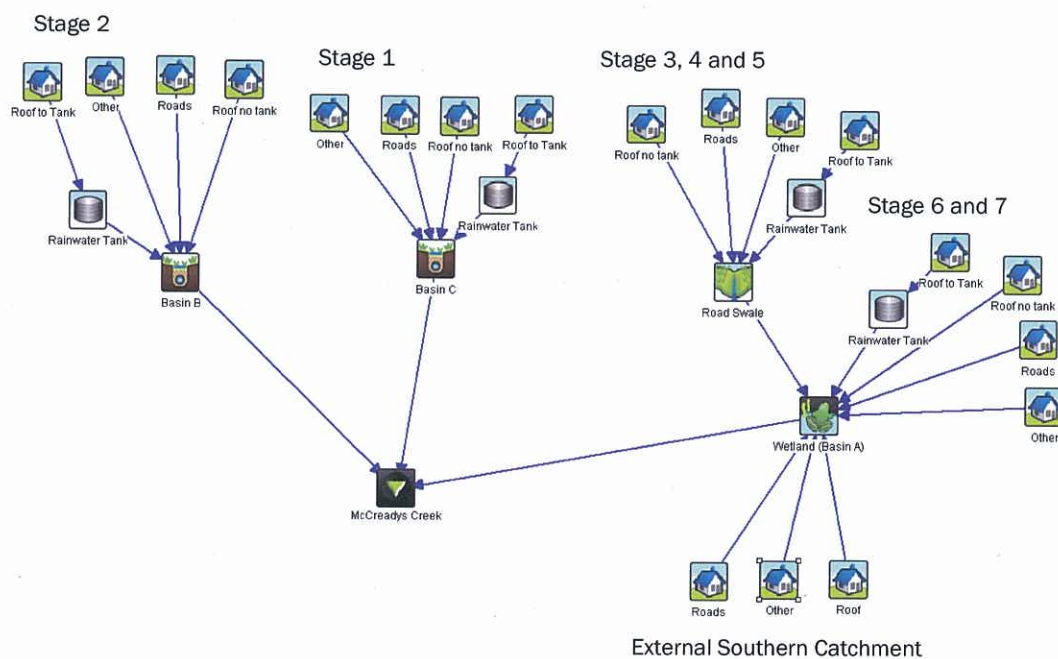


Figure 7.1 MUSIC Model Configuration

Table 7.2 Adopted Source Node Percent Imperviousness and Areas

Source Node ID	Adopted MUSIC Source Node Parameters	Area (Development Site) (ha)	Area (Southern Catchment) (ha)	Percent Impervious (%)
Roof to Tank	Urban - Roof	2.539	NA	100
Roof no Tank	Urban - Roof	2.539	2.126	100
Road	Urban - Road	1.719	0.766	100
Other (Yard, Road Reserves)	Urban - Other Pervious	5.264	7.078	10

7.4 WATER QUALITY RESULTS

Table 7.3 shows the mean annual pollutant loads for suspended solids, total nitrogen, total phosphorous and litter for mitigated and unmitigated developed conditions at Bedford Road (SDP1). This shows that the load reduction targets for all pollutants meet the performance criteria set by Mackay Regional Council.

Table 7.3 Mean Annual Pollutant Loads, at SDP 1

Pollutant	Annual Pollutant Load (kg/year)		Percent Reduction (%)	Performance Criteria (%)
	Developed Conditions Unmitigated	Developed Conditions Mitigated		
Suspended Solids	5860	1370	77	75
Total P	12.7	4.31	66	60
Total N	86.5	48	44	40
Litter	722	0	100	90

Table 7.3 shows the results for mitigated and unmitigated developed conditions at the western boundary (SDP2). This shows that the load reduction targets for all pollutants meet the performance criteria set by Mackay Regional Council.

Table 7.4 Mean Annual Pollutant Loads at SDP 2 for Development site only

Pollutant	Annual Pollutant Load (kg/year)		Percent Reduction (%)	Performance Criteria (%)
	Developed Conditions Unmitigated	Developed Conditions Mitigated		
Suspended Solids	11500	2270	80	75
Total P	26	8.81	66	60
Total N	182	110	40	40
Litter	1510	0	100	90

Table 7.5 shows the mean annual pollutant loads and the reductions when the external catchment (Ex 1) is included into the treatment train. The modelling shows that the total combined runoff downstream of the wetland does not meet best practice reduction targets, due to the limited space available for the wetland. However the treatment performance achieved by this wetland is considered to be a substantial improvement in the stormwater quality entering the significant vegetation on site.

Table 7.5 Mean Annual Pollutant Loads at SDP2 for total upstream catchment

Pollutant	Annual Pollutant Load (kg/year)		Percent Reduction (%)	Performance Criteria (%)
	Developed Conditions Unmitigated	Developed Conditions Mitigated		
Suspended Solids	22800	8340	64	75
Total P	52.5	26.6	49	60
Total N	342	249	27	40
Litter	2780	3.28	99.9	90

8 SUMMARY

The Urban Land Development Authority propose to develop Council's Depot land in Andergrove for residential use. WRM Water & Environment have prepared a stormwater management plan for the development site to support the development application.

No increase in peak discharge from the site will be achieved by the following:

- Discharges from the eastern catchment of the development site have been reduced by decreasing the catchment area contributing to discharges at this location; and
- Discharges from the southern catchment will be mitigated by the construction of a detention basin, located in the southern end of the site.

The stormwater quality management achieves the water quality objectives for all runoff produced from the development and significantly improves the water quality from the southern external catchment.

The proposed stormwater management plan for the site includes the following features;

- The construction of two biofiltration areas (totalling approximately 950m² in filter area) are proposed on the western and eastern boundaries of Stage 1. These will treat the runoff from Stage 1 and 2;
- A wetland is proposed in southern end of the catchment to treat runoff for the remaining Stages 3,4,5,6 and 7;
- The wetland will also treat the runoff from the external southern catchment;
- A GPT or trash rack/sediment forebay installed on the inlets to each of the bio-filtration basins will treat runoff prior to discharge to each bio-filtration basin; and
- The installation of 5kL rainwater tanks on each new dwelling with collected water used for gardening, cold water washing machine taps and toilet flushing.

Stormwater harvesting options can be assessed in conjunction with the operational works phases of Stages 3 through to 7.

9 REFERENCES

- BOM (2001), Climatic Atlas of Australia - Evapotranspiration, Bureau of Meteorology.
- CRCCH (2003), MUSIC (Model for Urban Stormwater Improvement Conceptualisation), CRC for Catchment Hydrology, Australia.
- HW (2006), Draft Design Objectives for Water Sensitive Urban Design in South East Queensland, Healthy Waterways
- IEAust (1998) – 'Australian Rainfall and Runoff: A guide to Flood Estimation', Institute of Engineers, Australia
- MRC (2008) Mackay Regional Council MUSIC Guidelines *Version 1.1*, Mackay Regional Council & Designflow, Brisbane
- MRC (2009) Mackay Planning Scheme, Planning Scheme Policy 3, Mackay Regional Council.
- MRC (2009), Stormwater Quality Performance Curves and Stormwater Quality Objectives for Mackay', Mackay Regional Council.
- KBR (2006), McCreadys Creek Stormwater Drainage Study, KBR.

APPENDIX A

RATIONAL METHOD CALCULATIONS

SDP 1 Existing Conditions

Rational Method Parameters	Units	Design Storm Event					
		1 Year ARI	2 Year ARI	5 Year ARI	10 Year ARI	20 Year ARI	100 Year ARI
Catchment Area	ha	7.68	7.68	7.68	7.68	7.68	7.68
Time of Concentration							
Standard Inlet Time	min	15.0	15.0	15.0	15.0	15.0	15.0
Channel Flow Time							
Length	m	3.2	2.9	2.5	2.4	2.2	2.0
Mannings 'n'		250	250	250	250	250	250
Slope of Channel	m/m	0.05	0.05	0.05	0.05	0.05	0.05
Total Time of Concentration	min	18.2	17.9	17.5	17.4	17.2	17.0
Runoff Coefficient (Cy)		0.62	0.66	0.74	0.78	0.82	0.94
Frequency Factor (Fy)		0.80	0.85	0.95	1.00	1.05	1.20
Rainfall Intensity (ly)	mm/hr	77.5	101.2	131.9	150.8	175.4	235.6
Design Discharge	m ³ /s	1.03	1.43	2.08	2.51	3.06	4.71

SDP 1 Developed Conditions

Rational Method Parameters	Units	Design Storm Event					
		1 Year ARI	2 Year ARI	5 Year ARI	10 Year ARI	20 Year ARI	100 Year ARI
Catchment Area	ha	4.01	4.01	4.01	4.01	4.01	4.01
Time of Concentration							
Standard Inlet Time	min	10.0	10.0	10.0	10.0	10.0	10.0
Total Time of Concentration	min	10.0	10.0	10.0	10.0	10.0	10.0
Runoff Coefficient (Cy)		0.67	0.71	0.80	0.84	0.88	1.01
Frequency Factor (Fy)		0.80	0.85	0.95	1.00	1.05	1.20
Rainfall Intensity (ly)	mm/hr	96.8	125.0	162.0	184.0	213.0	285.0
Design Discharge	m ³ /s	0.72	0.99	1.44	1.72	2.09	3.20

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SDP 2 Existing Conditions

Rational Method Parameters	Units	Design Storm Event				
		1 Year ARI	2 Year ARI	5 Year ARI	10 Year ARI	20 Year ARI
Catchment Area	ha	24.42	24.42	24.42	24.42	24.42
Time of Concentration						
Standard Inlet Time	min	15.0	15.0	15.0	15.0	15.0
Channel Flow Time						
Length	m	13.4	12.4	11.3	10.8	10.4
Mannings 'n'		700	700	700	700	700
Slope of Channel	m/m	0.06	0.06	0.06	0.06	0.06
		0.005	0.005	0.005	0.005	0.005
Total Time of Concentration	min	29.8	28.8	27.7	27.2	26.8
Runoff Coefficient (Cy)		0.61	0.65	0.72	0.76	0.80
Frequency Factor (Fy)		0.80	0.85	0.95	1.00	1.05
Rainfall Intensity (ly)	mm/hr	61.0	80.6	105.8	121.6	142.1
Design Discharge	m ³ /s	2.52	3.53	5.18	6.27	7.69
					10.12	11.91

SDP 2 Developed Conditions

Rational Method Parameters	Units	Design Storm Event				
		2 Year ARI	2 Year ARI	5 Year ARI	10 Year ARI	20 Year ARI
Catchment Area	ha	28.04	28.04	28.04	28.04	28.04
Time of Concentration						
Standard Inlet Time	min	15.0	15.0	15.0	15.0	15.0
Channel Flow Time						
Length	m	60.5	14.1	11.7	141.6	10.5
Mannings 'n'		700	700	700	700	700
Slope of Channel	m/m	0.05	0.05	0.05	0.05	0.05
		0.004	0.004	0.004	0.004	0.004
Total Time of Concentration	min	30.5	29.3	28.1	27.5	26.9
Runoff Coefficient (Cy)		0.63	0.67	0.75	0.79	0.83
Frequency Factor (Fy)		0.80	0.85	0.95	1.00	1.05
Rainfall Intensity (ly)	mm/hr	60.5	79.7	105.1	121.0	141.6
Design Discharge	m ³ /s	2.98	4.17	6.14	7.45	9.15
					12.07	14.22

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PLANS AND DOCUMENTS
referred to in the ULDA
APPROVAL dated 22/12/16

Engineering Report ULDA Andergrove – Stage 1

August 2010

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APPENDIX A

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 Figure BM00020-CSK011 – Sewer Reticulation Layout Plan
 Figure BM00020-CSK012 – Electrical & Communication Utilities Layout Plan

DOCUMENT CONTROL SHEET

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Previous versions of this document are superseded by the most recent revision.

1. Introduction

BMD Consulting Pty Ltd is engaged by the Urban Land Development Authority (ULDA) to provide civil engineering services for the proposed Stage 1 development of the Andergrove UDA. In that connection, this Engineering Report is in support of a development application to create Stage 1. The report provides concept design information for internal and external infrastructure provisions such as roads and streets, stormwater drainage and water quality infrastructure services, water reticulation, and sewer reticulation. This report does not discuss provision of power and telecommunications utility services, but does provide a conceptual design identifying where such services are to be located within the street network.

Stage 1 is proposed to be sub-staged into Stage 1A (11 lots and 12 dwellings), and Stage 1B (24 lots and 24 dwellings). The concept designs do not provide specific detail on provisions to be made for sub-stage extensions. This detail will be included in the detailed design. This report provides discussion on sub-stage extension issues where relevant.

2. Site Location

The Andergrove UDA measures some 22 hectares and is located at 271 Bedford Road, Andergrove, Mackay. The site is described as Lot 2 on RP711645. **Figure 1** identifies the site location and environs. Only a part of the total site will be developed to provide housing.

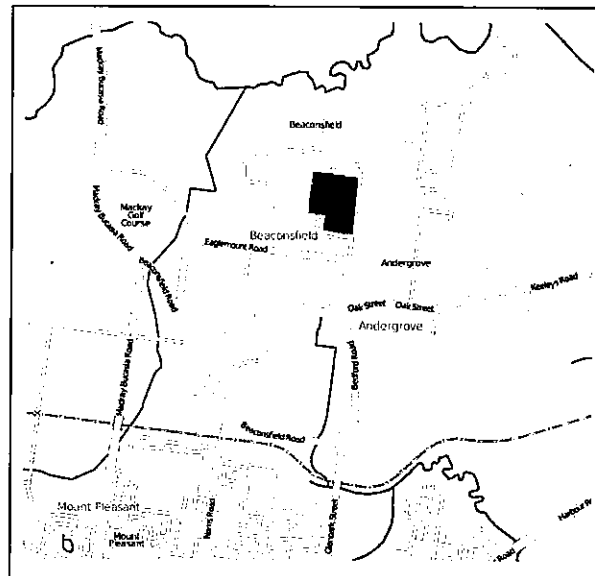


Figure 1 - UDA Andergrove – Site Location

StreetMap © Nearmap

The present site land use is mixed. The south-eastern corner of the site is currently used as the Mackay Regional Council Works Depot. It is intended that this Depot will be demolished in 2011 when new facilities at Paget, south of Mackay, are established and staff and equipment are relocated. The north-eastern corner of the site is mostly used for periodic grazing and animal management. Remnants of old cattle yards and an old dog pound remain on site. The western part of the site is a mixture of disturbed and undisturbed native forest. The major disturbance exists about a man made stormwater channel in the south and south-west, and clearing to the north of existing residential land adjoining the southern boundary of the development site.

3. Site Characteristics and Existing Infrastructure

3.1. Existing Land Form

The existing landform of the site is described in the RPS Australia East survey plan attached in **Appendix A**. The site has an existing ridge running from north to south dividing the site into two separate catchments; one draining east and the other west. A large open drain is located in the natural gully on the western side of the site, while the eastern side falls to an open drain along Bedford Road. Site levels range approximately from RL 10m AHD to RL 4m AHD.

3.2. Road & Pedestrian Infrastructure

The site is surrounded by existing residential development on three sides. The only road access is via Bedford Road extending along the full eastern frontage of the site. Bedford Road is classed as a Major Collector under the Mackay Regional Council Road Hierarchy Policy. However, it has a variable profile along the frontage of the development land. Adjoining Stage 1 the road profile is urban on the eastern side of the centreline and rural on the western (proposed development) side. Investigations have identified that the eastern urban profile does not conform to the Major Collector standard profile with a reduced carriageway width and a parking lane width that is too narrow to comply with the required minimum width under Australian Standards for on-street parking. The verge width is also less than that required under the standard profile. The western carriageway and road shoulder are a rural profile and widths are not consistent with standard rural arterial road profiles that are approximately equivalent to the Major Collector status.

Appendix A contains an Existing Bedford Road Layout Plan and corresponding Existing Bedford Road Section identifying the above inconsistencies.

An existing bus stop and shelter is located on the western side of Bedford Road just to the south of Monique Court intersection.

A concrete pathway is located at the northern boundary within the development land. It extends west from Bedford Road at the Fernleigh Avenue intersection through to the north-west corner of the development land. At this point it connects with another pathway extending from the northern residential land and it then heads south skirting the western boundary of the development land. The pathway caters for combined pedestrian and cyclist traffic. The length within the development land is not located within any easement or reserve.

3.3. Stormwater Drainage

There is limited stormwater infrastructure within the development land and certainly none within the Stage 1 area.

The associated Stormwater Management Report by WRM that addresses the whole of the development land identifies existing catchments and outlet points for existing drainage pathways within the site. Relevant external stormwater drainage points are the 1/900x600 RC Box Culvert under Bedford Road to the north of the Monique Court intersection, and the 1/600x300 RC Box Culvert under the above mentioned pathway towards the north-west corner of the site.

It is to be noted that the existing Bedford Road culvert is experiencing some structural distress with concrete separation having occurred in the roof of the western end units.

3.4. Water Supply

There are 2 existing Council water mains extending along the western side of Bedford Road for the entire site frontage. One is a trunk 300mm dia main. The other is a 150mm dia reticulation main. The existing Monique Court residential development on the eastern side of Bedford Road adjacent to the proposed Stage 1 development is serviced by a 150mm dia reticulation main connected to the same size reticulation main mentioned previously.

The RPS survey plan identifies existing fire hydrants that locate the 150mm dia reticulation main. The exact location of the 300mm dia main will be identified for detailed design purposes.

3.5. Sewerage Reticulation

Existing gravity sewer mains exist within the development site. A 250mm dia main servicing the northern adjoining residential development drains along the northern boundary of the development land to Fernleigh Avenue. It then turns south and extends inside the eastern development boundary until about 70m south of the Monique Court intersection with Bedford Road. The main then turns east crossing Bedford Road and connects to the extensive existing sewer system in the developed residential area about Tropical Avenue.

A 150mm dia gravity main also exists inside the development land eastern boundary south of the above mentioned Bedford Road crossing. It services the existing Council Depot.

Another 150mm dia gravity main extends as an end line diagonally into the Bedford Road Depot area from the sewer system within the residential area about Newton Street to the south of the development land. This sewer will not impact on the Stage 1 development.

3.6. Utility Services

Telstra and Ergon services extend along the Bedford Road frontage and feed the Council Depot within the development site.

4. Proposed Infrastructure – Stage 1

4.1. Development Plan

Plans identifying the proposed plan of development are contained within the planning report by Place accompanying the development application. **Figure BM00020-CSK001** in **Appendix A** is derived from this plan of development.

For ease of reference, the figure descriptor **BM00020-** will not be mentioned further in this report dialogue when identifying conceptual design figures located within **Appendix A** of this report.

4.2. Bulk Earthworks

Figures CSK002, CSK003, and CSK004 in **Appendix A** identify the changes to the existing landform required to create the Stage 1 development. The earthworks model is extended to the northern boundary of the development site and south of Stage 1 sufficiently to identify the Stage 1 developed landform and requirements for the interface between Stage 1 and future stage development north and south of Stage 1. **Figure CSK002** contains both existing and proposed development contours, and identifies areas of proposed cut and fill.

The main control impacting on the earthworks model is the requirement in the WRM Stormwater Management Plan for correction of the main north-south catchment boundary divide so that the developed Stage 1 area draining to the east generates peak stormwater discharges no greater than the peak stormwater discharges from the existing contributing catchment.

With only Stage 1A to be developed at this time, the earthworks design at the interfaces with future sub-stage and stage development will ensure the redirection of stormwater runoff from external land either to the east or west, depending on the catchment divide, ensuring that such redirection will not cause detriment to the proposed developed lots, or to existing external development and infrastructure.

Proposed cut and fill depths are not extensive and are generally of the order of 250mm. Maximum depths of fill are about 500mm on the lots north of Laneway 2 between Roads 2 and 3. Preliminary estimates indicate that approximately 1 000m³ of net imported fill will be required to achieve the finished profiles for the whole of Stage 1.

Stage 1A is likely to achieve a slight surplus in cut material. This will be spread and compacted in future fill areas on the northern side of Road No 1 at the Bedford Road end.

4.3. Roadworks

4.3.1. Internal Works

Figures CSK005 and CSK006 describe the internal road network. Proposed road reserve widths and pavement formations are derived from Mackay Regional Council standards and Residential 30 Guidelines.

- **Road No 1** is the main entrance road and in functional terms its classification is Minor Collector under Council's hierarchy. It therefore requires only a 17.5m road reserve width and a minimum 7.5m 2-way carriageway width. In this case a 20m road reserve width is adopted to identify this as a feature entry. While Council's standard does not require dedicated on-street car parking, indented car parking is proposed on the northern side of this street. The purpose of this is to provide initial stage public car parking for marketing purposes that will then serve as additional visitor car parking for residences on the northern side of Road No 1 once these are occupied.

Pathways are provided on both verges. The pathway on the northern verge is a joint cycleway/walkway. With its connection to the external pathway to be developed in Bedford Road it will substitute as the east-west pathway link through the development replacing the existing pathway on the northern boundary of the development land.

Proposed Lots 4 to 11 only will be allowed property access for vehicles from Road No 1.

Figure CSK006 shows the general formation for Road No 1. It generally complies with Residential 30 Guidelines.

- **Road No 2** is to be the main development traffic collector / distributor for internal development traffic and this function also classes it as a Minor Collector under Council's Road Hierarchy. A carriageway width of 7.5m is proposed and this is consistent with Council's standards and the Residential 30 Guidelines. Whereas Council's standard road reserve width is 17.5m the road reserve width for Road No 2 in this instance is reduced to 17.0m. This is due to the western carriageway profile being adopted as a flush kerb profile with no step to the western verge where this verge integrates with the retained open space on this side.

Figure CSK006 also shows the proposed Road No 2 profile. Note that further extensions of Road No 2 north of Road No 1 will adopt a fully urban profile to cater for future residential development to the north and west. Further extensions of Road No 2 to the south in future stages will likely provide for verge parking bays on the western side that will have a dual purpose water quality control through permeable pavement technology. Design will also incorporate the proposed north-south aligned swale addressed in the WRM Stormwater Management Plan.

- **Road No 3** is a low order street that will provide vehicular access to proposed Lots 30 to 32. A 5.5m carriageway is proposed consistent with Residential 30 Guidelines, and Council's standard for a Local Street. A 13.5m wide road reserve is proposed in compliance with Council's standard. This will allow 2 x 4.0m wide verges one of which will contain a walkway in compliance with Residential 30 Guidelines. Council's standard does not require a paved walkway for a Local Street. **Figure CSK006** demonstrates the profile for this street.

One feature of note is that garbage bins for Lots 27 to 29 will need to be collected from Road No 3 and not from the rear of these lots in Laneway No 3. The reason for this is explained in discussion on Laneway No 2 following.

- **Laneway 1** and **Laneway 3** have the same profile as shown on **Figure CSK006**. Council has no current road hierarchy standard profile for a Laneway. The closest is the Local Street profile adopted for Road No 3. The laneway carriageway width of 5.5m is consistent with the Residential 30 Guidelines profile. However, the road reserve width diverges from the guidelines laneway requirements. A standard minimum width of 8.0m is proposed for this development.

The laneways cater for 2-way traffic distribution but also act as pedestrian pathways. However, laneway dwellings can have zero lot development for garages at least and where such garages are enclosed this presents a potential safety problem. The combination of a zero lot line garage, a narrow laneway reserve, and the pedestrian pathway function raises visibility concerns for vehicles reversing out of the residential property. We have reviewed reverse turn movements and the 5.5m carriageway can accommodate a vehicle reversing out on a sealed access across the small verge, but a significant portion of the reversing vehicle has to enter the street before the driver has visibility of on-coming vehicles and pedestrians. Wider verges than the 0.5m in the Residential 30 Guidelines are considered necessary for this safety issue alone.

In addition, while there is no requirement for services to be established within the laneway reserve for Stage 1, there is the potential for the laneway verges to contain underground services. Water mains must be in the verge to allow access to each property service tap at the main connection. Electrical services need to be in a verge wide enough to cater for the property service connections pillar / points.

The proposed 8.0m minimum laneway road reserve is considered appropriate given the above issues.

Note here that Council's garbage collection vehicles are left hand drive with the collection arm mounted on the left hand side of the vehicles. Lots 23 to 26 off Laneway No 3 can only have their garbage collected from the laneway requiring the garbage truck to traverse from north to south.

- **Laneway No 2** essentially adopts the same profile as Laneways 1 and 3 but widens the northern verge to provide for verge parking bays. In this case the parking pays are not indented but are proposed to be constructed as permeable pavement. A drainage blanket underneath the parking areas will collect vehicle wash during rainfall events and feed this into the central drainage network. A 1.5m wide clearway is proposed between the proposed northern road reserve boundary and the verge parking to serve as an opportunistic walkway for pedestrians who have safety concerns with vehicle movements from the rear garages of Lots 12 to 22. Allowance is made for clearance from car door openings in the verge parking bays, and the width of this strip also provides for underground services should any be required.

Garbage collection can only occur through the garbage truck traversing nose forward from east to west along Laneway No 2. If bins are placed on the northern side of the laneway there will be conflict with vehicles parked in the verge parking areas. For the truck to access the bins it needs to travel as follows:

- North along Road No 2.
- Turn into Road No 3 – east west link.
- Continue to the northern end of Laneway No 3.
- Traverse south down Laneway No 3.
- Collect from the bin for Lot 22 in the special area on the north-east corner of the Road No 3 and Laneway No 2 intersection.
- Traverse west along Laneway No 2.
- The truck may then do another double loop to collect from both sides of Road No 3 unless there is turning provision at the future intersection at the northern end of Road No 3.

Whatever route is taken it will be complicated, but it is far safer than allowing a garbage truck to reverse along the laneway for collection purposes.

The land north of Stage 1 is not a part of the Stage 1 development application at this time. However, road access is necessary for garbage collection purposes, and water and utilities supply to lots off Road No 3. It is proposed that the northern road linkages are developed as temporary unsealed roads under Stage 1, and the services linkages provided. The temporary roads and services can be placed within easements on the balance land.

The temporary Road No 2 and 3 connections are not required under Stage 1A.

4.3.2. External Works

Stage 1 will provide a new intersection with Bedford Road to service the development. This intersection will be at the existing Monique Court intersection. Intersection control will be via a new single lane circulating roundabout. **Figure CSK007 in Appendix A** provides a concept design for this roundabout. The associated Traffic Impact Report by Cardno Ullman & Nolan provides justification on traffic engineering grounds for this roundabout. Present and future traffic on Bedford Road at this intersection point is not impacted upon by this roundabout control.

Stage 1 will also be required to upgrade Bedford Road to the Major Collector profile, and as a consequence additional land is to be granted for this purpose along the development frontage. While an additional 4m only is required, by agreement between Council and ULDA the widening will be 14m making the road reserve width generally 34m. The road reserve width narrows north of Laneway No 2.

Figure CSK006 provides a proposed profile for the Bedford Road upgrading. For the Stage 1 extent of works it will require a lateral shift of the existing road centreline to the west to establish the required urban profile on the eastern side. The western side of the centreline will remain a rural formation as shown. The standard 3.5m wide carriageway will be provided and a 1.5m wide sealed shoulder will comprise the western formation edge. The narrow shoulder width is so as not to encourage on-street parking or cyclist use on the western side of the formation.

The additional 10m widening to the west will be to encompass the proposed water quality bio-filtration swales, landscaping, and a north-south aligned walkway / cycleway. There are extensive numbers of large native trees south of the proposed Stage 1 intersection that will also be retained within this additional widening.

4.4. Stormwater Drainage Internal & External

Figure CSK008 in **Appendix A** identifies a conceptual stormwater drainage network proposed to service Stage 1. **Figure CSK009** provides contributing sub-catchment details for the proposed networks. The proposed network and sub-catchments have been determined in conjunction with the proposed landform so as to be consistent with the drainage strategy in the WRM Stormwater Management Plan for the overall development.

Drainage design parameters to be adopted will be:

- Minor Flow Design - the underground drainage system capacity will cater for the ARI 5 year event
- Major Flow Design - the combined underground drainage system and surcharge flow paths will cater for the ARI 100 year event.

The exception to this will be within the laneways where inverted road cross-sections with central underground drainage systems are adopted. In such cases and in light of the potential for zero lot line buildings, the requirement to not let the ARI 100 year event cause inundation within private property and dwellings, will mean that the underground drainage system will have a capacity in excess of the ARI 5 year discharge capacity to cater for the reduced surcharge flow capacity in the narrow inverted pavements, and freeboard requirements set under QUDM and Council standards.

Stage 1 will require 2 stormwater outlets to the east; one from Road No 1 and one from Laneway No 2. Discharge from these outlets will be treated in the bio-filtration pond to be established in the Bedford Road western swale north of Road No 1 intersection. The finished level of the pond will be depressed 300mm below the invert level of the Bedford Road cross-drainage culvert so as to ensure the average daily flow first flush is trapped within the pond. A second pond is to be established in the Bedford Road western swale south of the Road No 1 intersection to ensure that the 600m² surface area requirement set in the WRM Stormwater Management Plan is attained. The finished surface level of this second pond will also be set at 300mm below the invert level of the proposed culverts under the new Road No 1 intersection with Bedford Road. Each stormwater line will contain an in-line gross pollutant trap (GPT) to remove large solids prior to discharge entering the bio-filtration system.

Stage 1 will also require a single western stormwater outlet. This stormwater line will also contain an in-line GPT located just upstream of the outlet point. In accordance with the WRM Stormwater Management Plan this western drainage outlet will discharge to a small bio-filtration basin where stormwater will be treated before being discharged across level spreaders at the pond outlet to create sheet flow that will enter the existing natural drainage system to the west.

While the eastern stormwater network is designed so that there is no net increase in peak discharge as a consequence of development intensification, it is likely that the existing culvert under Bedford Road will need to be upgraded. It will require widening to achieve the Bedford Road profile changes, and since there is existing structural distress, replacement will be necessary. In this instance the upgraded culvert capacity will be selected to meet Council's cross-drainage standards (ARI 50 years under major roads), and to ensure pond depths do not cause inundation of development dwellings.

4.5. Water Supply

As shown in **Figure No CSK010** in **Appendix A** the proposed development will be serviced by the extension of the existing Bedford Road reticulation main. The proposed main in Road No 1 is likely to be a 150mm dia main. Further extension along Road No 2 is also likely to be a 150mm dia main. Extensions into Road No 3, and to service the lots fronting Laneways Nos 1 and 3 and Bedford Road will likely be 100mm dia mains.

Property service connections for Lots 12 to 22 will be from the proposed main in Road No 1. These will be installed under Stage 1A.

Detailed design will be accompanied by a network analysis that will consider the staged development impacts.

However, early discussions with Council identified that the external water reticulation and trunk network can service the whole of the development.

4.6. Sewerage Reticulation

Figure CSK011 in **Appendix A** provides a conceptual design for the sewer reticulation required to service Stage 1. Reticulation will be extended from the existing 250mm dia mains along the northern and eastern boundaries of the development land to service all Stage 1 lots. Where required property service connections will be provided for future stage lots adjoining the Stage 1 development.

Stage 1A will extend the sewer network to proposed Lot 19 and then across Road No 1 to services the Stage 1A Lots 4 to 11. Another sewer line will extend across Road No 1 from the manhole in Lot 22 to service proposed Lots 1 to 3.

Early discussions with Council identified that Council's external delivery network can cater for the UDA development.

4.7. Utility Services

Figure CSK012 in **Appendix A** provides a conceptual alignment of proposed utility services. Others will provide advice on the requirements to service this development. The utility services alignment has been designed taking into consideration the preferred separation of power and water services, the requirement for property services connections for power and water to be at alternate frontage boundaries, and available service corridors as defined in **Figure CSK006**.

5. Conclusion

Stage 1 of the UDA at Bedford Road, Andergrove, Mackay is to be developed in 2 sub-stages. Stage 1A will deliver 11 lots and 12 dwellings plus essential lead-in infrastructure to enable the progression of the development of the total site over time.

In that context, and recognising that other reports deal with planning, landscape, traffic, environmental, and stormwater management issues, this report identifies:

- The required civil engineering infrastructure provisions necessary to establish Stage 1 of the UDA off Bedford Road, Andergrove.
- The interface requirements and services extensions required to be provided in Stage 1 to enable seamless extension of the development into further stages to the north and south of Stage 1.

Civil engineering infrastructure can be established to create Stage 1, and Stage 1A in particular, without detriment.



Appendix A

Concept Civil Infrastructure Drawings

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