WESTERN AUSTRALIA

REGISTER NUMBER	
1/D65664	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
4	2/3/2018

VOLUME 1671 FOLIO 911

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 1 ON DIAGRAM 65664

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

ARD NO.5 PTY LTD OF PO BOX 7987 CLOISTERS SQUARE PO WA 6850

(A N842518) REGISTERED 1/3/2018

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. N319655 EASEMENT TO WATER CORPORATION FOR WATER AND WASTE WATER PURPOSES. SEE DEPOSITED PLAN 403532. REGISTERED 5/5/2016.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1671-911 (1/D65664)
PREVIOUS TITLE:	1520-857, 1520-858
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF SERPENTINE-JARRAHDALE

WESTERN AUSTRALIA

REGISTER NUMBER	
2/D65664	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
9	28/11/2019

VOLUME 1671 FOLIO 912

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 2 ON DIAGRAM 65664

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

LWP BYFORD SYNDICATE PTY LTD OF MEZZANINE LEVEL, BGC CENTRE, 28 THE ESPLANADE, PERTH
IN 9/20 SHARE
COLES GROUP PROPERTY DEVELOPMENTS LTD OF 800 TOORAK ROAD, HAWTHORN EAST, VICTORIA
IN 11/20 SHARE
AS TENANTS IN COMMON

(T L638692) REGISTERED 27/5/2011

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. L638693 MORTGAGE TO COLES GROUP PROPERTY DEVELOPMENTS LTD AS TO 9/20 SHARE OF LWP BYFORD SYNDICATE PTY LTD ONLY REGISTERED 27/5/2011.
   O240816 TRANSFER OF MORTGAGE L638693, MORTGAGEE NOW COLES GROUP TREASURY PTY LTD OF 800 TOORAK ROAD HAWTHORN EAST VIC 3123 REGISTERED 19/9/2019.
2. O010862 LEASE TO BAKER'S DELIGHT HOLDINGS LIMITED OF SUITE 1 LEVEL 1 293 CAMBERWELL ROAD CAMBERWELL VICTORIA 3124 EXPIRES: SEE LEASE. AS TO PORTION ONLY REGISTERED 18/10/2018.
3. O012371 LEASE TO THE COFFEE CLUB (PROPERTIES) PTY LTD OF LEVEL 13 199 GREY STREET SOUTH BRISBANE QLD 4101 EXPIRES: SEE LEASE. AS TO PORTION ONLY REGISTERED 22/10/2018.
4. O030621 LEASE TO S J PHARMACY PTY LTD OF UNIT 2 9 MCDONALD STREET OSBORNE PARK WA 6017 EXPIRES: SEE LEASE. AS TO PORTION ONLY REGISTERED 15/11/2018.
   O162597 TRANSFER OF LEASE O030621, LESSEE NOW WA HEALTH INVESTMENTS PTY LTD OF CARE OF WALKER WAYLAND PERTY PTY LTD LEVEL 3 1 PRESTON STREET COMO WA 6152 REGISTERED 31/5/2019.
5. O193495 LEASE TO KIRSTY NICHOLLS OF 5 SUMNER RISE SUCCESS WA 6164 EXPIRES: SEE LEASE. AS TO PORTION ONLY. REGISTERED 12/7/2019.
6. O193497 LEASE TO D'ONE P & H PTY LTD OF CARE OF INTEGRATIVE BUSINESS SOLUTIONS SUITE A18 550 CANNING HIGHWAY ATTADALE WA 6156 EXPIRES: SEE LEASE. AS TO PORTION ONLY. REGISTERED 12/7/2019.
7. O193498 LEASE TO MORTNET PTY LTD OF 39 CAVANAGH CLOSE CARDUP WA 6122 EXPIRES: SEE

END OF PAGE 1 - CONTINUED OVER

LEASE. AS TO PORTION ONLY REGISTERED 12/7/2019.

8. O250741 LEASE TO AP MARINE CONSULTANCY PTY LTD OF CARE OF TREMIN BUSINESS SERVICES FOREST CENTRE LEVEL 29 221 ST GEORGES TERRACE PERTH WA 6000 EXPIRES: SEE LEASE. AS TO PORTION ONLY REGISTERED 3/10/2019.

9. O250744 LEASE TO ALEANBH MO CHRO PTY LTD OF CARE OF ABRAMOFF WONG & ASSOCIATED 2B LINKS ROAD ARDROSS WA 6153 EXPIRES: SEE LEASE. AS TO PORTION ONLY REGISTERED 3/10/2019.

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
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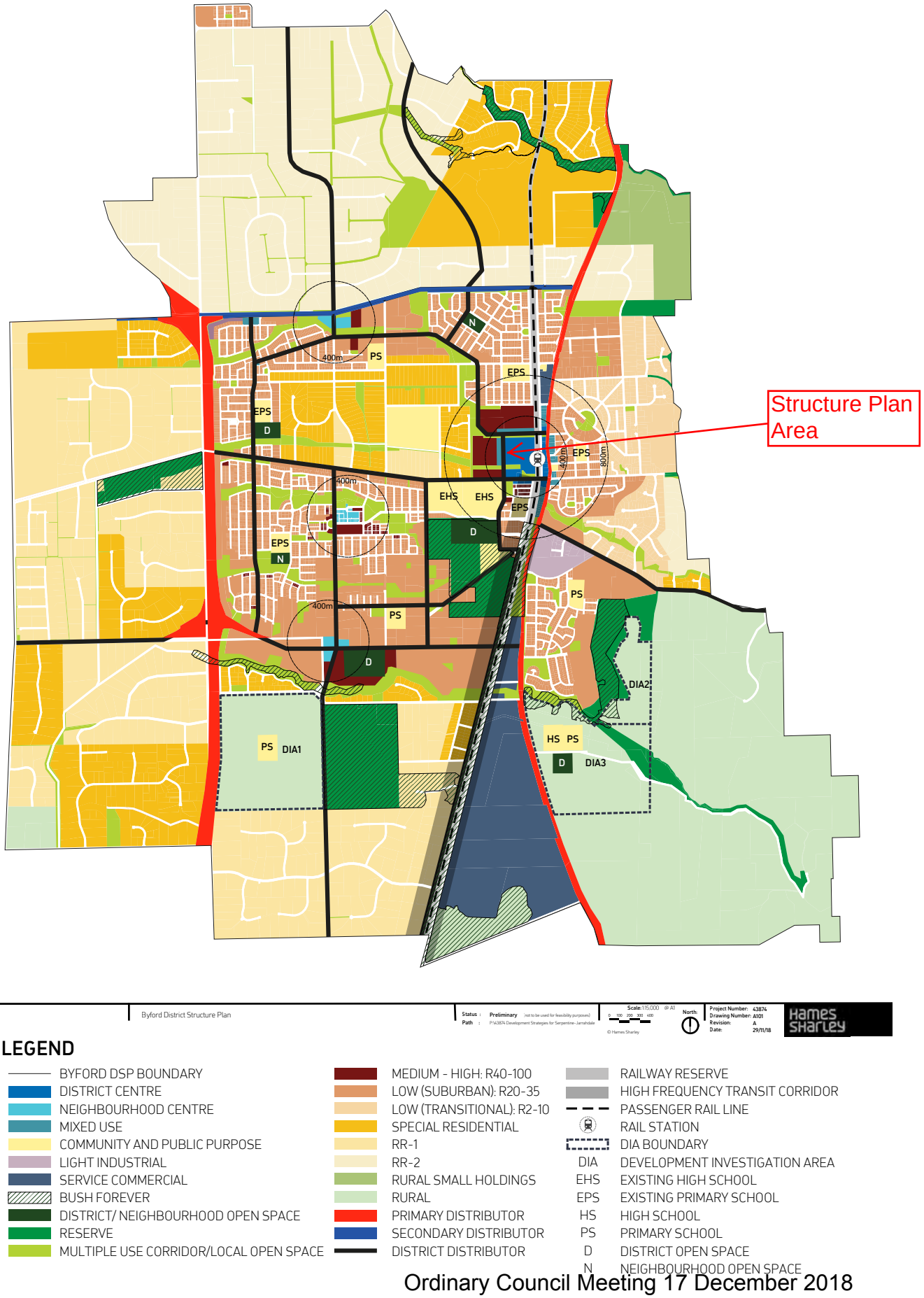
----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	1671-912 (2/D65664)
PREVIOUS TITLE:	1520-857, 1520-858
PROPERTY STREET ADDRESS:	20 ABERNETHY RD, BYFORD.
LOCAL GOVERNMENT AUTHORITY:	SHIRE OF SERPENTINE-JARRAHDALE

Figure 1: Byford District Structure Plan



LEGEND:

- BYFORD TOWN CENTRE LOCAL STRUCTURE PLAN BOUNDARY
- TOWN CENTRE
- MIXED-USE
- COMMERCIAL
- HIGHWAY COMMERCIAL
- RESIDENTIAL R60
- RESIDENTIAL R30
- RESIDENTIAL R25
- RESIDENTIAL R15
- PUBLIC AND COMMUNITY PURPOSES
- PUBLIC OPEN SPACE AND DRAINAGE
- RESOURCE ENHANCEMENT WETLAND
- DETAILED AREA PLAN REQUIRED

NOTES:

1. POTENTIAL RAILWAY CROSSING SUBJECT TO FURTHER INVESTIGATION
2. FUTURE TRAIN STATION LOCATION WITH BUS INTER CHANGE
3. AREA SUBJECT TO FURTHER INVESTIGATION BY SHIRE
4. TOWN SQUARE LOCATION. DETAIL DESIGN BY LAND-OWNER. THE TOWN SQUARE SHOULD HAVE A MINUMUM DIMENSION OF 25.0 BY 30.0 METRES.
5. WETLAND BUFFER ZONE TO BE RATIONALISED. APPROPRIATE INTERFACE TREATMENTS WITH WETLANDS TO BE IN PLACE
6. COMMUNITY FACILITY LOCATION. BUILT FORM TO ACT AS GATEWAY TO TOWN CENTRE
7. APPROPRIATE INTERFACE TREATMENT TO BE PROVIDED BETWEEN LOW DENSITY RESIDENTIAL DEVELOPMENT AND RURAL RESIDENTIAL LIVING WITHIN THE TROTTING COMPLEX PRECINCT
8. NO EAST WEST VEHICULAR ACCESS. PEDESTRIAN ACCESS ONLY
9. NO VEHICULAR ACCESS PERMITTED FROM WARBURTON COURT. LOTS TO HAVE VEHICULAR ACCESS FROM INTERNAL ROAD
10. PARKING FOR PUBLIC TRANSPORT TO BE LOCATED ON PUBLIC TRANSPORT AUTHORITHY LAND ADJACENT STATION. REMAINDER OF PARK AND RIDE FACILITIES TO BE CO-LOCATED WITHIN TOWN CENTRE DEVELOPMENTS.
11. MRS RAIL RESERVE (UNDER MANAGEMENT OF THE PUBLIC TRANSPORT AUTHORITY) IS CURRENTLY USED FOR PARKING FOR THE ADJACENT SUPERMARKET ON GEORGE STREET.

GENERAL NOTES

THE BYFORD TOWN CENTRE STRUCTURE PLAN MAP IS TO BE READ IN CONJUCTION WITH THE LSP STATUTORY PROVISIONS AND JUSTIFICATION REPORT

THERE IS NO MAXIMUM RESIDENTIAL DENSITY WITHIN THE TOWN CENTRE CLASSIFICATIONS. MEDIUM TO HIGH DENSITIES OF RESIDENTIAL DEVELOPMENT AND MIXED-USE DEVELOPMENT ARE SOUGHT. RESIDENTIAL AND MIXED-USE PROPOSALS WITHIN THE TOWN CENTRE CLASSIFICATIONS WILL BE ASSESSED PURSUANT TO THE REQUIREMENTS OF TOWN PLANNING SCHEME NO. 2, THE RESIDENTIAL DESIGN CODES OF WESTERN AUSTRALIA, THE BYFORD TOWN CENTRE DESIGN GUIDELINES AND ANY APPLICABLE DETAILED AREA PLAN.

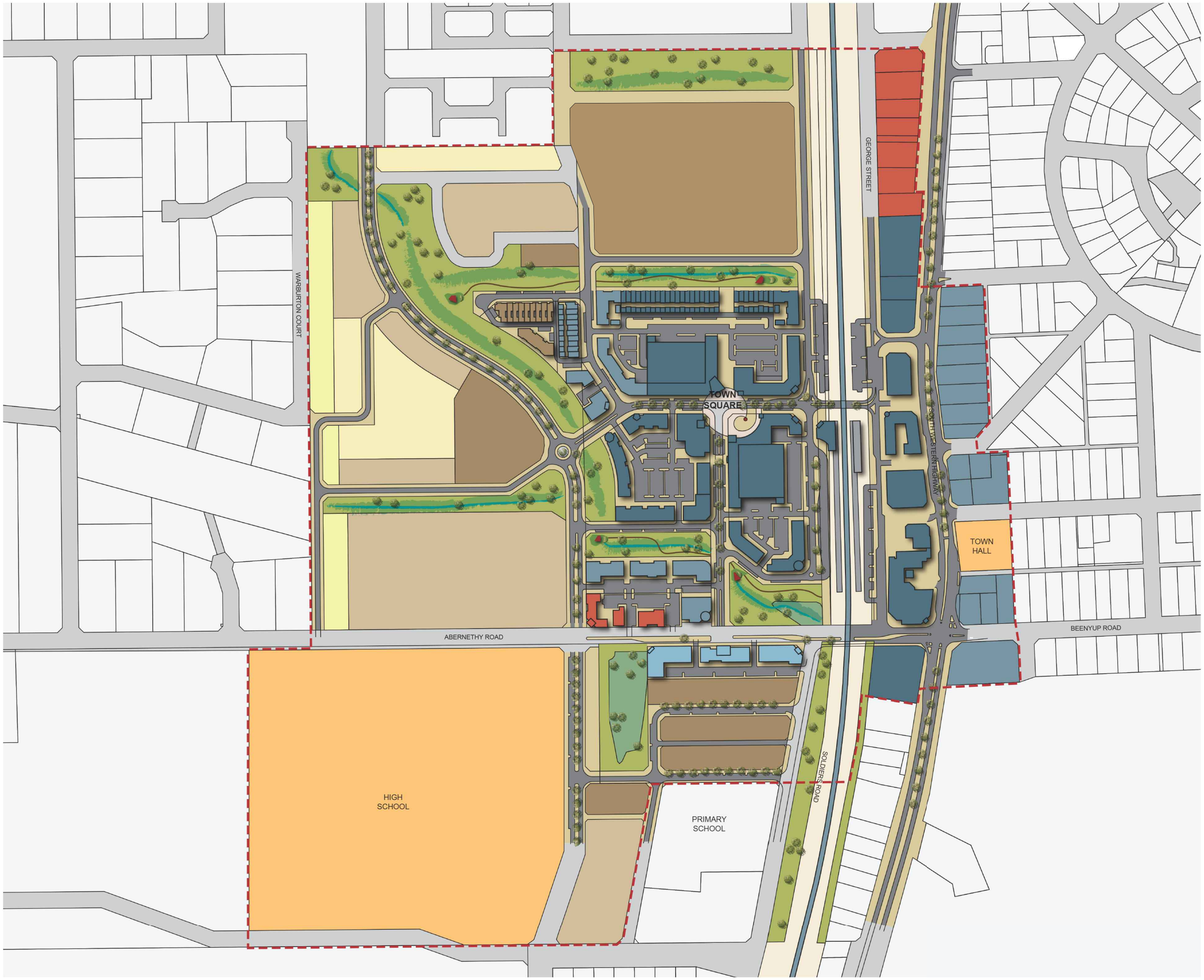
AS MODIFIED BY TAYLOR BURRELL BARNETT FOR LWP BYFORD SYNDICATE PTY LTD

LOCAL STRUCTURE PLAN

Byford Town Centre

DATE 15/11/2007 | DWG NO 001 | REV E | SCALE 1:2500 @ A1

Level 1, 55 St Georges Tce, Perth, WA 6000 Australia
Tel +618 9346 0500 Fax +618 9221 1779
info@urbis.com.au www.urbis.com.au
Urbis Pty Ltd ABN 50 105 256 288 Australia . Asia . Middle East



LEGEND:

- BYFORD TOWN CENTRE LSP BOUNDARY
- TOWN CENTRE (RETAIL CORE)
- TOWN CENTRE (MIXED-USE)
- COMMERCIAL
- HIGHWAY COMMERCIAL
- RESIDENTIAL R60
- RESIDENTIAL R30
- RESIDENTIAL R25
- RESIDENTIAL R15
- PUBLIC AND COMMUNITY PURPOSES
- PUBLIC OPEN SPACE
- RESOURCE ENHANCEMENT WETLAND

AS MODIFIED BY TAYLOR BURRELL BARNETT FOR LWP BYFORD SYNDICATE PTY LTD

BYFORD TOWN CENTRE CONCEPT PLAN

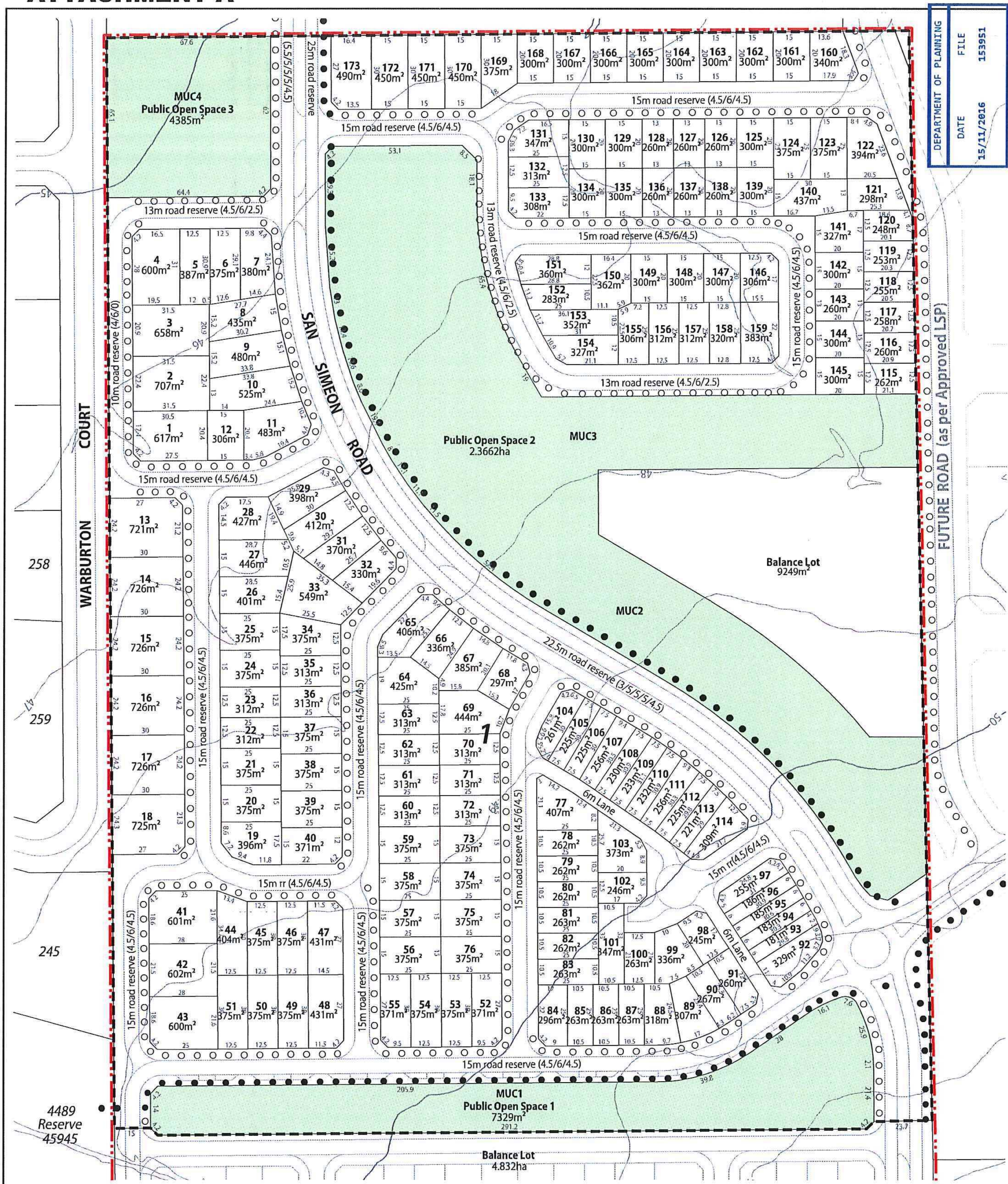
PA 0922 - BYFORD TOWN CENTRE UPDATE OF LSP

DATE 15/11/2007 | DWG NO 001 | REV C | SCALE NTS

Level 1, 55 St Georges Tce, Perth, WA 6000 Australia
Tel +618 9346 0500 Fax +618 9221 1779
info@urbis.com.au www.urbis.com.au
Urbis Pty Ltd ABN 50 105 256 288 Australia . Asia . Middle East

urbis

ATTACHMENT A



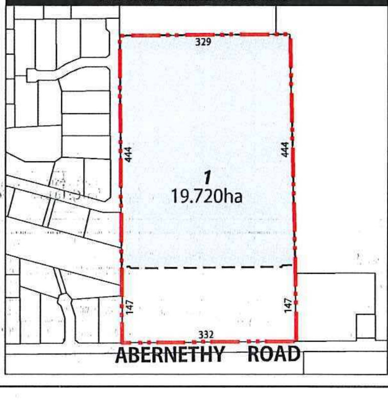
LOT SUMMARY					
Size	No. Lots	% Total Lots	Aveg. Size	% Total Area	Area
119m² - 234m²	11	6.36%	211m²	3.79%	2326m²
235m² - 319m²	76	43.93%	286m²	35.46%	21740m²
320m² - 449m²	65	37.57%	378m²	40.17%	24623m²
450m² - 499m²	6	3.47%	467m²	4.57%	2803m²
500m² - 599m²	2	1.16%	537m²	1.75%	1074m²
600m² - 699m²	6	3.47%	613m²	6.00%	3678m²
700m²+	7	4.05%	722m²	8.25%	5057m²
Total Number of Lots	173 + 2 Balance Lots				

Minimum Lot Size 181m²
Maximum Lot Size 726m²
Average Lot Size 354m²
Total Lot Area 61301m²

LEGEND

- SUBJECT SITE
- SUBDIVISION APPLICATION BOUNDARY (14.888ha)
- FOOTPATH (INDICATIVE)
- SHARED PATH (INDICATIVE)

ORIGINAL LANDHOLDING



PROPOSED SUBDIVISION

Lot 1 Abernethy Road, BYFORD

A PEET Project

NORTH

Scale 1:1500 @ A3

0 15 30 45 60m

DATE:	27/05/2016	DRAFTEE:	RF
REVISED:	15/11/2016	PLANNER:	VB
PROJECTION:	PCG 94	CHECK:	VB
DATUM:	AHD	PLAN NUMBER:	PACBY-3-012d

A 28 Brown St, East Perth WA 6004
P (08) 9325 0200
E Info@creativedp.com.au
W creativedp.com.au

Creative DESIGN+PLANNING

Bushfire Management Plan

Lot 1 and Lot 2 Abernethy Road, Byford

Project No: EP19-079(01)

Prepared for Aigle Royal Developments
March 2020

Document Control

Doc name:	Bushfire Management Plan Lot 1 and Lot 2 Abernethy Road, Byford				
Doc no.:	EP19-079(01)—001A HPB				
Version	**Date**	**Author**		**Reviewer**	
1	August 2019	Heidi Becker	HPB	Kirsten Knox	KK
				Anthony Rowe	AJR
	Report issued for client review.				
A	March 2020	Heidi Becker	HPB	Kirsten Knox	KK
				Anthony Rowe	AJR
	Report updated to address amendments to structure plan area and layout.				

Executive Summary

Aigle Royal Developments (the proponent) are in the process of preparing a revised structure plan for the Byford Town Centre for Lot 1 and Lot 2 Abernethy Road, Byford (herein referred to as 'the site'). The structure plan will enable a range of land uses to be supported within the site (including residential, commercial, town centre and mixed use). The site is approximately 34 ha in size and is located within the Shire of Serpentine Jarrahdale. It is bounded by residential development and a drainage reserve to the north, rural-residential development and a drainage reserve to the west, a shopping centre and Abernethy Road to the south, and the Armadale railway line to the east.

The site is currently identified as a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2019). The identification of the site within an area declared as bushfire prone necessitates that a further assessment of the determined bushfire risk affecting the site (in accordance with *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959)) and the satisfactory compliance of the proposal with the policy measures described in *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and its associated *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines).

The purpose of SPP 3.7 and its policy intent is best summarised as preserving life and reducing the impact of bushfire on property and infrastructure through effective risk-based land use planning. Importantly, it is required by SPP 3.7 that the determining authority is to apply its consideration to the precautionary principle (clause 6.11 in SPP 3.7) and that it must be satisfied that the intent of the policy measures have been met, before it issues an approval.

Pursuant to the policy measures outlined in SPP 3.7, this Bushfire Management Plan (BMP) examines the various responses to the identified bushfire risk (following development) that will make the ultimate use of the land suitable for its intended purpose. As part of this, a bushfire attack level (BAL) assessment has been undertaken to determine the associated bushfire risk, the applicable BAL ratings (if any), and in turn the building siting and construction response that will achieve compliance with the bushfire protection criteria and satisfy the precautionary principle.

As part of assessing the long-term bushfire risk to the site, the vegetation within 150 m of the site has been classified in accordance with AS 3959. The following bushfire hazards were identified in the post-development scenario:

- Forest (Class A) vegetation, associated with the drainage reserve to the west of the site (that extends in a strip approximately 65 to 70 m wide in a westerly direction) and forest vegetation to the east of the site associated with the railway reserve.
- Woodland (Class B) vegetation, located to the west of the site associated with Pethick Close road reserve and within private landholdings to the south of the site.
- Shrubland (Class C) vegetation, associated with the drainage reserve to the east of the site, and a drainage reserve to the north-west of the site.
- Scrub (Class D) vegetation, located within drainage reserves to the north-west and south-east of the site.

- Grassland (Class G) vegetation, largely associated with the railway reserve to the east of the site and grassland within landholdings south of Abernethy Road.

Overall, the outcomes of this BMP demonstrate that as development progresses, it will be possible for the intent of the bushfire protection criteria outlined in the Guidelines to be satisfied through an acceptable solution approach. This includes:

- **Location:** all future habitable buildings can be located in an area subject to a low or moderate bushfire hazard, given buildings can be located within areas identified as low threat in accordance with Clause 2.2.3.2(e) of AS 3959 and can achieve the minimum separation necessary to achieve BAL-29 or less.
- **Siting and Design:** all new future habitable buildings can be sited within the proposed development so that BAL-29 or less can be achieved based on the proposed structure plan and separation to nearby hazards through the location of public roads or public open space. A portion of the lots adjacent to the drainage reserve to the west of the site are likely to be subject to a BAL rating of BAL-FZ and BAL-40, however the lots are approximately 40 m deep and are suitably sized to accommodate a future dwelling that will not be exposed to a BAL rating exceeding BAL-29.
- **Vehicular Access:** appropriate vehicle access can be provided, with the proposed development connecting to the existing public road network including Abernethy Road immediately south of the site and Sansimeon Boulevard and Evans Way to the north of the site. Abernethy Road is a major regional connector road which provides egress opportunities to the east and west, including to Byford town centre and South Western Highway (approximately 420 m east of the site), and Tonkin Highway approximately 5 km to the north-west of the site.
- **Water:** the development will be provided with a permanent and reticulated water supply to support onsite firefighting requirements.

The management/mitigation measures to be implemented through this structure plan and associated future subdivision processes have been outlined as part of this BMP and can be used to support future planning and development approval processes. A revised BMP is likely to be required to support any future subdivision applications, in order to address the specific bushfire risk reduction measures applicable to future proposed lots.

Table of Contents

List of Tables

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Appendices

List of Abbreviations

Table A1: Abbreviations – General terms

General terms	
AHD	Australian Height Datum
AS	Australian Standard
APZ	Asset Protection Zone
BAL	Bushfire Attack Level
BMP	Bushfire Management Plan
BPAD	Bushfire Planning and Design
EEP	Emergency Evacuation Plan
ESL	Emergency Services Levy
FDI	Fire Danger Index
FZ	Flame Zone

Table A2: Abbreviations – Organisations

Organisations	
DBCA	Department of Biodiversity Conservation and Attractions
DoW	Department of Water (now known as Department of Water and Environment Regulation)
DFES	Department of Fire and Emergency Services
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation
OBRM	Office of Bushfire Risk Management
SES	State Emergency Services
WAPC	Western Australian Planning Commission

Table A3: Abbreviations – Legislation and policies

Legislation	
Guidelines	*Guidelines for Planning in Bushfire Prone Areas version 1.3 (WAPC and DFES 2017)*
SPP 3.7	*State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)

Table A4: Abbreviations – Planning and building terms

Planning and building terms	
AS 3959	*Australian Standard 3959-2018 Construction of buildings in bushfire prone areas*
MRS	Metropolitan Region Scheme
POS	Public Open Space
ROS	Regional Open Space
TPS	Town Planning Scheme

1 Introduction

1.1 Background

Aigle Royal Developments (the proponent) are in the process of preparing a revised structure plan for the Byford Town Centre, and in particular for Lot 1 and Lot 2 Abernethy Road, Byford (herein referred to as 'the site'). The proposed structure plan is to enable a range of land uses to be supported within the site (including residential, commercial, town centre and mixed use) and has been prepared in consideration of the previous *Byford Town Centre Local Structure Plan* (Urbis 2015) and has been provided in **Appendix A**. The site is shown in **Figure 1** and consists of an area approximately 34 ha and is located within the Shire of Serpentine Jarrahdale. It is bounded by residential development and a drainage reserve to the north, rural-residential development and a drainage reserve to the west, a shopping centre and Abernethy Road to the south, and the Armadale railway line and associated reserve to the east.

The site is currently identified as a 'bushfire prone area' under the state-wide *Map of Bush Fire Prone Areas* prepared by the Office of Bushfire Risk Management (OBRM 2019) and is shown in **Plate 1** below. The identification of an area within a declared bushfire prone area necessitates further assessment of the bushfire risk and suitability of the proposed development to be undertaken in accordance with *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (SPP 3.7) (WAPC 2015) and the *Guidelines for Planning in Bushfire Prone Areas Version 1.3* (the Guidelines) (WAPC and DFES 2017).

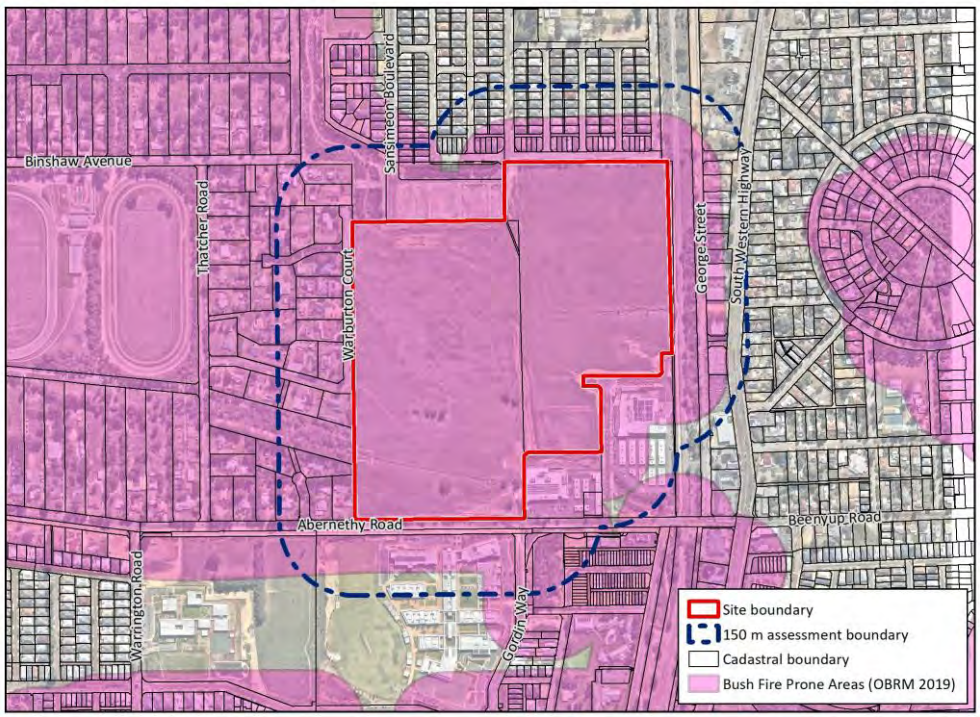

Plate 1: Areas within and surrounding the site identified as 'bushfire prone areas' (as indicated in purple) under the state-wide Map of Bush Fire Prone Areas (OBRM 2019).

1.2 Aim of this report

The aim of this BMP is to assess bushfire hazards within the site and nearby areas and ensure that the threat posed by any identified hazards can be appropriately mitigated and managed and demonstrate satisfaction of clause 6.11 of SPP 3.7, the precautionary principle. It has been prepared to support the proposed structure plan for the site and addresses the requirements of SPP 3.7 (WAPC 2015), the Guidelines (WAPC and DFES 2017) and *Australian Standard 3959-2018 Construction of buildings in bushfire prone areas* (AS 3959) (Standards Australia 2018). The document provides an assessment of the general bushfire management strategies to be considered as part of the future development within the site and includes:

- An assessment of the existing classified vegetation in the vicinity of the site (within 150 m) and consideration of bushfire hazards that will exist in the post development scenario (**Section 3**).
- Commentary on how the future development can achieve the bushfire protection criteria outlined within the Guidelines (**Section 5**).
- An outline of the roles and responsibilities associated with implementing this BMP (see **Section 6**).

1.3 Statutory policy and framework

The following key legislation, policies and guidelines are relevant to the preparation of a bushfire management plan:

- *Fire and Emergency Services Act 1998*
- *Bush Fires Act 1954*
- *Planning and Development Act 2005* and associated regulations
- *Building Act 2011* and associated regulations
- *State Planning Policy 3.7 Planning in Bushfire Prone Areas* (WAPC 2015)
- *Guidelines for Planning in Bushfire Prone Areas version 1.3* (WAPC and DFES 2017)
- *Australian Standard AS 3959 – 2018 Construction of buildings in bushfire prone areas* (Standards Australia 2018)

1.4 Description of the proposed development

The proposed structure plan for the site will facilitate the future subdivision and development of the site to support a mix of land uses and is provided in **Appendix A**. The structure plan is proposed to include:

- Residential areas throughout the site with a range of densities (including R10, R30, R40, R60 and R80).
- Commercial areas in the central and southern portion of the site.
- Mixed use areas in the eastern portion of the site.
- Town centre type land uses in the eastern portion of the site, adjacent to a future train station and bus interchange.
- An indicative Metronet station precinct comprising the majority of the eastern portion of the site (associated with the town centre uses).
- A public open space network for recreation and drainage purposes.
- An interconnected road network.

The site is zoned largely 'Urban' under the Metropolitan Region Scheme (MRS) with the north-west corner of the site zoned 'Urban Deferred' (as shown in **Plate 2**), and 'Urban Development' under the Shire of Serpentine Jarrahdale Town Planning Scheme (TPS) No.2.

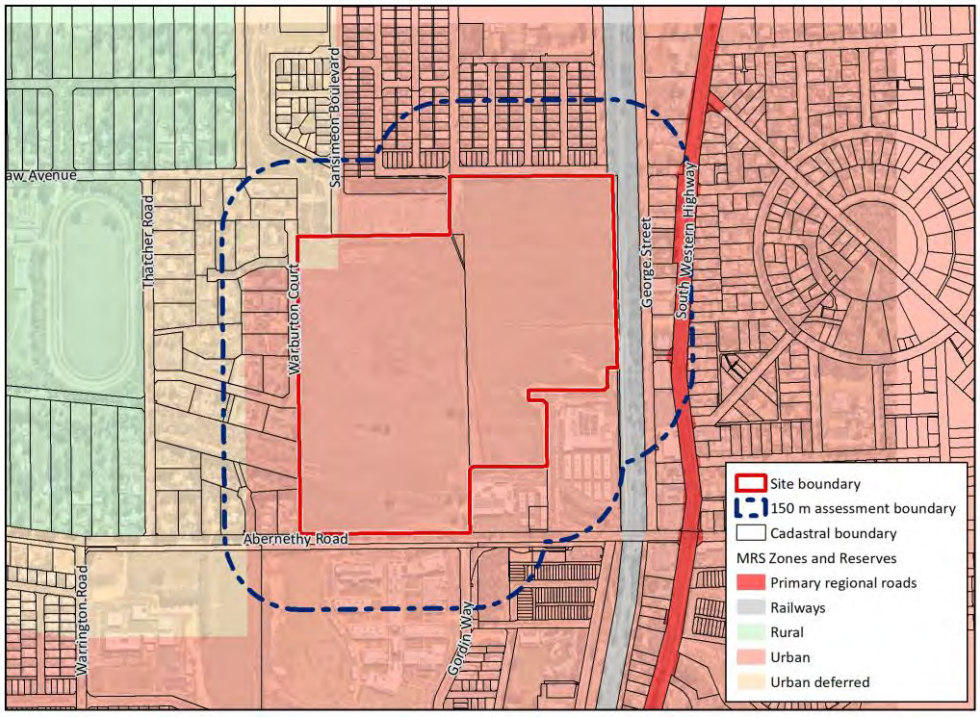

Plate 2: MRS zones and reserves within and surrounding the site

1.5 Description of land characteristics

The natural topographical contours indicate that the site generally slopes to the north-west, with an elevation of approximately 52 m Australian Height Datum (m AHD) in the south-eastern portion of the site and 44 m AHD in the north-western portion of the site, as shown in **Figure 1**.

The site was historically cleared of native vegetation (prior to 1953, based on available historic aerial photography) to support agricultural purposes.

The land uses surrounding the site (within 150 m) include:

- Immediately to the north of the site is a drainage reserve and undeveloped residential lots and further north is existing residential development.
- A drainage reserve and existing rural-residential development to the west of the site.
- Byford shopping centre complex and Abernethy Road located to the south of the site and Byford Secondary College further south.
- Armadale railway line and associated reserve immediately to the east of the site, South Western Highway and existing residential development further to the east.

2 Environmental Considerations

In accordance with the *Bushfire Management Plan – BAL Contour* template prepared by the Department of Planning, Lands and Heritage (2018), this BMP has considered whether there are any environmental values that may require specific consideration through either protection, retention or revegetation. To support this, a review of publicly available databases as well as site specific information (where available) has been undertaken, with particular reference to the Shared Location Information Platform (SLIP) databases. A summary of the search results has been provided in **Table 1**.

The site has previously been cleared of native vegetation prior to 1953, based on a review of publicly available aerial photography (Landgate 2019), with the exception of a few remnant native paddock trees scattered throughout the site, so it is unlikely that environmental values of conservation significance occur within the site.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Conservation category wetlands and buffer (Geomorphic wetlands, Swan Coastal Plain (DBCA-019))	No	Not applicable. The entire site is mapped as a multiple use wetland which forms part of an expansive palusplain wetland that dominates the lower lying areas in the Shire of Serpentine Jarrahdale and City of Armadale. This wetland does not need to be retained, and no buffer or revegetation is required.
RAMSAR wetlands (DBCA-010)	No	Not applicable. No RAMSAR sites are located within or nearby to the site.
Threatened and priority flora (DBCA-036)	No	The site has been historically cleared of native vegetation for agricultural purposes and is now dominated by paddock grasses. It is highly unlikely that any threatened or priority flora species occur within the site.
Threatened and priority fauna (DBCA-037)	No	Due to the lack of intact native vegetation within the site, it is highly unlikely that the site contains suitable habitat for conservation significant fauna species.
Threatened ecological communities (TEC) (DBCA-038)	No.	Not applicable. The site has historically been cleared of native vegetation and is dominated by paddock grasses. As a result, it is highly unlikely that the site would contain any vegetation that would be considered a TEC.
Bush Forever areas (DOP-071)	No	Not applicable. Bush Forever Site No. 321 (Brickwood Reserve) is located approximately 450 m to the south-west of the site, however does not require any consideration as part of the proposed development.

Table 1: Summary of potential environmental considerations that may be associated with the site (based on a search of the SLIP databases) (continued)

Key environmental feature (information in brackets refers to mapping data source)	Yes / no / potentially occurring within the site	If yes / potentially, describe value that may be impacted
Clearing regulations – Environmentally Sensitive Areas (DWER-046)	Yes	An environmentally sensitive area (ESA) extends into the south-west corner of the site. The ESA would be associated with a 500 m buffer typically applied to known TECs present within the Brickwood Reserve. As no native vegetation is present within the site, the ESA is a not a relevant consideration.
Swan Bioplan Regionally Significant Natural Areas 2010 (DWER-070)	No	Not applicable.
Conservation Covenants Western Australia (DPIRD-023)	No	Not applicable.

2.1 Native vegetation – modification and clearing

An environmentally sensitive area (ESA) extends into the south-west corner of the site. The ESA would be associated with a 500 m buffer typically applied to known TECs present within the Brickwood Reserve. As no native vegetation is present within this portion of the site, the ESA is a not a relevant consideration.

The few remaining trees within the site will most likely be removed for residential and commercial development as part of future subdivision in accordance with the structure plan provided in **Appendix A**. Clearing undertaken in accordance with addressing conditions associated with a subdivision approval, pursuant to the *Planning and Development Act 2005*, are exempt from requiring a clearing permit pursuant to Schedule 6 of the *Environmental Protection Act 1986* (where approved by a responsible authority).

2.2 Revegetation and landscape plans

No revegetation is proposed within the site as part of the future development.

Portions of the site, namely areas of public open space and road reserves are proposed to be landscaped as part of the proposed development. These areas will be designed to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. The management of the landscaped areas will be the responsibility of the proponent initially prior to handover to the Shire of Serpentine Jarrahdale, with ongoing management likely to include:

- Regular mowing/slashing of grass to less than 100mm in height (where present).
- Irrigation of grass and garden beds (where required).
- Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.).
- Low pruning of trees (branches below 2 m in height removed where appropriate).
- Application/replacement of ground/surface covers such as mulch or non-flammable materials as required.

3 Bushfire Assessment Results

Bushfire risk for the site has been appropriately considered in the specific context of the Guidelines (WAPC and DFES 2017) and AS 3959. The objective of AS 3959 is to reduce the risk of ignition and loss of a building to bushfire. It provides a consistent method for determining a radiant heat level (radiant heat flux) as a primary consideration of bushfire attack on a building or object. It also prescribes simple construction responses that can resist the determined radiant heat level at a given distance from the fire and is based on six Bushfire Attack Level (BAL) ratings: BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40 and BAL-FZ.

Two separate methods are outlined in AS 3959 for determining the impact of bushfire on dwellings and have been outlined below:

- **Method 1**, outlined in Section 2 and Appendix A of AS 3959, provides a basic assessment of radiant heat flux levels at various distances from classified vegetation (up to 100 m). This method assumes standard fuel loads for classified vegetation as outlined in AS 3959 and considers the effective slope beneath vegetation. This method can be used to determine appropriate setbacks to dwellings to achieve different levels of radiant heat exposure (i.e. BAL-12.5 to BAL-FZ).
- **Method 2**, outlined in Appendix B of AS 3959, provides access to the formula used to derive the Method 1 values. Where justified it enables the inputs used in Method 1 to be varied, to reflect true site conditions to provide a site-specific assessment of the radiant heat level at any given distance from the fire.

Not all vegetation is a classified bushfire risk. Vegetation and ground surfaces that are exempt from classification as a potential hazard is identified as low threat under Section 2.2.3.2 of AS 3959. Low threat vegetation includes the following:

a) Vegetation of any type that is more than 100 m from the site.
b) Single areas of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified.
c) Multiple areas of vegetation less than 0.25 ha in area and not within 20 m of the site, or each other, or of other areas of vegetation being classified.
d) Strips of vegetation less than 20 m in width (measured perpendicular to the elevation exposed to the strip of vegetation) regardless of length and not within 20 m of the site or each other, or other areas of vegetation being classified.
e) Non-vegetated areas, that is, areas permanently cleared of vegetation, including waterways, exposed beaches, roads, footpaths, buildings and rocky outcrops.
f) Vegetation regarded as low threat due to factors such as flammability, moisture content or fuel load. This includes grassland managed in a minimal fuel condition, mangroves and other saline wetlands, maintained lawns, golf courses (such as playing areas and fairways), maintained public reserves and parklands, sporting fields, vineyards, orchards, banana plantations, market gardens (and other non-curing crops), cultivated gardens, commercial nurseries, nature strips and wind breaks.

3.1 Bushfire attack level (BAL) assessment

In accordance with Appendix Five of the Guidelines, a method 1 BAL assessment has been undertaken to support the proposed structure plan for the site in order to determine the BAL ratings potentially applicable to future habitable buildings based on the vegetation classification and effective slope, and to prepare the associated BAL contour plan.

3.1.1 Assessment inputs

Assessing bushfire hazards takes into account the classes of vegetation within the site and surrounding area for a minimum of 150 m, in accordance with AS 3959. The assignment of vegetation classifications is based on an assessment of vegetation structure, which includes consideration of the various fuel layers of different vegetation types. For example, fuel layers in a typical forest environment can be broken-down into five segments as illustrated in **Plate 3** below. These defined fuel layers are considered when determining the classification of vegetation and associated bushfire hazard levels.

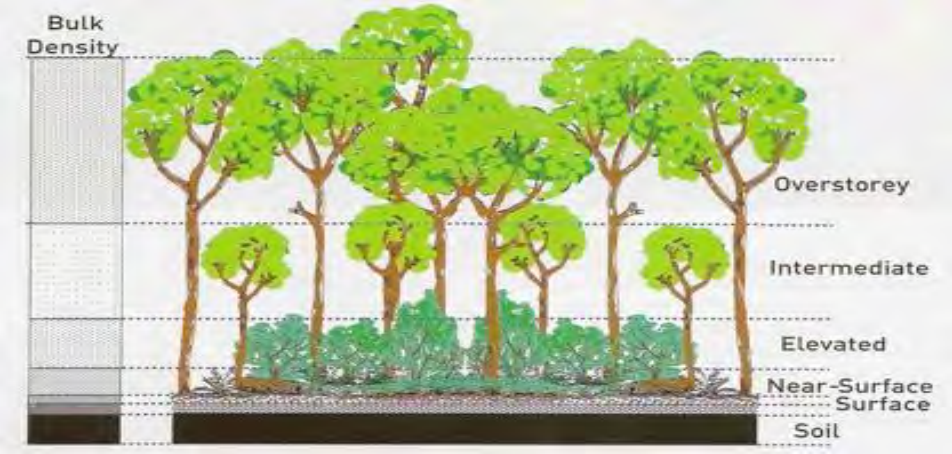

Plate 3: The five fuel layers in a forest environment that could be associated with fire behaviour (Gould et al. 2007)

An assessment of existing vegetation within the site and surrounding 150 m as well as effective slope was undertaken on the 3rd July 2019 and 28th February 2020 in accordance with AS 3959 and the Guidelines.

Table 2 outlines:

- The pre-development AS 3959 vegetation classifications (and associated photo locations), which are also shown in **Figure 2**. Additional photo locations not included in **Table 2** are provided in **Appendix B**.
- The bushfire hazard ratings, which are also shown in **Figure 3**.
- The post-development AS 3959 vegetation classifications, which are also shown in **Figure 4**.
- The effective slope for each area of classified vegetation present in the post-development scenario, which is also shown in **Figure 5**.

Table 2: Vegetation classification, effective slope and future management

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
1, 2	Forest vegetation has been identified immediately west of the site (Plot 1) and to the east of the site (Plot 2). Plot 1 is associated with an existing drainage reserve, whilst Plot 2 is associated with a railway reserve. Both areas of vegetation are not managed and are associated with multiple fuel layers, including near-surface, understorey, elevated and overstorey. **AS 3959 classification (Figure 2):** Forest (Class A) **Bushfire hazard rating (Figure 3):** Extreme **Photo points:** 27, 28, 29, 30, 31, 32, 33, 34, 54, 56, 60	 *Photo location 28: forest vegetation associated with the drainage reserve to the west of the site, looking west*  *Photo location 30: forest vegetation, looking south-east.*  *Photo location 54: forest vegetation within the railway reserve to the east of the site, looking east.*  *Photo location 56: forest vegetation within the railway reserve to the east of the site, looking west.*	1, 2	The drainage reserve to the west of the site and vegetation within the railway reserve to the east of the site does not appear to have been subject to any form of management in the past and it is assumed that no future management of these areas will occur. Therefore, the forest vegetation within Plot 1 and Plot 2 are assumed to remain in the same condition as the pre-development assessment in the long term (noting some areas may be subject to future development as a Metronet station) and will remain a bushfire hazard to future development. **AS 3959 classification (Figure 4):** Forest (Class A) **Effective slope (Figure 5):** Flat/upslope

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
3	Forest vegetation has been identified to the south of the site and is associated with retained remnant vegetation in an area of public open space. This area appears to be subject to seasonal waterlogging with surface water (see Photo 18 and 19). The vegetation has multiple fuel layers with a continuous fuel load from the surface to the overstorey. **AS 3959 classification (Figure 2):** Forest (Class A) **Bushfire hazard rating (Figure 3):** Extreme **Photo points:** 16, 17, 18, 19	 *Photo location 16: forest vegetation to the south of the site, looking south.*  *Photo location 17: forest vegetation, looking south.*  *Photo location 18: forest vegetation with multiple fuel layers, looking south-east.*  *Photo location 19: forest vegetation in the background, looking south-east.*	3	Once development progresses within the site, existing classified vegetation (in the pre-development scenario) will be converted to either non-vegetated areas (exclusion clause 2.2.3.2 (e)) or low threat vegetation (exclusion clause 2.2.3.2 (f)). As a result, the area of forest vegetation to the south-east of the site will be excluded in the post-development scenario in accordance with exclusion clause 2.2.3.2 (b) - single area of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified vegetation. **AS 3959 classification (Figure 4):** Single area of vegetation less than 1 ha in area and not within 100 m of other areas of vegetation being classified vegetation (exclusion clause 2.2.3.2(b)) **Effective slope (Figure 5):** Not applicable

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
4, 5	Woodland vegetation has been identified to the west of the site associated with Pethick Close road reserve (Plot 4). The narrow strips of vegetation within the road reserve are characterised by overstorey *Eucalyptus* species, with unmanaged understorey of grasslands and high leaf litter fuel loads and cannot be excluded due to their width. Woodland vegetation has also been identified to the south of the site associated with unmanaged areas within private landholdings (Plot 5). This area of vegetation has been subject to previous disturbance and contains a mix of species with a grass understorey and does not appear to be subject to management. **AS 3959 classification (Figure 2):** Woodland (Class B) **Bushfire hazard rating (Figure 3):** Extreme **Photo points:** 22, 24, 39, 40	 *Photo location 22: woodland vegetation (associated with Plot 5) to the south of the site, looking west.*  *Photo location 24: woodland vegetation with grass understorey (associated with Plot 5), looking east.*  *Photo location 39: woodland vegetation within Pethick Close road reserve (Plot 4), looking west.*  *Photo location 40: woodland vegetation to the west of the site (Plot 4), looking west.*	4, 5	Woodland vegetation located outside of the site (associated with both Plot 4 and Plot 5) is assumed to remain in the same condition as the pre-development assessment in the long-term, and therefore will remain a bushfire hazard. **AS 3959 classification (Figure 4):** Woodland (Class B) **Effective slope (Figure 5):** Flat/upslope

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
6, 7	Shrubland vegetation has been identified within drainage reserves to the north-west of the site (associated with Plot 6) and to the south-east of the site (associated with Plot 7). Plot 6 is associated with portions of planted vegetation immediately adjacent to the flow path within a drainage area consisting of smaller height vegetation. Plot 7 is associated with planted vegetation on either side of a drain running in an east-west direction. This area of vegetation is mainly associated with planted *Jacksonia sp.* up to 1 to 2 m in height and appears to be unmanaged. **AS 3959 classification (Figure 2):** Shrubland (Class C) **Bushfire hazard rating (Figure 3):** Moderate **Photo points:** 10, 11, 12, 13, 45, 47	 *Photo location 10: shrubland vegetation (associated with Plot 7) on either side of the drain, looking east.*  *Photo location 12: shrubland vegetation within the drainage reserve (Plot 7), looking east.*  *Photo location 45: shrubland vegetation within the centre of the photo (Plot 6), looking west.*  *Photo location 47: shrubland vegetation within the drainage reserve (Plot 6), looking north.*	6, 7	The shrubland vegetation identified outside of the site is located within a drainage reserve (Plot 6 and Plot 7) that does not appear to be subject to any regular maintenance. It is assumed that no future management of this area is expected. Therefore the shrubland vegetation is assumed to remain in the same condition as the pre-development assessment in the long term. This area will remain a bushfire hazard to future development within the site. **AS 3959 classification (Figure 4):** Shrubland (Class C) **Effective slope (Figure 5):** Flat/upslope

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
8, 9	Areas of scrub vegetation has been identified to the north-west and south-east of the site. These areas of vegetation are associated with drainage reserves that include a mix of planted species with a likely canopy height of between 2 m and 4 m where fully grown. These areas do not appear to be subject to any regular maintenance. **AS 3959 classification (Figure 2):** Scrub (Class D) **Bushfire hazard rating (Figure 3):** Extreme **Photo points:** 2, 3, 42, 43, 44, 46, 48, 49, 57, 58	 *Photo location 2: showing scrub vegetation within the drainage reserve to the north-west of the site, looking east.*  *Photo location 42: scrub vegetation to the north-west of the site, looking north-east.*  *Photo location 57: scrub vegetation within the drainage reserve to the south-east of the site, looking north-east.*  *Photo location 58: scrub vegetation to the south-east of the site, looking west.*	8, 9	The identified areas of scrub vegetation do not appear to be subject to any regular maintenance and this is assumed to remain the case. Therefore, the scrub vegetation within Plot 8 and Plot 9 are assumed to remain in the same condition as the pre-development assessment in the long term and will remain a bushfire hazard to future development within the site. **AS 3959 classification (Figure 4):** Scrub (Class D) **Effective slope (Figure 5):** Flat/upslope

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
10	Grassland vegetation has been identified throughout the whole site, with scattered individual paddock trees in the southern portion of the site. Paddock grasses within the site may be subject to some management, but this appears to be intermittent and therefore has been identified as a bushfire hazard. **AS 3959 classification (Figure 2):** Grassland (Class G) **Bushfire hazard rating (Figure 3):** Moderate **Photo points:** 6, 7, 8, 9, 35, 38, 51, 52 Continued below.	 *Photo location 6: grassland within the eastern portion of the site, looking south-east.*  *Photo location 7: grassland within the northern portion of the site, looking south-west.*  *Photo location 35: grassland within the south-western portion of the site, looking east.*  *Photo location 38: grassland vegetation within the site, looking east.*	13	The majority of the site will be converted to hardstand areas in the form of buildings, driveways and roads and is therefore considered to be low threat in accordance with (exclusion clause 2.2.3.2(e)). It is noted that some of these areas will contain managed grass, garden areas or verges in the future (as residential and commercial development is completed), however for ease of reference have been excluded as non-vegetated on the basis that these will form part of future lots. **AS 3959 classification (Figure 4):** Non-vegetated (exclusion clause 2.2.3.2(e)). **Effective slope (Figure 5):** Not applicable

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
10	Continued from above.	Continued from above.	14	Portions of the site will be converted to areas of public open space and will support recreation and drainage purposes. These areas will be designed, implemented and maintained to a low threat standard in accordance with exclusion clause 2.2.3.2 (f) based on the requirements of Liveable Neighbourhoods and the Shire of Serpentine Jarrahdale. These areas will be maintained by the proponent initially, and then the Shire of Serpentine Jarrahdale following handover. **AS 3959 classification (Figure 4):** Low threat vegetation (exclusion clause 2.2.3.2(f)) **Effective slope (Figure 5):** Not applicable

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
11, 12	Unmanaged grassland vegetation has been identified within private landholdings to the south-west of the site and Abernethy Road (associated with Plot 11). Unmanaged grassland vegetation has also been identified within the railway reserve adjacent to the eastern boundary of the site (associated with Plot 12). **AS 3959 classification (Figure 2):** Grassland (Class G) **Bushfire hazard rating (Figure 3):** Moderate **Photo points:** 25, 26, 53, 55	 *Photo location 25: grassland vegetation to the south-west of the site (Plot 11), looking south-east.*  *Photo location 26: grassland vegetation within landholdings to the south-west of the site (Plot 11), looking south.*  *Photo location 53: unmanaged grassland within the railway reserve to the east of the site, looking south-east.*  *Photo location 55: grassland vegetation along the eastern side of the railway reserve, looking north-west.*	11, 12	The identified grassland vegetation associated with Plot 11 and Plot 12 is assumed to remain in the same condition as the pre-development assessment in the long-term, and therefore will remain a permanent bushfire hazard. **AS 3959 classification (Figure 2):** Grassland (Class G) **Effective slope (Figure 5):** Flat/upslope

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
13	Non-vegetated areas such as roads, driveways, existing residential and commercial buildings and areas of mineral earth within and surrounding the site have been excluded in accordance with Clause 2.2.3.2(e) of AS 3959. **AS 3959 classification (Figure 2):** Non-vegetated (exclusion clause 2.2.3.2(e)) **Bushfire hazard rating (Figure 3):** Low, however as required under the Guidelines, any areas within 100 m of moderate or extreme hazards would be considered moderate hazard, to reflect the potential increased risk. **Photo points:** 4, 14, 15, 20, 21, 36, 59	 *Photo location 4: showing existing residential houses and Evans Way to the north of the site, looking north.*  *Photo location 15: areas of partially developed road within the south-eastern corner of the site, looking south.*  *Photo location 20: Abernethy Road and associated road works immediately south of the site, looking west.*  *Photo location 14: carparks associated with the shopping centre complex to the south of the site, looking south.*	13	The existing maintenance regimes for all existing non-vegetated areas surrounding the site are assumed to continue in the long-term based on current land uses and management arrangements and will remain low threat. In addition, areas within the site that have been identified as non-vegetated will remain non-vegetated when converted to public roads and/or residential or commercial lots as part of the proposed development of the site. **AS 3959 classification (Figure 4):** Non-vegetated (exclusion clause 2.2.3.2(e)) **Effective slope (Figure 5):** Not applicable

Table 2: Vegetation classification, effective slope and future management (continued)

Pre-development (see Figure 2 and Figure 3)			Post development (see Figure 4 and Figure 5)	
Plot no.	**AS 3959 classification and bushfire hazard rating**	**Site photo/s (location points shown in Figure 2)**	**Plot no.**	**AS 3959 classification, effective slope and assumptions**
14	Surrounding the site, areas of low threat vegetation have been identified and are largely associated with either existing managed road verges, playing fields and gardens associated with Byford Secondary College to the south of the site, and managed gardens/verges associated with surrounding residential development. **AS 3959 classification (Figure 2):** Low threat vegetation (exclusion clause 2.2.3.2(f)) **Bushfire hazard rating (Figure 3):** Low, however as required under the Guidelines, any areas within 100 m of moderate or extreme hazards would be considered moderate hazard, to reflect the potential increased risk. **Photo points:** 1, 5, 23, 37, 41, 50	 *Photo location 5: single row of windbreak planting immediately north of the site, looking north-east.*  *Photo location 23: playing fields associated with Byford Secondary College to the south of the site, looking south.*  *Photo location 37: managed residential landholdings to the west of the site, looking west.*  *Photo location 41: managed lawns and gardens to the west of the site, looking west.*	14	The maintenance regimes for all existing low-threat vegetation surrounding the site is assumed to continue in the long-term based on current land uses and management arrangements, in accordance with the requirements of the Shire of Serpentine Jarrahdale fire control notice and community expectations. **AS 3959 classification (Figure 4):** Low threat vegetation (exclusion clause 2.2.3.2(f)) **Effective slope (Figure 5):** Not applicable

3.1.1.1 Post development assumptions

The BAL assessment, to determine the predicated BAL ratings applicable to the site, has assumed the following:

- **Designated FDI**: 80
- **Flame temperature**: 1090 K
- **Vegetation classification**: forest (Class A), woodland (Class B), shrubland (Class C), scrub (Class D) and grassland (Class G) vegetation identified within the post-development scenario, see **Figure 4**.
- **Effective slope beneath classified vegetation**: flat/upslope (see **Figure 5**)
- **Setback distances**: as per Table 2.5 in AS 3959 with the relevant distances used to inform the BAL contour plan summarised in **Table 3** with the BAL contour provided in **Figure 6**.

In addition to the above, the following key assumptions have informed this assessment:

- All classified vegetation within the site that is within the proposed areas of public open space will be removed or modified to achieve low threat in accordance with Section 2.2.3.2 of AS 3959. Management of low threat areas are may include (but is not limited to):
  - Removal of grassland vegetation
  - Irrigation of grass and garden beds
  - Regularly mowing/slashing of grass to less than 100mm in height.
  - Regular maintenance including removal of weeds and dead material
  - Low pruning of trees
  - Application of ground covers such as mulch or non-flammable materials
- Areas of low threat vegetation outside of the site (and not under the proponent's control) will continue to be managed and/or considered to achieve low threat (in accordance with Section 2.2.3.2 of AS 3959) based on the existing maintenance regimes, and/or as per the Shire of Serpentine Jarrahdale's fire control notice.
- Classified vegetation that has been identified outside of the proponent's landholdings has been assumed to remain in its current state (unless stated otherwise), and will therefore remain a bushfire hazard to development within the site.

3.1.2 Assessment outputs

The BAL assessment completed for the site indicates that a BAL rating of BAL-29 or less can be achieved at future habitable buildings based on the indicated spatial layout for the structure plan (**Appendix A**). Portions of the lots adjacent to the drainage reserve to the west of the site will likely be subject to a BAL rating of BAL-FZ and BAL-40, however these lots are of a suitable depth to accommodate a future dwelling that will not be exposed to a BAL rating exceeding BAL-29.

Table 3 provides a summary of the setback distances necessary from classified vegetation to achieve the indicated BAL ratings, with the BAL Contour Plan (**Figure 6**) being a visual representation of these distances. The setback distances are based on the post-development classified vegetation (**Figure 4**), effective slope (**Figure 5**) and are taken from Table 2.5 of AS 3959.

Table 3: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment

Post development plot number (see Figure 4)	Vegetation classification (see Figure 4)	Effective slope (see Figure 5)	Distance to vegetation (from Table 2.5 of AS 3959)	BAL rating (see Figure 6)
Plot 1, 2	Forest (Class A)	Flat/upslope	< 16 m	BAL-FZ
			16 - < 21 m	BAL-40
			21 - < 31 m	BAL-29
			31 - < 42 m	BAL-19
			42 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 4, 5	Woodland (Class B)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 14 m	BAL-40
			14 - < 20 m	BAL-29
			20 - < 29 m	BAL-19
			29 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 6, 7	Shrubland (Class C)	Flat/upslope	< 7 m	BAL-FZ
			7 - < 9 m	BAL-40
			9 - < 13 m	BAL-29
			13 - < 19 m	BAL-19
			19 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW

Table 3: Setback distances based on vegetation classification and effective slope and Table 2.5 of AS 3959, as determined by the method 1 BAL assessment (continued)

Post development plot number (see Figure 4)	Vegetation classification (see Figure 4)	Effective slope (see Figure 5)	Distance to vegetation (from Table 2.5 of AS 3959)	BAL rating (see Figure 6)
Plot 8, 9	Scrub (Class D)	Flat/upslope	< 10 m	BAL-FZ
			10 - < 13 m	BAL-40
			13 - < 19 m	BAL-29
			19 - < 27 m	BAL-19
			27 - < 100 m	BAL-12.5
			> 100 m	BAL-LOW
Plot 11, 12	Grassland (Class G)	Flat/upslope	< 6 m	BAL-FZ
			6 - < 8 m	BAL-40
			8 - < 12 m	BAL-29
			12 - < 17 m	BAL-19
			17 - < 50 m	BAL-12.5
			> 50 m	BAL-LOW

4 Identification of Bushfire Hazard Issues

From a bushfire hazard management perspective, the key issues that are likely to require management and/or consideration as part of future development within the site include:

- Provision of appropriate separation distance from permanent bushfire hazards within or surrounding the site (i.e. the drainage reserves to the west and east of the site and the railway reserve to the east of the site) to ensure a BAL rating of BAL-29 or less can be achieved at new habitable buildings. Consideration will also need to be given to providing appropriate separation from any temporary bushfire hazards (i.e. unmanaged vegetation within the site) that may exist at the time development is progressed.
- Ensuring that future public open space areas are appropriately designed and managed to achieve low threat standards in accordance with AS 3959 and the requirements of the Shire of Serpentine Jarrahdale.
- Provision of appropriate vehicular access to ensure that when development within the site is fully constructed, egress to at least two different destinations will be available to future residents and emergency personnel. The site is located immediately north of Abernethy Road, which provides egress opportunities to the east and west including Byford town centre and South Western Highway to the east, and Tonkin Highway to the north-west.
- Provision of appropriate water supply and associated infrastructure.

These issues are considered further in **Section 5.**

5 Assessment Against the Bushfire Protection Criteria

This BMP provides an outline of the mitigation strategies that will ensure that as development progresses within the site, an acceptable solution and/or performance-based system of control can be adopted for each of the bushfire protection criteria detailed within Appendix Four of the Guidelines (WAPC and DFES 2017). The bushfire protection criteria identified in the Guidelines and addressed as part of this BMP are:

- Element 1: Location of the development
- Element 2: Siting and design of the development
- Element 3: Vehicular access
- Element 4: Water supply.

As part of future development, the intent of the bushfire protection criteria can be satisfied through a mix of acceptable and performance solutions. A summary of how this can be achieved and an associated compliance statement for each has been provided in **Table 4**.

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Table 4: Summary of bushfire protection criteria and compliance statement

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 1: Location	To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.	A1.1 Development location		It is possible for all future new proposed habitable buildings to be located in an area of developable land[1] subject to a low or moderate bushfire hazard, given buildings will be located within areas identified as low threat in accordance with Clause 2.2.3.2(e) of AS 3959. Appendix Two of the Guidelines (WAPC and DFES 2017) states that non-vegetated or low threat areas will be considered a 'low' hazard, except where within 100 m of a moderate or extreme hazard (associated with areas of classified vegetation), and in that case would be subject to a 'moderate' hazard. Sufficient area will be available within each proposed lot to enable the 'developable land' (i.e. land that can accommodate a habitable building) to achieve a BAL rating of BAL-29 or less. This is discussed further below. The proposed structure plan is therefore able to satisfy the acceptable solution.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 1: Location.
		Yes.	N/A		

[1] *Position Statement: Planning in bushfire prone areas - Demonstrating Elements 1: Location and Element 2: Siting and design* (WAPC 2019) has outlined that 'developable land' is "*land that can accommodate a habitable dwelling and would not generally include areas of BAL-40 and/or BAL-FZ, areas within the local government setback and areas subject to environmental constraints*".

Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 2: Siting and design	To ensure the siting and design of development minimises the level of bushfire impact.	A2.1 Asset Protection Zone		Asset protection zones (APZ) around buildings are an important bushfire protection measure influencing the safety of people and property. The APZ is a low fuel area immediately surrounding a building, and can include non-flammable features such as irrigated landscapes, gardens, driveways, public roads and managed public open space. Bushfire hazards have been identified associated with classified vegetation within the drainage reserves to the north, east and west of the site, the railway reserve to the east of the site and vegetation within nearby landholdings. As outlined above, the outcomes of the BAL assessment (see **Figure 6**) indicates that future habitable buildings can be located in areas subject to a BAL rating of BAL-29 or less, with the majority likely to be subject to a BAL rating of BAL-LOW. This is largely accommodated through the structure plan layout and the location of public open space and public roads. Portions of the lots adjacent to the drainage reserve to the west of the site are likely to be subject to a BAL rating of BAL-FZ and BAL-40, however these lots are for R10 purposes and are suitably sized to accommodate a future dwelling that will not be exposed to a BAL rating exceeding BAL-29. The drainage reserves immediately to the north-west and south-east of the site, and the grassland vegetation within the railway reserve to the east of the site, will result in BAL ratings of BAL-FZ and BAL-40 extending into the site. However, suitable separation has been provided through the provision of a road interface and areas proposed for public open space to enable BAL-29 or less to be achieved at future habitable buildings. Overall, the acceptable solution can be satisfied for all future habitable buildings. Class 1, 2, 3 and 10a buildings, where located within a designated bushfire prone area and an area subject to a BAL rating of BAL-12.5 or higher will need to satisfy higher construction standards in accordance with AS 3959.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 2: Siting and design.
		Yes.	N/A		

Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 3: Vehicular access	To ensure vehicular access serving a subdivision/ development is available and safe during a bushfire event.	A3.1 Two access routes		The site is located immediately north of Abernethy Road, a regional connector road which provides egress opportunities to the east and west, including to Byford town centre and South Western Highway (approximately 420 m east of the site) and Tonkin Highway approximately 5 km to the north-west. The proposed development will have direct access to Abernethy Road (via four connections) to the south of the site, as well as Sansimeon Boulevard and Evans Way to the north of the site (which connect to Larson Road). Subject to future investigations associated with the proposed Metronet station, a connection to Clara Street to the east of the site may also be available.	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 3: Vehicular access.
		Yes.	N/A		
		A3.2 Public road		Existing roads surrounding the site, in addition to the proposed new public road within the site, can and will comply with the minimum standards outlined in Appendix Four of the Guidelines (WAPC and DFES 2017) or as agreed with the Shire of Serpentine Jarrahdale and includes a minimum 6 m-wide trafficable surface. An excerpt of the requirements (from Table 6 of Appendix Four the Guidelines) has been provided below. *Excerpt of Table 6 from Appendix Four of the Guidelines (WAPC & DFES 2017)*	
		Yes	N/A		

TECHNICAL REQUIREMENTS	1 Public road	2 Cul-de-sac	3 Private driveway	4 Emergency access way	5 Fire service access routes
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal clearance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 metres	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius (m)	8.5	8.5	8.5	8.5	8.5
*Refer to E3.2 Public roads: Trafficable surface					

Table 4: Summary of bushfire protection criteria and compliance statement (continued)

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 3: Vehicular access (continued from above)	Continued from above.	A3.3 Cul-de-sac (including dead-end-road)		The proposed structure plan provides for a number of dead-end roads in the central portion of the site, to accommodate the proposed density of development while also enabling access to the areas of public open space. No turn-around area is proposed at the end of these roads, however, the dead end portion of the roads will all be largely less than 30 m in length, which will allow fire appliances to safely operate from the road junction without having to travel down the dead-end road and turn around (similar to the considerations for private driveways less than 50 m in length, where no additional access considerations are required). If a fire appliance does need to travel down the dead-end road it could easily navigate reversing this section of road. Therefore, while a number of dead-end roads are proposed, the length of these mean that these will function similar to driveways less than 50 m in length, rather than a longer public road. No turn-around areas are proposed, however all other requirements, as outlined within Appendix Four of the Guidelines (WAPC and DFES 2017), can be satisfied. Accordingly, vehicular access and egress can be safely accommodated within the development.	Continued from above.
		N/A	Yes		
		A3.4 Battle-axe		Not applicable. At this stage, no battle-axe properties are proposed as part of the development within the site.	
		N/A	N/A		
		A3.5 Private driveway longer than 50 m		Not applicable. No private driveways longer than 50 m are proposed based on the structure plan and the density of the proposed development.	
		N/A	N/A		
		A3.6 Emergency access way		Not applicable. Given the proposed structure plan layout provides for egress to at least two different destinations emergency access ways are not required as part of the proposed development of the site.	
		N/A	N/A		
		A3.7 Fire service access routes (perimeter roads)		Not applicable. Future development within the site will be provided with appropriate vehicular access, as outlined above, and therefore fire service access routes are not required.	
		N/A	N/A		

Table 5: Summary of bushfire protection criteria and compliance statement

Bushfire protection criteria	Intent	Method of compliance		Proposed bushfire management strategies	Compliance statement
		Acceptable solution	Performance principle		
Element 3: Vehicular access (continued from above)	Continued from above.	A3.8 Firebreak width		Once development is progressed within the site, in accordance with the Shire of Serpentine Jarrahdale fire control notice (or as specified by the Shire of Serpentine Jarrahdale in accordance with Section 33 of the *Bush Fires Act 1954*), firebreaks are unlikely to be required. Instead landholdings will be required to be managed clear of all flammable matter to a height of no greater than 25 mm.	Continued from above
		Yes.	N/A		
Element 4: Water	To ensure water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.	A4.1 Reticulated areas		Development is located within an Emergency Services Levy (ESL) Category 3 area, which indicates that bushfire events are responded to by a volunteer fire and rescue service with the availability of a network of career fire stations, and the State Emergency Services (SES) if required. Fire response services require ready access to an adequate water supply during bushfire emergencies. The site will connect with a reticulated water supply and will include fire hydrants installed by the developer to meet the specifications of Water Corporation (Design Standard DS 63) and DFES. Fire hydrants on land zoned for residential purposes are generally required to be sited at or within 200 m of dwellings (Class 1a).	Based on the outlined management measures, future development would be able to comply with and meet the intent of Element 4: Water.
		Yes.	N/A		
		A4.2 Non-reticulated areas		Not applicable.	
		N/A	N/A		
		A4.3 Individual lots within non-reticulated areas (only for use if creating 1 additional lot and cannot be applied cumulatively)		Not applicable.	
		N/A	N/A		

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5.1 Additional management strategies

5.1.1 Future approval considerations

The BAL assessment within this document is considered to be a conservative assessment of potential bushfire risk posed to future habitable buildings within the site based on the assumptions outlined in **Section 3**.

The measures to be implemented through this structure plan and associated future subdivision process have been outlined as part of this BMP and can be used to support future planning and development approval processes. A revised BMP is likely to be required to support any future subdivision applications, particularly if the development layout is different to that outlined within this document, and will need to respond to the subdivision design (and/or stage of development).

5.1.2 Landscape management

5.1.2.1 Within the site

Drainage reserves and public open space

As part of the proposed works within the site, formal landscaping will be undertaken within the areas of public open space and will be designed to achieve low threat vegetation in accordance with Section 2.2.3.2 of AS 3959. The management of the landscaped areas will be the responsibility of the proponent/landowner initially and following handover, long-term the Shire of Serpentine Jarrahdale. Ongoing management will be aligned with typical urban requirements and will likely include:

- Irrigation of grass and garden beds (where required).
- Regular mowing/slashing of grass to less than 100 mm in height.
- Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.).
- Low pruning of trees (branches below 2 m in height removed where appropriate).
- Application of ground/surface covers such as mulch or non-flammable materials as required.

Future lots

All lots within the site will be managed to a low threat standard by the proponent initially, and once sold, will be managed by the applicable landowners in accordance with the Shire of Serpentine Jarrahdale fire control notice (as published).

5.1.2.2 Surrounding the site

Within existing private landholdings

Where indicated as low threat in **Figure 4**, it is assumed that the private landholdings surrounding the site will be managed by the applicable landowners in accordance with the Shire of Serpentine Jarrahdale fire control notice (as published) and/or in accordance with existing maintenance regimes.

Existing drainage reserves

Where indicated as classified vegetation in **Figure 4**, it is assumed that the drainage reserves surrounding the site will remain in the same condition as pre-development and will not be managed in the long-term.

Existing public road reserves

The maintenance of existing public road reserves is assumed to continue to achieve low threat in accordance with Section 2.2.3.2 of AS 3959, in line with the existing maintenance regimes and/or Shire of Serpentine Jarrahdale requirements for residential areas. Management of these areas may include:

- Regular mowing/slashing of grass to less than 100 mm in height.
- Regular removal of weeds and built up dead material (such as fallen branches, leaf litter etc.) (where required).
- Low pruning of trees (branches below 2 m in height removed where appropriate).
- Application of ground/surface covers such as mulch or non-flammable materials as required.

5.1.3 Shire of Serpentine Jarrahdale Fire Control Notice

The Shire of Serpentine Jarrahdale releases a fire control notice annually (or as required) to provide a framework for bushfire management within the Shire. The Shire of Serpentine Jarrahdale is able to enforce this order in accordance with Section 33 of the *Bush Fires Act 1954* and landowners will need to ensure compliance with the fire control notice, as published, or any directions provided by the Shire of Serpentine Jarrahdale.

In particular, in accordance with the fire control notice, all properties that are 1 acre or less (i.e. majority of future residential lots within the site) are required to clear and maintain the land free of all flammable material and cut all grass to less than 25 mm in height and/or manage properties in accordance with an approved bushfire management plan.

5.1.4 Vulnerable or high-risk land uses

No vulnerable or high-risk land uses, as defined under SPP 3.7, are identified within the site as part of the structure plan. Therefore, the requirements of policy measure 6.6 within SPP 3.7 are not applicable.

If any high-risk or vulnerable land uses are proposed in the future, the requirements of policy measure 6.6 SPP 3.7 will need to be addressed, including the assessment of bushfire risk and/or the preparation of an emergency evacuation plan (for vulnerable land uses) or risk management plan (for high-risk land uses).

Currently, it is possible based on permanent bushfire hazards and proposed layout for all future habitable buildings within the site to be located in an area subject to a BAL rating of BAL-29 or less, and appropriate vehicle access is provided to support emergency evacuation, enabling the requirements of SPP 3.7 to be satisfied.

5.1.5 Public education and preparedness

Community bushfire safety is a shared responsibility between individuals, the community, government and fire agencies. DFES has an extensive Community Bushfire Education Program including a range of publications, a website and Bushfire Ready Groups. The DFES publication '*Prepare. Act. Survive.'* (DFES 2014) provides excellent advice on preparing for and surviving the bushfire season. Other downloadable brochures are available from http://www.dfes.wa.gov.au/safetyinformation/fire/bushfire/pages/publications.aspx

The Shire of Serpentine Jarrahdale provides bushfire safety advice to residents available from their website http://www.sjshire.wa.gov.au/what-we-do/emergency-services/bushfires-and-fire-control/. Professional, qualified consultants also offer bushfire safety advice and relevant services to residents and businesses in high risk areas in addition that that provided in this BMP.

In the case of a bushfire in the area, advice would be provided to residents and businesses by DFES, the Department of Biodiversity Conservation and Attractions (DBCA) and/or the Shire of Serpentine Jarrahdale on any specific recommendations with regard to responding to the bushfire, including evacuation if required. However, it is highly recommended that residents and businesses make themselves aware of their responsibilities with regard to preparing for and responding to a potential bushfire that may impact upon them, their property and their visitors at the time, regardless of the BAL rating the building is subject to.

6 Responsibilities for Implementation and Management of Bushfire Measures

Table 6 outlines the future responsibilities of the proponent (developer) and the Shire of Serpentine Jarrahdale associated with implementing this BMP with reference to ongoing bushfire risk mitigation measures for existing land uses (through compliance with the Shire of Serpentine Jarrahdale fire control notice) or future mitigation measures to be accommodated as part of the development process. These responsibilities will need to be considered as part of the subsequent development and implementation process.

Table 6: Responsibilities for the implementation of this BMP

Management action	Timing
Developer/landowner	
Provide a copy of this BMP to the relevant decision makers to support approval of the proposed structure plan.	To support the structure plan approval process.
Prepare a new/revised BMP in accordance with SPP 3.7, the Guidelines and AS 3959 to support future subdivision applications, based on the proposed detailed layout and in consideration of existing bushfire hazards or those that will be present following development. In addition, if the assumptions regarding the treatment of the public open space areas changes as part of future detailed design stages, a revised BMP will be required.	To support each future subdivision application.
Where required, and based on the outcomes this BMP or subsequent BMP/s, make spatial provision within the subdivision layout/design to accommodate: • A suitable road network that provides access to at least two different destinations which may include a temporary emergency access way depending upon staging of the subdivision. Public roads should be at least 6 m-wide and consider the minimum requirements of Appendix Four in the Guidelines (or as agreed with the Shire of Serpentine Jarrahdale). The proposed structure plan currently supports this requirement. • Where possible avoid cul-de-sacs/dead-end roads and battle axe lots, or where utilised ensure these consider the general requirements outlined in this BMP, Appendix Four of the Guidelines, or as agreed with the Shire of Serpentine Jarrahdale. • Ensure future habitable buildings are able to be located so that BAL-29 or less applies. Separation distances should be in accordance with the minimum distances outlined in **Table 3** of this BMP for the corresponding vegetation plot/classification, or as determined in subsequent BMPs/BAL assessments. This may include the provision of public roads and/or managed public open space between habitable buildings and bushfire hazards, or by ensuring lots are an adequate depth or width to ensure BAL-29 is not exceeded at future habitable buildings (this is particularly relevant for lots adjacent to the drainage reserve to the west of the site).	To support each future subdivision application.
Comply with the Shire of Serpentine Jarrahdale fire control order until subdivision progresses. Confirm requirements based on the annual firebreak notice, but currently for residential land greater than 1 acre, provide firebreaks of at least 3 m-wide (and no wider than 5 m) and keep grass fuels short.	At all times, where applicable.
Shire of Serpentine Jarrahdale	
Maintaining fuel loads in existing public road reserves and public open space (under their management) to appropriate standards to minimise fuel loads (as per current maintenance regimes).	Ongoing, as required.
Monitoring vegetation fuel loads in private landholdings against the requirements of the Shire's fire control order (and/or existing maintenance regimes outlined in this BMP) and liaising with relevant stakeholders to maintain fuel loads at minimal/appropriate fuel levels.	Ongoing, as required.

7 Applicant Declaration

7.1 Accreditation

This BMP has been prepared by Emerge Associates who have been providing bushfire risk management advice for more than six years, undertaking detailed bushfire assessments (and associated approvals) to support the land use development industry. (DPLH 2019)

Anthony Rowe is a Fire Protection Association of Australia (FPAA) Level 3 Bushfire Planning and Design (BPAD) accredited practitioner (BPAD no. 36690) with over nine years' experience and is supported by a number of team members who have undertaken BPAD Level 1 and Level 2 training and are in the processing of gaining formal accreditation.

7.2 Declaration

I declare that the information provided is true and correct to the best of my knowledge.

Signature:

Name: Anthony Rowe

Company: Emerge Associates

Date: 10th March 2020

BPAD Accreditation: Level 3 BPAD no. 36690

Signature:

Name: Kirsten Knox

Company: Emerge Associates

Date: 10th March 2020

(DPLH 2019)

8 References

8.1 General references

Department of Fire and Emergency Services (DFES) 2014, *Prepare. Act. Survive.*, Perth. August 2014.

Department of Planning, Lands and Heritage (DPLH) 2019, *Position Statement: Planning in bushfire prone areas - Demonstrating Element 1: Location and Element 2: Siting and design*, Western Australian Planning Commission.

Standards Australia 2018, *AS 3959-2018 Construction of buildings in bushfire-prone areas*, Sydney.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Perth.

Western Australian Planning Commission and Department of Fire and Emergency Services (WAPC and DFES) 2017, *Guidelines for Planning in Bushfire Prone Areas Version 1.3*, Western Australia. December 2017.

Urbis 205, *Byford Town Centre Local Structure Plan*, Perth.

8.2 Online references

Department of Water 2008, *LIDAR derived 1 m elevation contours* dataset, Government of Western Australia.

Landgate 2019, *Locate V5,* viewed February 2020, <https://maps.slip.wa.gov.au/landgate/locate/>

Office of Bushfire Risk Management (OBRM) 2019, *Map of Bush Fire Prone Areas*, viewed February 2020, https://maps.slip.wa.gov.au/landgate/bushfireprone/

Figures

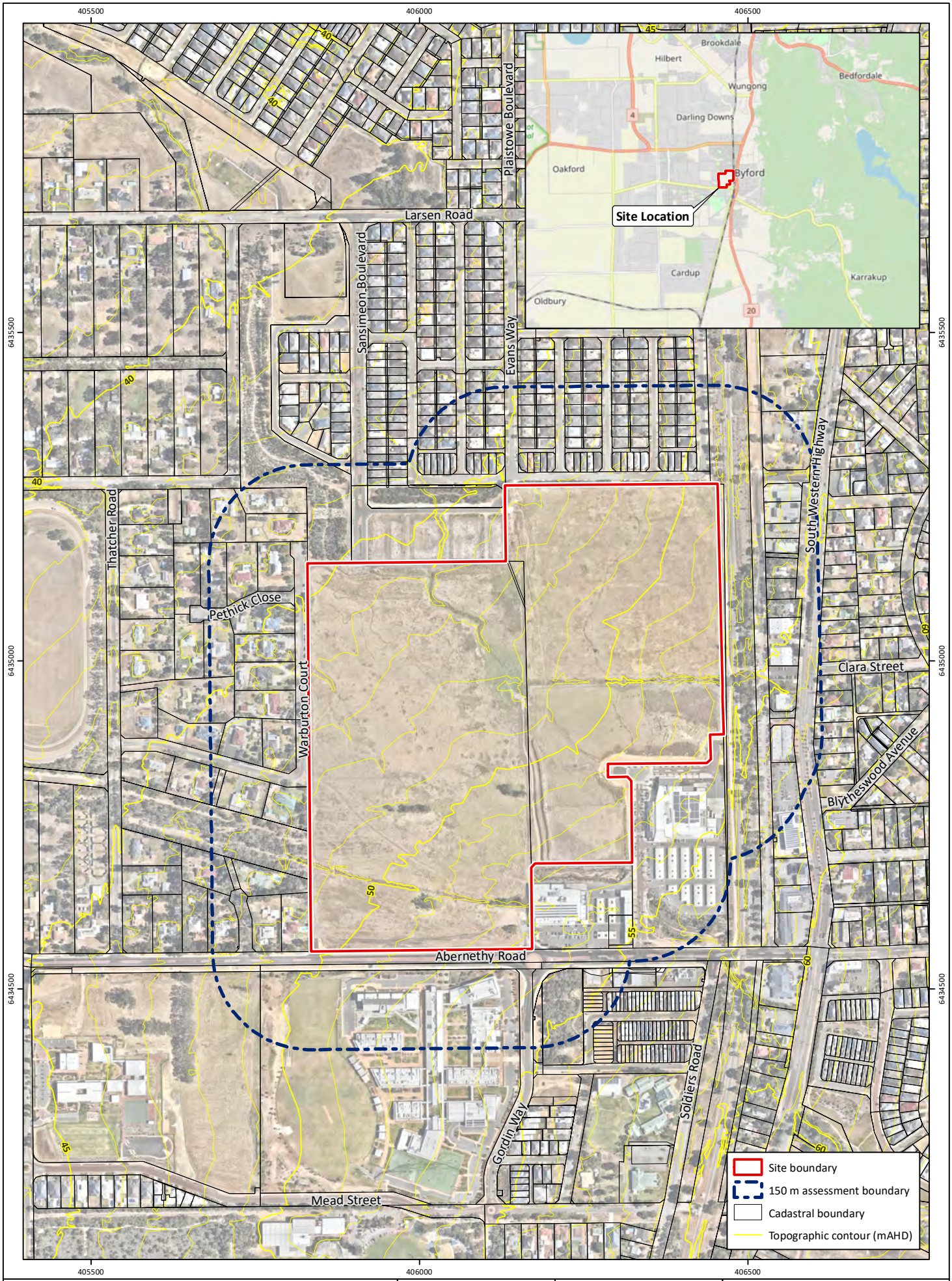

Figure 1: Site Plan and Topographic Contours

Project:	Bushfire Management Plan Lot 1 and Lot 2 Abernethy Road, Byford
Client:	Aigle Royal Developments

Plan Number: **EP19-079(01)--F02a**

Drawn:	AFF
Date:	6/03/2020
Checked:	HPB
Approved:	KK
Date:	10/03/2020

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Metres

Scale: 1:7,500@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

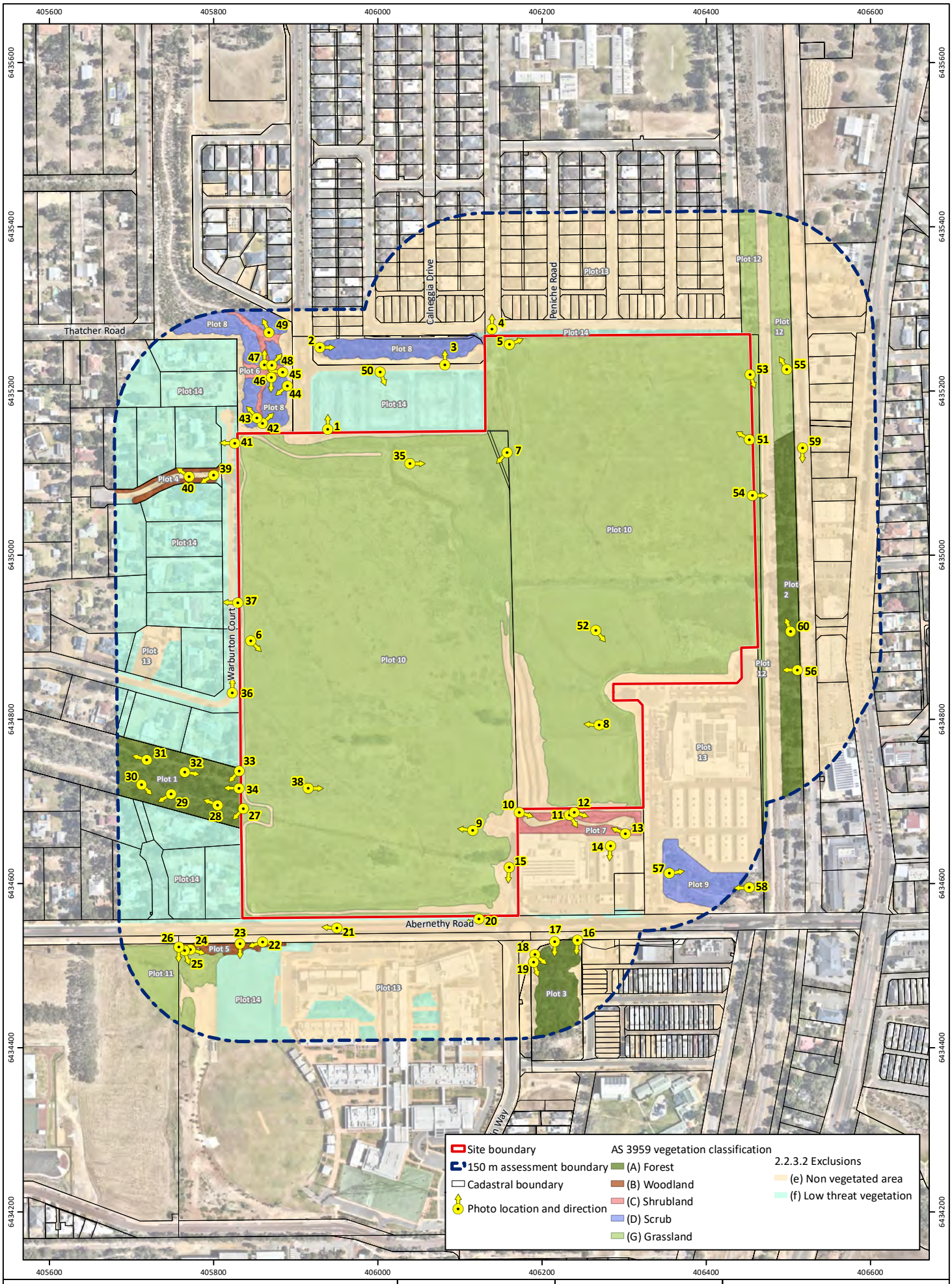

Figure 2: **Existing Site Conditions – AS 3959 Vegetation Classifications**

Project: Bushfire Management Plan
Lot 1 and Lot 2 Abernethy Road, Byford

Client: Aigle Royal Developments

Plan Number: EP19-079(01)--F03a

Drawn:	AFF
Date:	9/03/2020
Checked:	HPB
Approved:	KK
Date:	10/03/2020

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Metres

Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

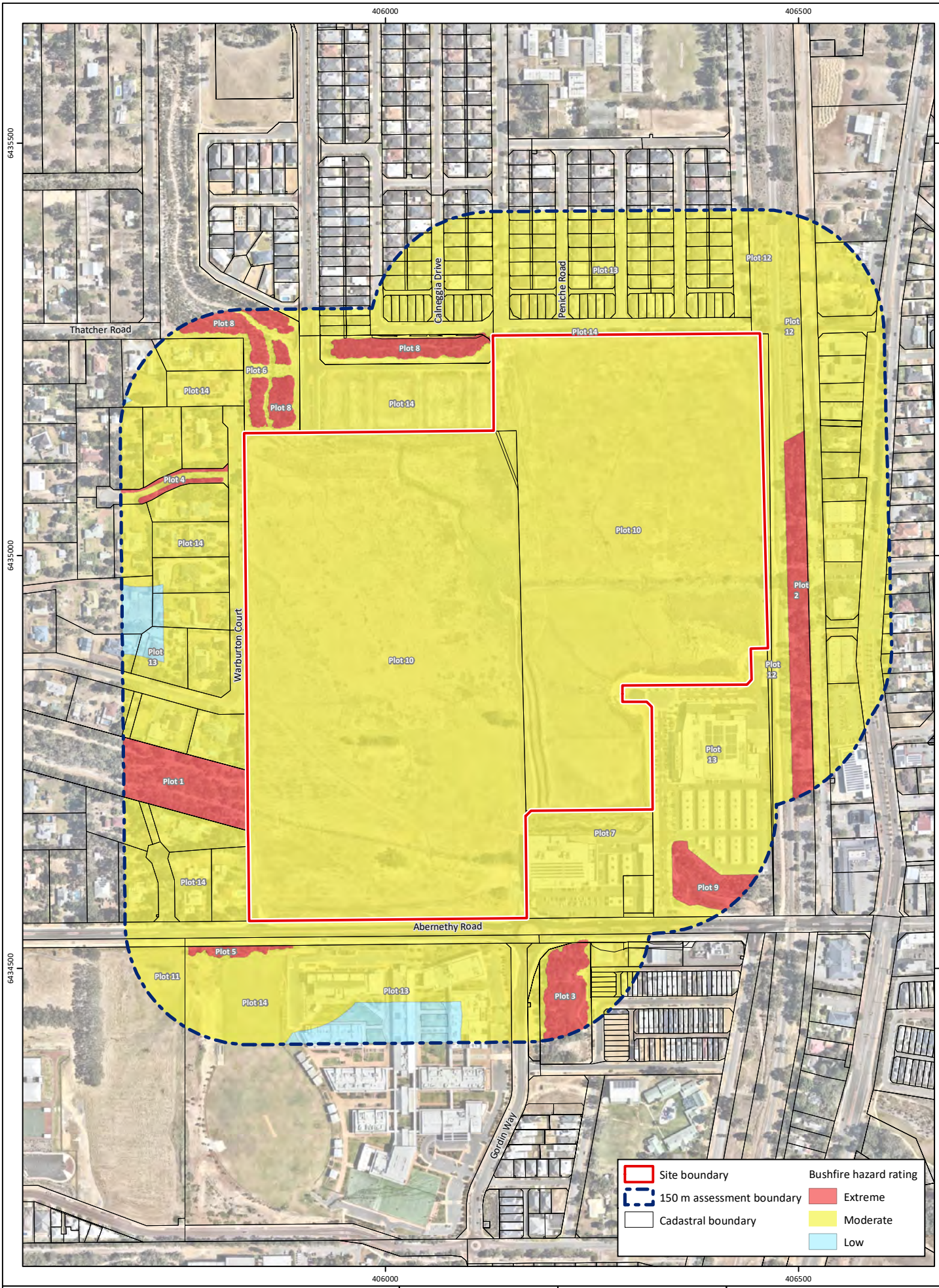

Figure 3: Bushfire Hazard Rating

Project: Bushfire Management Plan
Lot 1 and Lot 2 Abernethy Road, Byford

Client: Aigle Royal Developments

Plan Number: EP19-079(01)--F04a

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Date:	9/03/2020
Checked:	HPB
Approved:	KK
Date:	10/03/2020

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Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

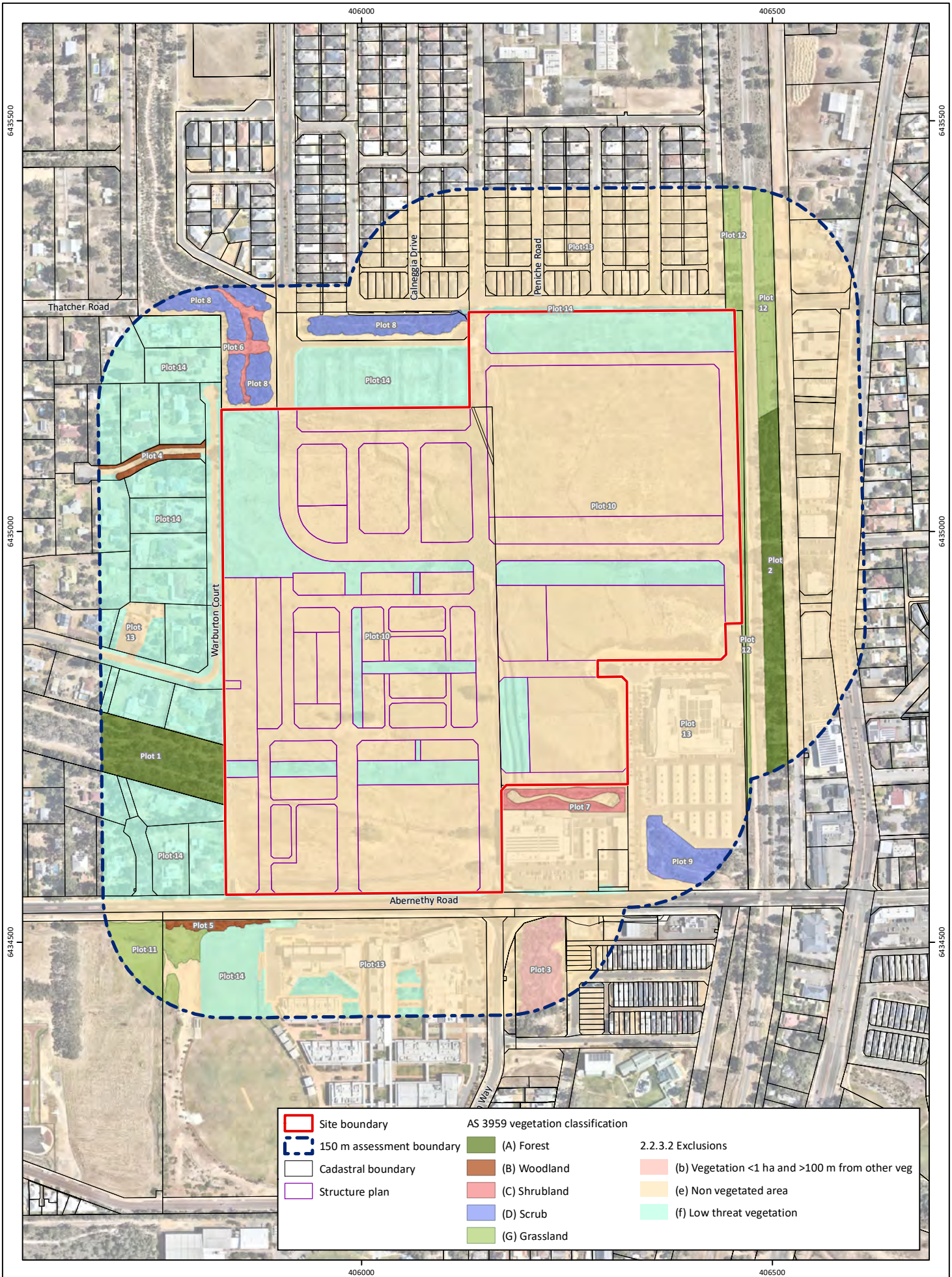

Figure 4: **Post Development Conditions – AS 3959 Vegetation Classifications**

Project: Bushfire Management Plan
Lot 1 and Lot 2 Abernethy Road, Byford

Client: Aigle Royal Developments

Plan Number: EP19-079(01)--F05a
Drawn: AFF
Date: 9/03/2020
Checked: HPB
Approved: KK
Date: 10/03/2020

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Scale: 1:6,000@A4

GDA 1994 MGA Zone 50

emerge ASSOCIATES

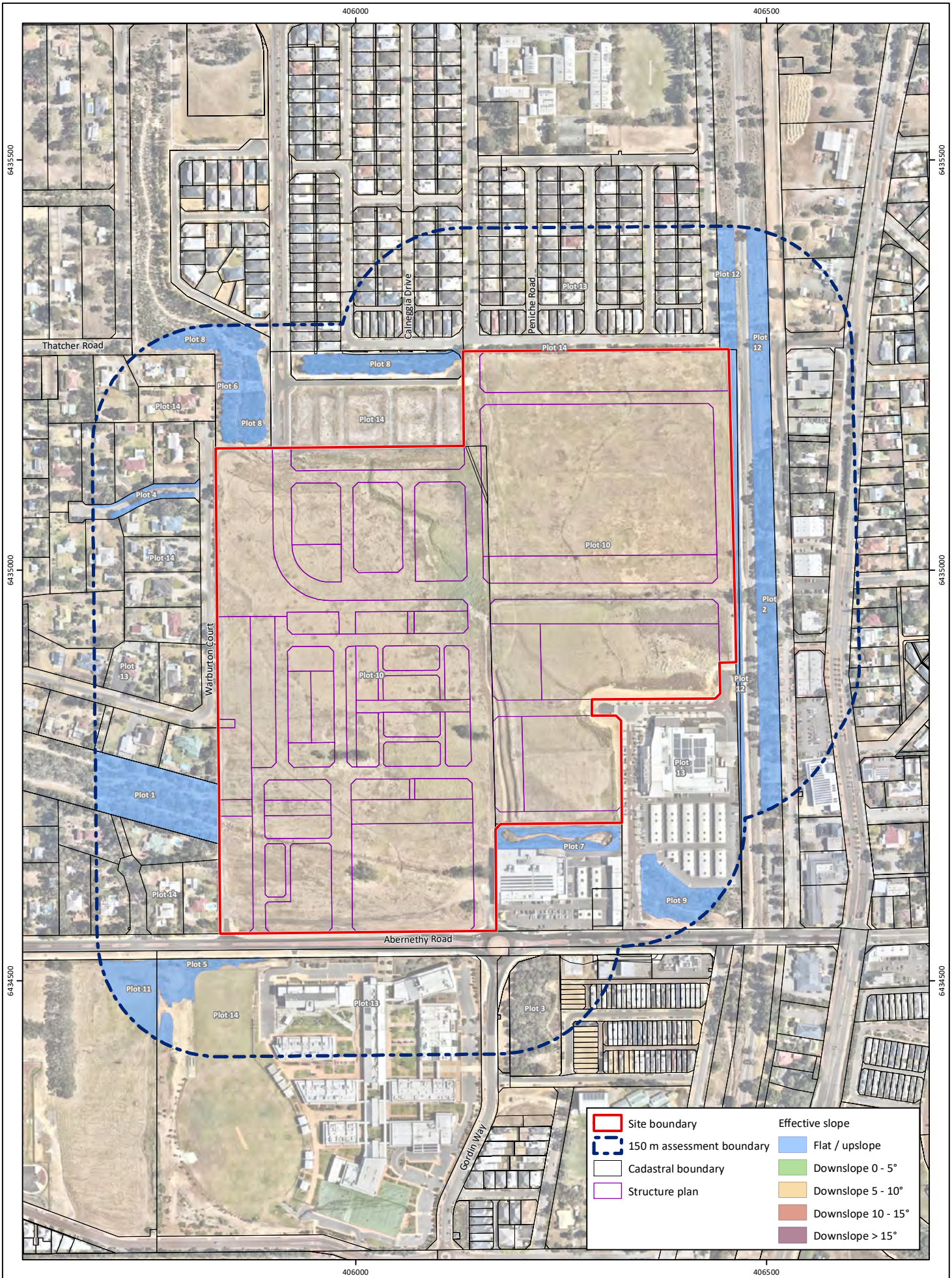

Figure 5: **Post Development Conditions – Effective Slope**

Project: Bushfire Management Plan
Lot 1 and Lot 2 Abernethy Road, Byford

Client: Aigle Royal Developments

Plan Number: EP19-079(01)--F06a

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Date:	9/03/2020
Checked:	HPB
Approved:	KK
Date:	10/03/2020

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

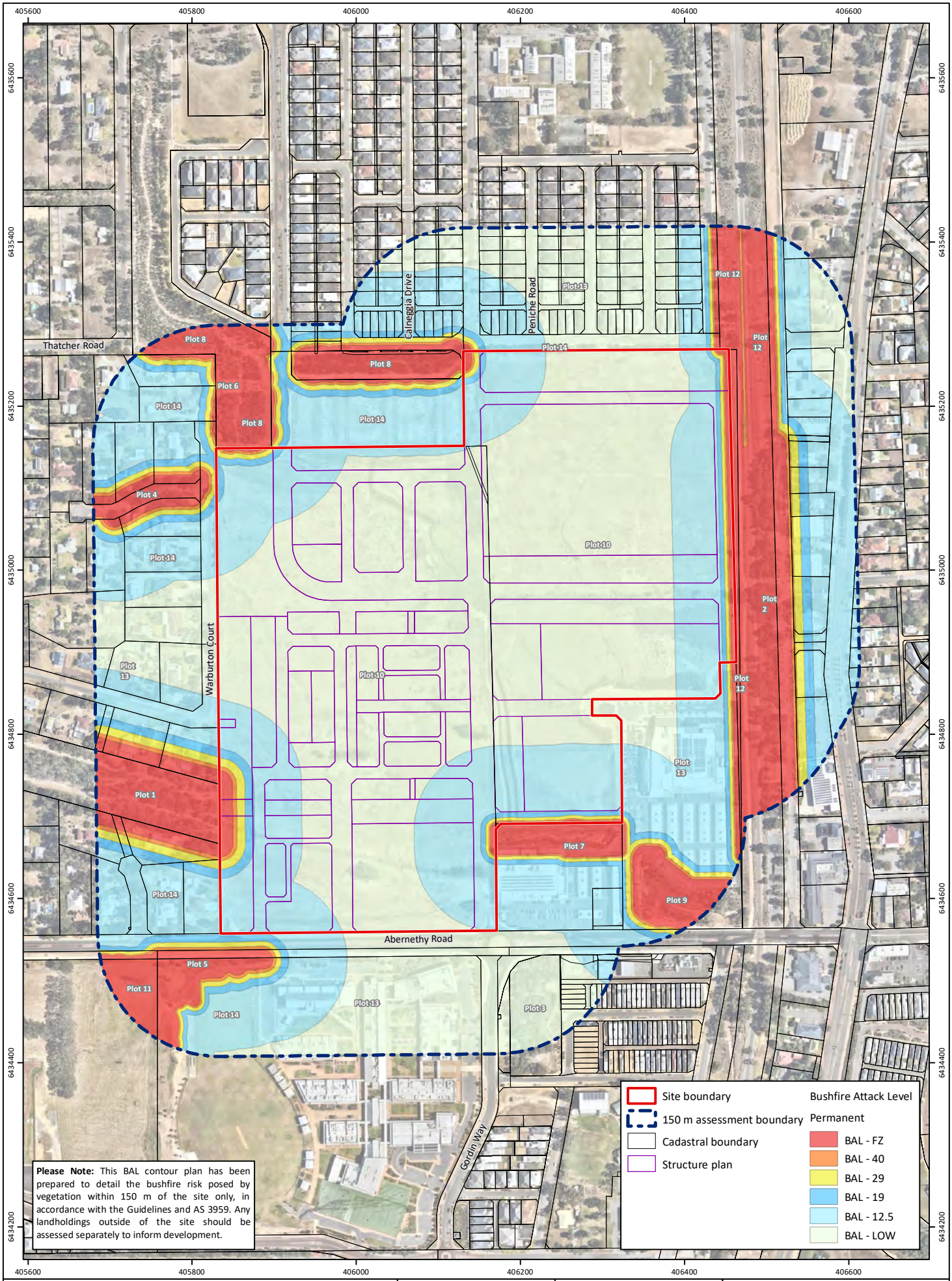

Figure 6: Bushfire Attack Level Contours

Project: Bushfire Management Plan
Lot 1 and Lot 2 Abernethy Road, Byford

Client: Aigle Royal Developments

Plan Number: EP19-079(01)--F07a

Drawn:	AFF
Date:	9/03/2020
Checked:	HPB
Approved:	KK
Date:	10/03/2020

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GDA 1994 MGA Zone 50

emerge ASSOCIATES

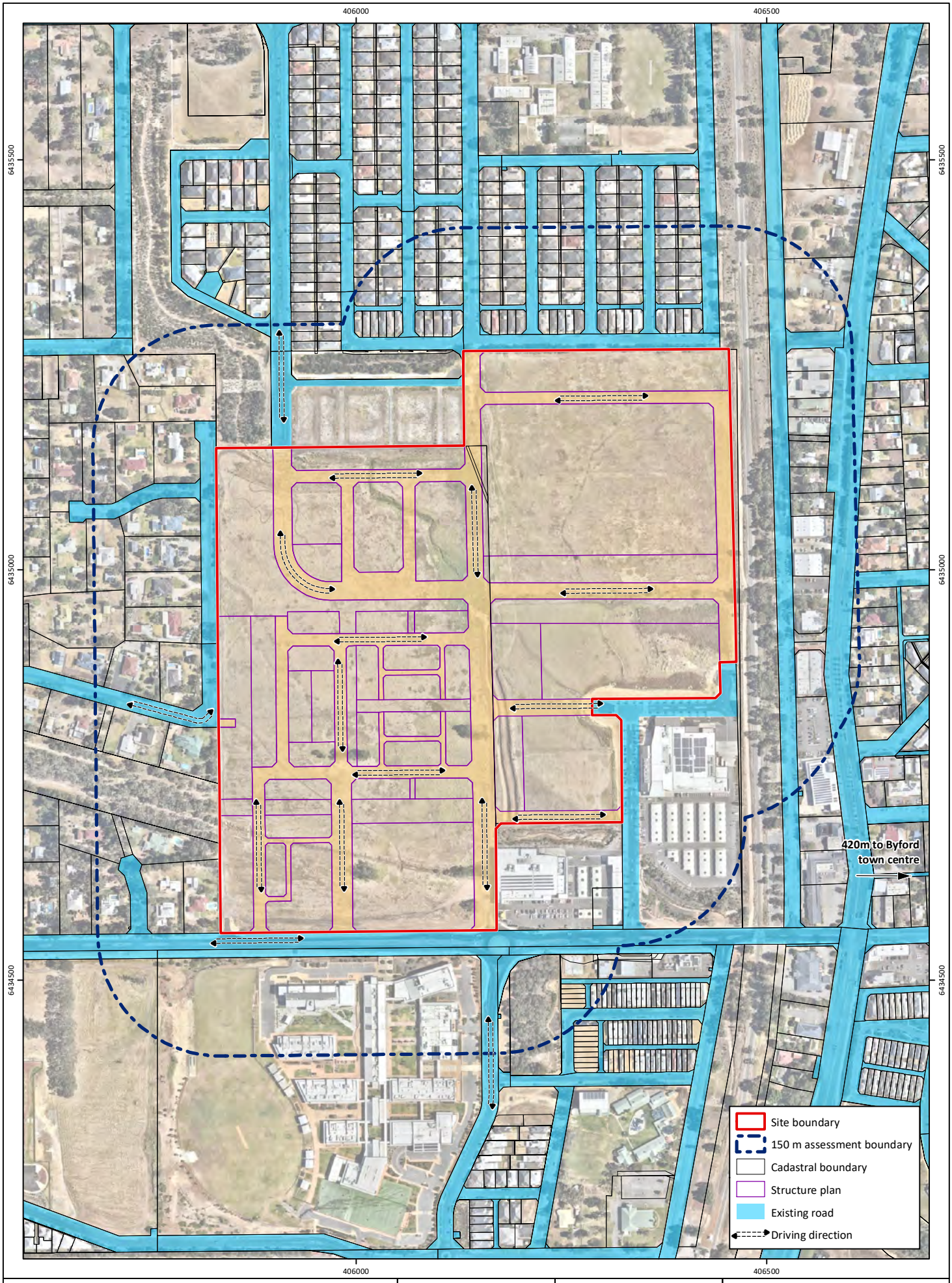

Figure 7: Vehicle Access Plan

Project: Bushfire Management Plan
Lot 1 and Lot 2 Abernethy Road, Byford

Client: Aigle Royal Developments

Plan Number: EP19-079(01)--F08a

Drawn:	AFF
Date:	9/03/2020
Checked:	HPB
Approved:	KK
Date:	10/03/2020

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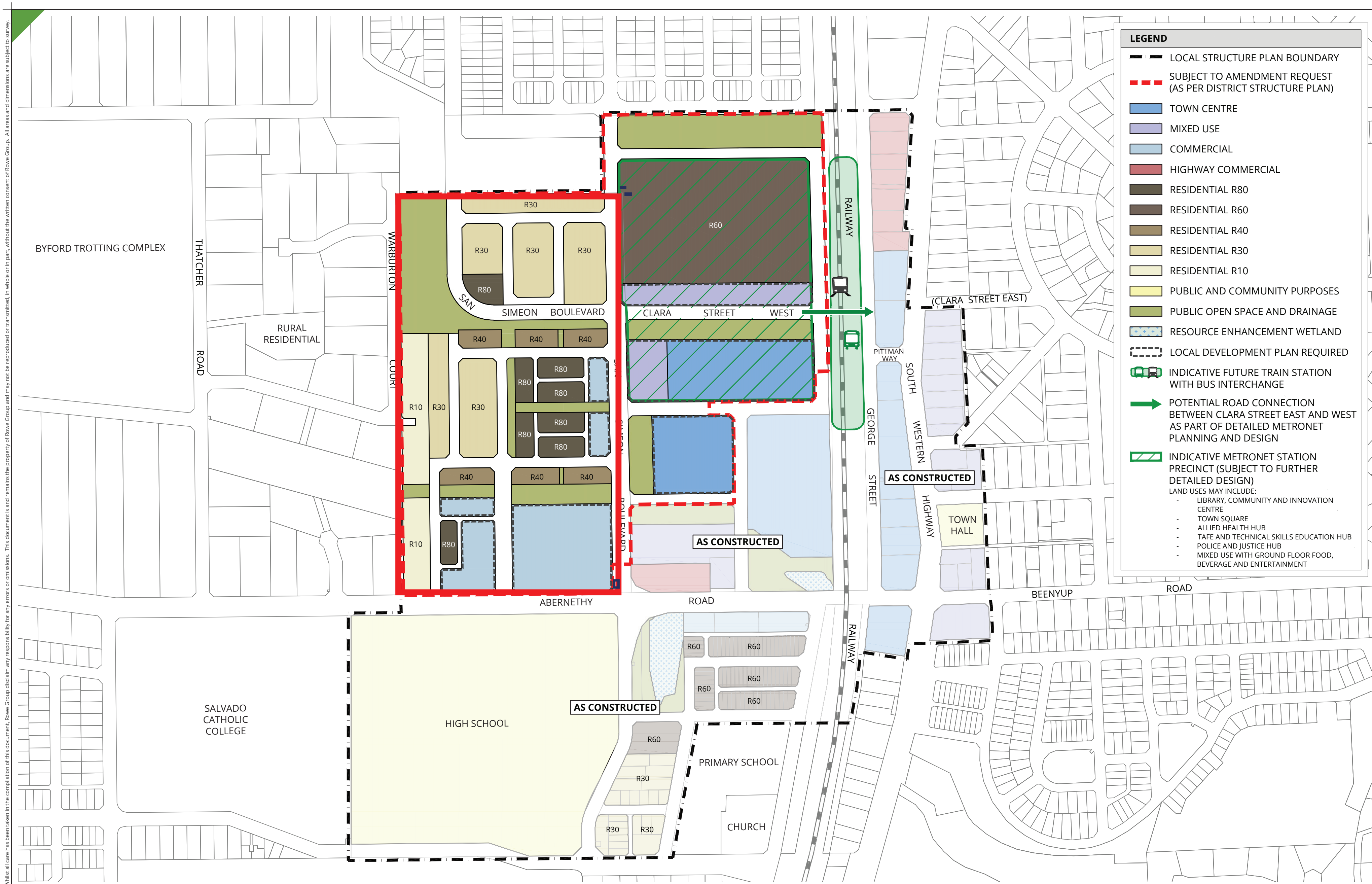
GDA 1994 MGA Zone 50

emerge ASSOCIATES

Appendix A

Proposed structure plan (Rowe Group)



LOCAL STRUCTURE PLAN AMENDMENT

ABERNETHY ROAD

BYFORD TOWN CENTRE

8861-STR-02-C

ROWE GROUP DESIGN

8861_STR02C_20191210_BYFORD (Structure Plan Extended) - DRAWN: W. CLEMENTS - DATE CREATED: 2019.12.10 - PROJECTION: MGA50 GDA94 -

Appendix B

Additional photographs

Table B1: Additional photo points organised by plot, as shown within Figure 2

Plot 1, 2	
AS 3959 classification (Figure 2): Forest (Class A)	
 *Photo location 27: forest vegetation with multiple fuel layers, looking south-west.*	 *Photo location 29: forest vegetation within the drainage reserve to the west of the site, looking south-west.*
 *Photo location 31: forest vegetation, looking west.*	 *Photo location 32: forest vegetation, looking east.*
 *Photo location 33: forest vegetation to the west of the site, looking south-west.*	 *Photo location 34: forest vegetation with multiple fuel layers, looking south-west.*
 *Photo location 60: forest vegetation to the east of the site, looking north-west.*	

Table B1: Additional photo points organised by plot, as shown within Figure 2 (continued)

Plot 6, 7	
AS 3959 classification (Figure 2): Shrubland (Class C)	
 *Photo location 11: shrubland vegetation within the drainage reserve to the south-east of the site, looking east.*	 *Photo location 13: shrubland vegetation to the south-east of the site, looking north-west.*
Plot 8, 9	
AS 3959 classification (Figure 2): Scrub (Class D)	
 *Photo location 3: scrub vegetation to the north-west of the site, looking north.*	 *Photo location 43: scrub vegetation within the drainage reserve immediately north of the site, looking north-west.*
 *Photo location 44: scrub vegetation up to 4 m in height, looking south-west.*	 *Photo location 46: scrub vegetation up to 4 m in height, looking south.*

Table B1: Additional photo points organised by plot, as shown within Figure 2 (continued)

Plot 8, 9	
AS 3959 classification (Figure 2): Scrub (Class D)	
 *Photo location 48:scrub vegetation to the north-west of the site, looking north-east.*	 *Photo location 49: scrub vegetation in the background of the photo, looking north-west.*
Plot 10	
AS 3959 classification (Figure 2): Grassland (Class G)	
 *Photo location 8: grassland vegetation within the southern portion of the site, looking west.*	 *Photo location 9: grassland vegetation within the southern portion of the site, looking west.*
 *Photo location 51: grassland vegetation within the eastern portion of the site, looking north-west.*	 *Photo location 52: grassland vegetation within the southern portion of the site, looking south-east.*

Table B1: Additional photo points organised by plot, as shown within Figure 2 (continued)

Plot 13

AS 3959 classification (Figure 2): Non-vegetated (e)

Photo location 21: Abernethy Road, looking west.

Photo location 36: Warburton Close immediately west of the site, looking north.

Photo location 59: George Street to the east of the site, looking south.

Plot 14

AS 3959 classification (Figure 2): Low threat vegetation (f)

Photo location 1: areas of grassland associated with undeveloped land to the north of the site, looking north-east.

Photo location 50: areas of grassland associated with undeveloped land to the north of the site, looking south.

Aigle Royal Developments

Byford town Centre

Environmental Management Plan

May 2020

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Executive summary

This document, an Environmental management Plan (EMP), has been prepared to support the Byford Town Centre Local Structure Plan. The EMP identifies environmental impacts and appropriate management measures for implementation during the design and construction phases of actual works within the Byford Town Centre Local Structure Plan.

Scope and Structure of the EMP

This document, aims to provide, in sufficient detail, information with respect to the management of environmental impacts that are anticipated as a result of development of the Byford Town Centre.

Potential environmental impacts have been identified with respect to the project as a whole and specifically the following key environmental assets:

- Hydrology of the area and associated drainage channels and wetlands
- Native flora and fauna, especially in the Brickwood Reserve
- Sites of Aboriginal Heritage and significance.

This EMP provides details of management tailored to minimise environmental impact and includes:

- An outline of statutory requirements, environmental commitments and Shire policies and guidelines that must be met
- An outline of the roles and responsibilities of both the client and the construction contractor
- Through the identification of environmental aspects and impacts and risk assessment and prioritisation of impacts, management of the project's environmental issues which include:
  - Training, Awareness and Communication
  - Flora and Vegetation
  - Fauna
  - Acid Sulphate Soils
  - Contaminated Soils
  - Spills
  - Water
  - Fire
  - Noise and Vibration
  - Air Quality
  - Traffic and Public Safety
  - Heritage
  - Hazardous Materials
  - Incident Management
  - Community Liaison and Participation
  - Auditing, Review and EMP revision.

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Acronyms and definitions

Acronym / Term	Definition
AASS	Actual Acid Sulfate Soils
CEMP	Construction Environmental Management Plan (to be prepared by the Contractor)
Construction	The use of this term includes the clearing of vegetation and topsoil at the site, excavation for service installation, general earthworks and road construction
Contractor	Personnel/Company contracted to carry out the construction of the Byford Town Centre works.
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
Environmental Officer	Person responsible for environmental management onsite during construction of the works
FESA	Fire and Emergency Services
LSP	Local Structure Plan
PASS	Potential Acid Sulfate Soils

1. Introduction

1.1 Background

The Shire of Serpentine Jarrahdale (the Shire) is experiencing a period of rapid urban growth that is expected to result in a population within the Byford Structure Plan Area of approximately 35,400 by 2036. The development of Byford is guided by the Byford Structure Plan which was approved in 2005 and provides a guide to the subdivision and development of the town site and surrounding rural residential area.

A Local Structure Plan and associated documentation was developed for the Byford Town Centre (the project). This document, an Environmental Management Plan (EMP), has been prepared to support the Byford Town Centre Local Structure Plan (LSP).

The Shire has a mandate to enable the development of a well-defined and distinctive place that respects the intrinsic social values and natural features of the Byford Town Centre in a responsible and sustainable manner to give effect to the expectations of the community. This mandate is well documented and is the driving force (in terms of direction) for the preparation of a Local Structure Plan, Detailed Area Plan and Design Guidelines for the town centre.

1.2 Purpose of the EMP

The purpose of this EMP is to identify environmental impacts and appropriate management measures for implementation during the design and construction phases of actual works within the project area, the area covered by the Byford Town Centre Local Structure Plan.

2. Environmental setting

The Shire of Serpentine Jarrahdale is located approximately 45 km south east Perth and is within the Perth Metropolitan Region. The Shire is predominantly rural in character and comprises an area of approximately 921 km^2.

The Byford Town Centre is a 104.5 ha site within the Shire of Serpentine Jarrahdale (the Shire), approximately 32 km south of Perth.

2.1 Climate and rainfall

Byford is 68 m above sea level, a mild climate, generally warm and temperate. The average annual temperature is 17.9 °C and annual rainfall is approximately 961 mm.

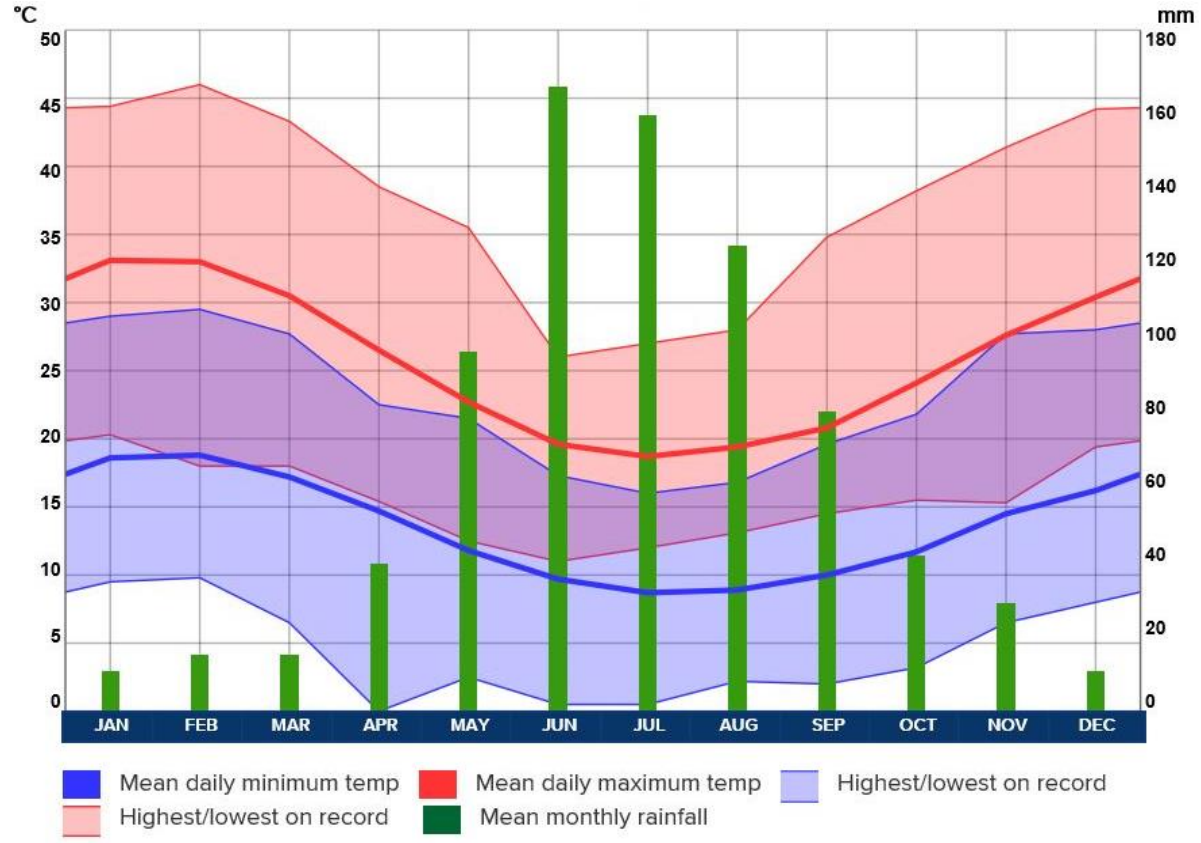

Figure 1 Yearly climate data for Gosnells City

2.2 Topography

The topography of the town centre is characterised by steep slopes in the foothills of the Darling Range which is located to the east of Byford Town Centre. The elevation varies across the project area between 120 m in the east to 55 m at the South West Highway. To the west of the highway the terrain is relative flat and seasonally waterlogged (palusplain).

2.3 Vegetation

The main feature of the Byford Town Centre is the Brickwood Reserve which is located in the south west of the area with some areas of remnant vegetation. The reserve is listed as Bush Forever site no. 321 and includes at least five Priority taxa and three Threatened (Declared Rare Flora, DRF) taxa.

There is a wetland south of Abernethy classified as a conservation category wetland and a resource enhancement wetland located north of Thomas Road.

Other areas of conservation vegetation/wetland include the area of land between South Western Highway and Cardup Brook.

2.4 Geotechnical

The Byford Town Centre may be described as having a site classification of M (AS 2870). The soils in the area comprise sands, silty sands and clayey sands overlying clayey and sandy gravels to depths of up to 2.5 m below existing ground level of the following types:

- Ridge Hill colluvium of the Yogannup formation
- Guildford Clays – low to medium plasticity clays with silts and sands
- Bassendean Sands – bleached grey to pale yellow, fine to coarse sands.

2.5 Geology

The Byford Town Centre is located towards the eastern edge of the Swan Coastal Plain. The site is underlain by the Darling Fault which forms the eastern boundary of the rifted Perth Basin. The fault separates the granites and gneiss of the Darling Plateau and the shales sandstones of the Perth Basin. These bedrock materials are in turn overlain by colluvial deposits and later marine and coastal sand dune deposits.

2.6 Soils

The DWER Acid Sulfate Soil (ASS) risk mapping indicates that the potential for the acid sulphate soils occurring within 3 m of the natural surface across the project is of moderate to low risk in the west of the project area and low to no risk in the eastern portion of the project area.

2.7 Heritage

There are no existing registered Aboriginal Heritage Sites in the Byford Town Centre, however due to the existence of natural creek areas, there is the possibility that these areas may be of significance to Aboriginal people.

The discovery of any artefacts at later development stages will need to comply with the requirements of the *Aboriginal Heritage Act 1972*, which details specific responsibilities related to the management and protection of heritage sites.

Heritage in Western Australia is protected under the *Heritage Act 2016*, administered by the Department of Planning, Lands and Heritage. The Heritage Council maintains the State Register of Heritage Places, an extensive list of places which should be conserved for future generations.

A search of the State Register of Heritage Places was undertaken for the project area. The Byford Hall was identified on the State register (Place 13058), and is located within a Public Purpose reserve on South Western highway. Other State heritage listed places in the vicinity of the project area but not within its boundaries include the Byford Uniting Presbyterian Church on Clifton Street and the Byford War Memorial on South Western Highway.

2.8 Summary of significant environmental impacts

An assessment of the proposed works required as part of the development of the Byford Town Centre has identified a series of significant environmental impacts. These include:

- Potential contamination of local waterways
- Potential disturbance of vegetation in the Brickwood Reserve (No. 17490), including sites of known Threatened (DRF) and Priority flora
- Potential disturbance of Aboriginal Heritage Sites.

In addition the following impacts are also anticipated as a result of future town centre development:

- Potential release of hazardous materials to the surrounding environment (e.g. fuel, hydrocarbons)
- Potential injury to fauna during trenching/excavation
- Removal and storage of topsoil
- Construction dust and noise
- Traffic disruption.

The identified impacts are summarised in Table 1. The impacts have been quantified where possible and used to develop the Management Aspects as presented in Section 7 to 21 of the EMP (this document).

Providing the above and other identified risks are managed appropriately, it is unlikely that future development of the town centre will have any significant long-term environmental impacts.

Table 1 Summary of activity, environmental aspect and environmental impacts

Activity	Environmental Aspect	Environmental Impact	EMP Reference
Clearing of site prior to works	Disturbance of flora, fauna and waterways	Removal of vegetation, fauna habitats, topsoil degradation, erosion, runoff to waterways, weeds, waste, Aboriginal site disturbance.	See sections 8 to 14, 16 and 17.
Topsoil stripping	Loss of topsoil resource	Removal of topsoil, spread of dieback, dust.	See sections 10, 11, 16 and 17.
Excavation	Disturbance	Disturbance of acid sulfate soils, fauna trapping, waste generation.	See sections 11, 13 and 16 to 18.
Earthworks	Disturbance	Importation of contaminated fill (acid sulfate soils, dieback, weeds), dust creation, noise, erosion, waterway contamination.	See sections 11, 13, 14 and 16 to 18.
Dewatering	Disturbance of surface water and groundwater	Reduced stream flow, contamination of waterways, groundwater contamination.	See sections 8, 9, 16 and 17.
Equipment operation and maintenance	Contamination of environment	Spills and leaks of hydrocarbons (fuel, oils, lubes) to ground and water, waste, fire.	See sections 9, 14 to 16, 18 and 19.
Office/messing	Contamination of environment	Spills, leaks, generation of wastes (paper, organic), to ground and water, waste, fire.	See sections 16.

3. Construction stages

Future development of the Byford Town Centre will occur in the stages as defined by the Local Structure Plan and Staging Plan. It is anticipated that the following works will be undertaken as part of future development:

- Topographical survey
- Geotechnical investigations
- Site establishment including clearing of native and other vegetation
- General earthworks for the site
- Installation of project related infrastructure, including:
  - power
  - water
  - gas
  - telecoms
  - fibre to the home if required.
- Retaining walls
- Roads and footpaths
- Lighting
- Landscaping of Public Open Space
- Finishing off and site inspection.

4. Shire of Serpentine Jarrahdale environmental policy and procedures

All construction works should comply with the relevant Shire policies and standards. These include:

- Revegetation Policy
- Landscape and Vegetation Policy
- Water Sensitive Design Policy
- Natural Assets Management Plan
- Energy and Water Efficiency Policy December 2017.

In addition to the above documents, all construction works should be completed in accordance with the relevant standards as specified in relevant construction tender documentation.

5. Statutory requirements and guidelines

The Byford Town Centre development will be completed in accordance with and all works are to comply with the relevant environmental legislation, regulations, Australian Standards and codes of practices administered by relevant State and Federal Government agencies. The Acts, standards and codes of practice, their applications to the project works and the responsible Government department are referred to in each section of this EMP.

6. Roles and responsibilities

6.1 Environmental management responsibilities

The Shire of Serpentine Jarrahdale is primarily responsible for environmental management associated with development in the Shire, including the Byford Town Centre Local Structure Plan. A Shire representative will be delegated to provide final approval of all activities undertaken during construction on behalf of the Shire.

The responsibility for undertaking the site activities will be delegated to the Superintendent's Representatives. Staff under the control of the Superintendent's Representative will include a person responsible for environmental management, referred to herein as the Environmental Officer. Whilst the Contractor is responsible for ensuring environmental objectives associated with the construction of the project are met, the Environmental Officer will be responsible for overseeing the implementation of necessary environmental mitigation activities. This will involve activities such as obtaining and assessing all Construction Environmental Management Plans (CEMPs) from the Contractor, ensuring the implementation of the plans is achieved by the Contractor to protect Shire's interests, assessing monitoring reports and other environmental data, overseeing (but not necessarily implementing) any corrective action that is necessary, and assessing the effectiveness of corrective action(s).

Instructions on corrective actions shall only come from the Superintendent and delegated representative. The Contractors shall prepare a CEMP that addresses the elements contained within this EMP. The CEMP shall be approved by the Superintendent prior to works commencing on site. The CEMP should outline the management procedures, strategies and methods that will be used by the Contractor to ensure effective management of all environmental aspects relating to the town centre development. As part of the CEMP the Contractor will address the following:

- Water Quality and Dewatering Management, including Acid Sulfate Soils, surface water flows and water
- Spills Management
- Flora Protection and Rehabilitation
- Fauna Protection and Management
- Aboriginal and European Heritage Management
- Fire Management
- Construction Dust, Noise and Vibration Management
- Traffic and Public Safety Management
- Hazardous Materials Management
- Incident Management
- Community Liaison, Communication Protocol and Complaints Procedure
- Audit Procedures.

6.2 Reporting

The Contractor's Representative shall provide the Shire with a number of reports. The reports required, and the frequency at which they must be prepared, are defined (but not restricted) to those included in Table 2.

Table 2 Summary of contractor reporting requirements

Report	Frequency
List of inducted personnel	Fortnightly
List of licences obtained prior to and during construction	Each time a licence is obtained or renewed
Forecasting of movements on site	Fortnightly, in advance
Traffic management (including noise) report	Fortnightly during peak construction activities, monthly thereafter
Water quality monitoring report (if applicable)	Fortnightly
Exceedance/incident reports	Daily as incidents or exceedances occur
Complaints register	Daily or as complaints are recorded
Outcomes of internal (first party) audits	Monthly, or as audits occur
Outcomes and actions of First Party, Second Party and Compliance audits	Monthly, or as audits occur

The reports must include:

- Any exceedances of criteria or incidents and corrections that have been or are to be taken
- Any community complains and corrective action taken
- Success of previous corrective actions undertaken.

Utilising the information above, a combined register including date and time of all incidents and complaints must be kept by the Contractor. The register must also include how the incident was rectified.

7. Training, awareness and communication

7.1 Training

All relevant personnel will be required to complete an induction that includes information on environmental issues and impacts. The induction will be conducted prior to the personnel commencing work and will include:

- Information on the environment of the town centre project
- Requirements for emergency response, incidents and accidents
- Summary of the content of the management procedures
- Requirements for communications.

Records of personnel attendance at the induction shall be kept on record for auditing purposes.

7.2 Communication

7.2.1 Contract communication

There shall be open communication channels between the Contractor and the Shire via the Superintendent.

The Contractor will provide relevant information on environmental issues and impacts and any environmental incidents to the Superintendents Representative.

The Superintendents Representative will provide the Contractor with any required information and will issue any necessary instructions to the Contractor.

7.2.2 Communication on site

Effective communication within the Contracted group(s) is required on a daily basis to ensure both environmental and health and safety issues are discussed and mitigated.

Prior to commencement of site works and construction, the Contractor will discuss and agree with the Shire and Superintendent the proposed method of communication for the project. This is to include the use of two-way radios during machinery movement on site and daily pre-start meetings to outline the proposed activities for each day.

7.2.3 Communication with other parties

The Contractor shall develop communication protocols to minimise potential impacts and to facilitate the sharing of further environmental information that may be collected during the construction activities for the project. The following contacts will be maintained:

- The Department of Biodiversity, Conservation and Attractions (DBCA) and the Fire and Emergency Services (FESA) with respect to fire access and fire prevention issues. Contact names and telephone numbers will be recorded in a convenient location, in case of emergency; and
- The Department of Water and Environmental Regulation (DWER) with respect to any large (>100 L) groundwater or surface water contaminating spills.

8. Water management

8.1 Objectives

To minimise the impact that future development within the Byford Town Centre Local Structure Plan area will have on groundwater and surface water quality and quantity, aquatic habitats and terrestrial habitats. This includes the management of groundwater quality and minimisation of contamination, erosion and damage to vegetation and fauna from dewatering procedures.

8.2 Potential impacts

8.2.1 Surface water impacts

Dewatering and surface drainage can have a number of potential impacts, including:

- Loss or reduction of flows to watercourses
- Adverse changes to the water quality and metal concentrations of soil water and nearby water systems
- Deterioration of the ecosystem and nearby water systems
- Runoff from the project area and access tracks has the potential to cause flooding, erosion and sedimentation in sensitive areas of bushland as well as on roads
- Temporary diversion of drains or watercourses leads to adverse impact on local flora and fauna
- Costs associated with minimising impacts and repairing disturbed areas.

8.2.2 Groundwater impacts

Dewatering can have a number of impacts on groundwater including:

- Temporary lowering of the groundwater table
- Changes in water quality of adjacent areas.

Other groundwater impacts include contamination by hydrocarbons or hazardous liquids as a result of spills on/within the project area.

8.3 Scope

Contractors are responsible for ensuring activities affecting ground and surface water quality and flows, are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

8.4 Legal and other requirements

The Contractor shall comply with the relevant statutory requirements and any policies concerning the preservation of water quality and dewatering. These include:

- DWER, Water Quality Protection Note 13, Dewatering of soils at construction sites, November 2012
- *Environmental Protection Act 1986*, in relation to the impact of dewatering and commissioning water on values and ecology of natural water bodies.

State and Commonwealth legislation that applies to the management of surface water and dewatering on the project is presented in Table 3.

Table 3 Key legislative requirements for surface water and dewatering management

Reference	Relevant Condition	Limit/Requirement
Conservation and Land Management Act 1984	Provides for the use, protection and management of certain public lands and waters and the establishment of responsible authorities.	Permission to undertake activities impacting on DBCA managed lands and compliance with management plans.
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment.	Approval to undertake an assessed proposal, with conditions.
Rights in Water and Irrigation Act 1914	Provides for the regulation, management, use and protection of water resources and irrigation schemes. Rights and licences to take water; permit to obstruct or interfere with a watercourse or wetland, including its bed or banks.	Licence to take groundwater (abstraction during construction phase).
Waterways Conservation Act 1976	Management and conservation of water related land and environment.	Drainage requirements.
Metropolitan Water Supply, Sewerage and Drainage Act 1909	Defines the metropolitan water, sewerage and drainage control area and establishes method of control.	Ensure that development does not endanger water supply areas.
Soil and Land Conservation Act 1988	Manages the conservation of soil and land resources and the mitigation of the effects of erosion.	Conservation of soil and land resources and manages erosion.

8.5 Commitments

The Contractor shall liaise with the relevant Regulatory authorities to ensure the disposal of surface or groundwater is acceptable and to negotiate any conditions as required.

Any dewatering approvals or permits for disposal or redirection of surface water required by the Regulatory authorities are the responsibility of the Contractor.

The Contractor's Water Quality and Dewatering Management procedures will be submitted to DWER for review and approval. These procedures shall be implemented for the duration of the construction and will include the following aspects:

- Runoff management
- Dewatering
- Commissioning water and scour management.

8.6 Management activities

8.6.1 Surface water management

The Contractor will be responsible for the construction, maintenance and operation of all diversion and protective works up and to the end of the maintenance period of the works. After this time responsibility for maintenance and operation will transfer to the Shire.

Stormwater runoff shall be managed/controlled in order to:

- Maintain levels of flow as required by DWER and Water Corporation in existing waterways
- Prevent discharge of excessive or contaminated stormwater from the project area
- Maintain drainage channels
- Erosion controls and sediment traps shall be setup, as required.

8.6.2 Groundwater management

- A groundwater management plan is to be developed for groundwater discharge in the event of dewatering in the project area
- Groundwater levels should be monitored on a quarterly basis to assess changes in flow directions and groundwater chemistry prior to and during construction
- Minimise the amount of dewatering required by timing the works during drier months;
- Any refuelling or maintenance of vehicles or machinery will take place on hard standings and not in close proximity (<10 m) to surface water drains or watercourses
- Any hazardous liquids or fuels required during construction will be stored in a bunded compound able to hold at least 110% of the volume of the liquids stored in accordance with Australian Standards
- A spill management procedure will be developed and implemented in the unlikely event that an accident occurs.

8.7 Monitoring during construction

A monitoring program will be implemented to provide early warning of possible adverse impacts and allow the timely intervention should unacceptable adverse trends be observed.

9. Spills management

9.1 Objectives

Spills of any variety have the potential to contaminate the soil, affect surrounding vegetation and may also leach into the surrounding water systems, adversely affecting the water quality and habitat. The objective is to minimise the potential for spills during construction and lessen the environmental impacts should spills occur.

9.2 Potential impacts

Potential impacts as a result of spills include:

- Contamination of soils and water from the uncontrolled releases of chemicals, fuels or construction water

9.3 Scope

For the purpose of this EMP, spills include hydrocarbon spills, chemical spills and large leaks of excess water causing flooding of surrounding areas. For example, any matter that could contaminate waters (whether treated or otherwise) so they become unsafe for animal, plant or human use that may significantly disrupt ecological processes or lose their aesthetic appeal.

Contractors are responsible for ensuring activities with the potential to cause in spills are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

9.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of spills on the project is presented in Table 4.

Table 4 Legislation that applies to spills management

Reference	Relevant Condition	Limit/Requirement
Dangerous Goods Safety Act 2004 and associated regulations	Provides for the safe storage, handling and transport of dangerous goods	Dangerous Goods Licences
Environmental Protection (Unauthorised Discharges) Regulations 2004	Provides for the identification, recording, management and remediation of contaminated sites	Prevent and / or report any unauthorised discharges
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment	Approval to undertake an assessed proposal, with conditions

9.5 Commitments

The Shire or its designated consultant shall develop a specific Spill Response Procedure for the response and removal of spills/contaminated areas within the project area or offsite, should spills extend outside the project area. In addition, Contractors shall prepare and implement a CEMP comprising procedures that includes all the management measures that are described in this section of the EMP. These procedures will ensure that impacts of existing and removed contamination, on and around the project area, are minimised. This plan shall be implemented for the duration of the construction.

9.6 Management measures

The following management techniques should be included (but not limited to) within the EMP:

- Preparation of an onsite incident response manual placed in an easily accessible location for all construction personnel
- Training of staff in spill response
- Vessels used for storage and transport of hydrocarbon fuels and chemicals are to be selected in accordance with the relevant Safety Data Sheet
- All hydrocarbon fuels and chemicals are to be stored within dedicated bunded storage areas
- Provide adequate spill containment material (e.g. spill kits) around the construction site
- Regular inspections of storage vessels and equipment on-site to confirm that there are no leaks and that all taps are adequately closed off after use and at the end of each day
- Vehicles to be serviced and refuelled on adequately bunded hardstand areas
- Vehicles to be parked in locked compound areas overnight.

10. Flora and vegetation management

10.1 Objectives

To ensure development in the Byford Town Centre Local Structure Plan area is carried out in a manner so as to cause the minimum practicable disturbance to the existing flora and vegetation, particularly:

- Minimising disturbance to native vegetation throughout Byford Town Centre Local Structure Plan area and surrounds, including the Brickwood Reserve
- Protecting any significant vegetation including known Threatened (DRF) and Priority flora
- Controlling the spread of weeds and dieback.

10.2 Potential impacts

Potential impacts to flora and vegetation for the project include:

- Removal of native flora and vegetation
- Unauthorised vehicle and plant movements in adjoining vegetation
- Contamination of soils and water from uncontrolled releases of chemicals, fuels or construction water leading to impacts on flora, fauna and associated habitats
- Facilitation of the spread of pathogens and weeds through the transport of soils, water and other materials on and off-site
- Increase in edge effects and fragmentation
- Inadequate erosion and sediment control leading to increased sedimentation in waterways
- Dust / sediment deposition on adjacent vegetation or into waterways leading to loss of plant viability and/or weed infestation.

10.3 Scope

Land clearing may occur as a part of future development of the Byford Town Centre Local Structure Plan area. However due to the extent of the current development, it is anticipated clearing would be minimal and not impact on existing conservation areas, for example the Brickwood Reserve. To confirm this, local scale investigations will be required to be undertaken by the land developers in subsequent stages of planning.

Based on available information Dieback, which is caused by Phytophthora species, has been recorded in the community and specifically within the Brickwood Reserve (DEC 2009, Shire 2009).

Contractors are responsible for ensuring activities with the potential to affect flora and vegetation are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

10.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of flora and vegetation on the project are presented in Table 5.

Table 5 Key legislation that applies to flora and vegetation management

Reference	Relevant Condition	Limit/Requirement
Biosecurity and Agriculture Management Act 2007	Provides for the management, control and prevention of spread of declared pests within Western Australia.	Control of declared plants.
Conservation and Land Management Act 1984	Provides for the use, protection and management of certain public lands and waters and the establishment of responsible authorities.	Permission to undertake activities impacting on DBCA managed properties and compliance with management plans.
Environment Protection and Biodiversity Conservation Act 1999	Provides for the protection of matters of national environmental significance (MNES).	Approval, with conditions, for activities likely to have a significant impact on any matter of national environmental significance.
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment.	Approval to undertake an assessed proposal, with conditions.
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Manages the clearing of native vegetation within the state to ensure it is managed appropriately and is not excessive.	Approval to clear native vegetation on State land with conditions.
Biodiversity Conservation Act 2016	Provides for the conservation and protection of Western Australia's biodiversity.	Licence to take protected flora and fauna, consent to take rare or endangered flora.
Agriculture and Related Resources Protection Act 1976	Protects agriculture from threatening influences, including weeds. Provides a list of declared plants (weeds) that require controlling.	Control of declared plants.

10.5 Commitments

The Contractor shall develop and implement Vegetation Protection and Management procedures covering all the aspects included in this section of the EMP and which will be submitted to the Superintendent for approval. The procedures will also be forwarded to DBCA for review.

These procedures will ensure impacts on vegetation and significant flora due to the project are, where possible, avoided or minimised. This plan shall be implemented for the duration of the construction.

10.6 Management measures

10.6.1 General vegetation clearing

The Contractor shall ensure the following actions are implemented:

- Prior to any disturbance; clearing zones will be delineated on construction plans and onsite with pegs and flagging in all areas
- Trees to be removed will be clearly marked by the Environmental Officer to ensure no inadvertent clearing occurs. This is to occur several days prior to clearing, using the clearing plan developed by the Contractor specifying which trees are to be removed
- No unauthorised clearing will occur. The Contractor will not destroy, remove or clear trees, timber, or scrub to any extent greater than approved in the Shire and project clearing plan. The Contractor will not carry out any activity outside the areas defined for clearing, unless otherwise approved by the Superintendent
- The Contractor will develop detailed construction procedures and a clearing checklist to minimize clearing of native vegetation
- Areas with weeds present will be removed and stockpiled separately for removal off site prior to topsoil stripping
- Stripped topsoil will be salvaged for use in rehabilitation of the project area
- No cleared vegetation will be burnt
- During vegetation clearing, public safety risks will be managed by the Contractor.

10.6.2 Topsoil removal and storage

Topsoil is a valuable resource and must be carefully protected where possible or otherwise removed, stored and reused where appropriate. The contractor will be responsible for topsoil management across the project area:

- Where present, topsoil will be stripped to a depth of 150 mm and temporarily stockpiled in a windrow adjoining its area of origin. If present, a second layer of topsoil will be removed to a depth of 200 mm and stockpiled separately in a windrow adjacent to the first windrow
- Stripped topsoil will be replaced in the reverse order in which it was removed. The removed topsoil will not be mixed but will be placed back in layers as required. Overburden will be removed and placed in a separate windrow
- Compaction of the topsoil during stockpiling will be avoided. As far as is practicable, stockpiles will be kept to a maximum height of 1.2 m, stabilised and flattened to avoid erosion
- The quality of topsoil in stockpiles will be maintained by measures including protection against contamination from other materials, minimising stockpiling periods and prevention of erosion by surface runoff or wind
- Following construction, stockpiled topsoil will be returned where required and evenly respread without delay
- Topsoil replacement will ensure the surface is reinstated to original levels, not less than 150 mm depth and isolated high or low points do not remain
- Some areas may require a ‘top up’ with soil where settlement has resulted in ponding or poor drainage. “Top up” soil will be sourced locally

- Following overburden and topsoil respreading, land will be reshaped to remove any ridges, depressions or pits
- Compacted areas will be ripped or tyned to a nominal depth of 200 mm, except over the backfilled trench and retained access tracks, and will follow close to natural contours wherever possible
- Any spoil will be replaced in the area from which it was removed. Any excess spoil will be removed from the project area and taken to an appropriate site
- Any erosion will aim to be mitigated within two working days.

10.6.3 Weed management and dieback management

- Where Declared Plants (weeds) are observed, a Weed Management Plan will be developed. Appropriate management measures will also be employed to prevent the introduction of new weed species
- Where Dieback is observed, a Dieback Management Plan will be agreed with DWER and Shire. The plan should be developed with reference to the Shire's Natural Assets Management Plan. Appropriate mitigation methods should be employed to prevent the introduction and spread of the disease

All basic raw materials (e.g. fill) will be sourced in consultation with the Shire and DBCA with priority given to local provenance and hygiene.

11. Fauna management

11.1 Objectives

To minimise, wherever possible, any negative impacts from construction within the Byford Town Centre Local Structure Plan area on native fauna.

11.2 Potential impacts

Potential impacts on fauna as a result of construction works include:

- Displacement of fauna as a result of noise and vibration
- Decline in connectivity resulting in increased risks to fauna attempting to move between habitat
- Loss or injury of fauna due to fauna strike and open excavations
- Encouraging feral animals and pests to frequent the project area and adjacent areas due to inappropriate waste disposal.

11.3 Scope

Any construction area may potentially result in the harm of local fauna. However, there is little risk of long term impact on fauna from vegetation clearing which is anticipated to be minimal

Contractors are responsible for ensuring activities with the potential to affect fauna are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

11.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of fauna on the project are presented in Table 6.

Table 6 Key legislation that applies to fauna management

Reference	Relevant Condition	Limit/Requirement
Biodiversity Conservation Act 2016	Provides for the conservation and protection of Western Australia's biodiversity.	Licence to take protected flora and fauna, consent to take rare or endangered flora
Environmental Protection Act 1986	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.	Approval to undertake an assessed proposal.
Conservation and Land Management Act 1945	Provides for the use, protection and management of certain public lands and waters and the establishment of responsible authorities.	License/permit to undertake activities impacting on DWER managed properties and compliance with management plans

Reference	Relevant Condition	Limit/Requirement
Environment Protection and Biodiversity Conservation Act 1999	Provides for the protection of MNES.	Approval required for activities likely to have a significant impact on any matter of national environmental significance.

11.5 Commitments

The Contractors shall develop and implement fauna management procedures covering all the aspects included in this section of the EMP and which will be submitted to the Superintendent for approval. These procedures will ensure impacts on both terrestrial and aquatic fauna, on and around the project area, are minimised. This plan shall be implemented for the duration of the construction.

11.6 Management measures

The Fauna Management procedures shall include, but not be limited to, the following:

- Construction staff shall be educated in relation to the risks of fauna deaths and how to manage animals which are injured or displaced
- Any trenched areas will be kept open for the minimal period required to undertake works
- Trenches to be inspected and cleared of any fauna each morning and evening and prior to backfilling
- Trenches left open overnight will have a method of egress for trapped fauna
- Wildlife shall not be fed, harassed or intentionally harmed
- If fauna enter the construction area or trenches, the contractors should notify the Environmental Officer. Where possible, the animal should be ushered out or removed by a suitably qualified animal handler
- All vehicles will yield right-of-way to fauna
- Any open ended structures will be sealed/covered when work is not in progress to prevent fauna entering
- Lighting that is not required and will not impair operations and/or safety shall be switched off
- Directional lighting will be used where practicable to prevent excessive light spill into adjacent fauna habitats
- To reduce the potential for noise created during demolition or construction impacting on any nesting species (in the project area and around the vicinity), it is recommended that such activities occur outside of the Spring season to avoid disruption of nesting birds
- The Contractor shall ensure litter and rubbish within the project area is removed daily, especially food scraps, to prevent the increase of undesirable fauna species.

12. Heritage management

12.1 Objectives

To protect places of Aboriginal or European Cultural Heritage.

12.2 Potential impacts

Potential impacts on heritage during construction works include:

- Localise alterations in groundwater distribution and surface water drainage patterns resulting in a reduction of integrity of mythological values, particularly with regard to perceived effects on the Waugal
- Reduced “sense of place” arising from changes in hydrological regimes through localised alterations in groundwater distribution and surface water drainage patterns.

12.3 Scope

Where an activity is proposed in a developed area it is generally unlikely that the activity will harm Aboriginal or European Heritage. In the event a suspected heritage artefact is discovered, all work will cease in the vicinity until appropriate management procedures are undertaken.

Based on information available from the Department of Planning, Lands and Heritage, all sites in the project area have been reported, data has been stored and are registered as being open for access.

Contractors are responsible for ensuring activities with the potential to affect heritage are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

12.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of heritage on the project are presented in Table 7.

Table 7 Key legislation that applies to heritage management

Document Reference	Relevant Condition	Limit/Requirement
Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth)	Protects areas and objects of significance to Aboriginal people	Protects areas and objects of significance to Aboriginal people
Native Title Act 1993 (Commonwealth)	Recognises and protects Native Title and provides for land use agreements where Native Title exists	Native Title assessment over any land that is required for development
Aboriginal Heritage Act 1972	Preservation of places and objects customarily used by the original inhabitants of Australia	Consent to disturb Aboriginal sites under Section 18 of the Act
Heritage Act 2016	Conservation of places having significance to	Approval to disturb, damage or demolish heritage sites

Document Reference	Relevant Condition	Limit/Requirement
	Western Australia's cultural heritage	Government Heritage Property Disposal Process
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment	Approval to undertake an assessed proposal, with conditions

12.5 Commitments

The Contractor shall develop an Aboriginal Heritage Management plan for use should any Aboriginal artefacts be encountered during the works. These shall include, but are not limited to, the following:

- Names and contact details of responsible staff for management of heritage issues including police and Aboriginal Liaison Officers
- Procedures/flow chart that illustrates process to be followed should artefacts be encountered.

12.6 Management measures

The management measures for heritage include, but is not limited to:

- Adherence to requirements under the *Aboriginal Heritage Act 1974*
- Immediately report any potential Aboriginal Heritage or Non-Indigenous Heritage artefacts uncovered during construction (within the meaning of the relevant legislation), including likely human remains and cease works in immediate vicinity. Works will not resume until advised by the Environmental Officer, on advice from relevant authorities
- Should skeletal remains be uncovered this will require that the Police service be called as well as a qualified archaeologist
- If potential Non-Indigenous heritage objects are found during construction works, they shall be salvages and managed according to advice from a suitably qualified archaeologist and the Environmental Officer
- Programme works to be flexible and to allow continuation of development without delays should any new sites or artefacts be encountered.

13. Acid sulfate soils (ASS) management

13.1 Objectives

Acidity within groundwater or soil has the potential to adversely affect subsurface structures, for example sewer, drains or building foundations. It may also leach into wetlands, adversely affecting the habitat. The objective is to minimise the potential environmental impacts due to the disturbance of Actual Acid Sulfate Soils (AASS) or Potential Acid Sulfate Soils (PASS).

13.2 Potential impacts

Potential impacts during construction works include:

- Mobilisation of aluminium, iron and manganese from soils as a result of increased acidity from disturbance of ASS
- Corrosion of foundations and structures due to inappropriately managed disturbance of PASS
- Exposure and oxidation of PASS
- Release of sulphuric acid and metals resulting in the deterioration of soil and water quality and impacts to flora, vegetation and fauna.

13.3 Scope

It is unlikely the region (to the anticipated depth of excavation during the project works) will have any AASS or PASS. In the event that ASS is encountered during the works (typically during excavation for sewer and drainage), appropriate management measures will be undertaken.

Contractors are responsible for ensuring activities with the potential to affect ASS and PASS are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

13.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of ASS on the project is presented in Table 8.

Table 8 Key legislation that applies to ASS/PASS management

Reference	Relevant Condition	Limit/Requirement
Contaminated Sites Act 2003 and associate regulations	Provides for the identification, recording, management and remediation of contaminated sites	Reporting of potential new contaminated sites where applicable Approval of Acid Sulfate Soil Management Plan
Environmental Protection (Unauthorised Discharges) Regulations 2004	Regulations to prevent the release of contaminants into the environment	Prevent and / or report any unauthorised discharges
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting,	Approval to undertake an assessed proposal, with conditions

Reference	Relevant Condition	Limit/Requirement
	enhancing and managing the environment	

13.5 Commitments

The Contractor shall implement ASS management procedures including, but not limited to, all the aspects are covered in this section of the EMP. This plan shall be implemented for the duration of the construction.

13.6 Management measures

Any disturbance of AASS or PASS in and adjacent to the project area will require preparation of site and scope specific Management Plans as follows:

- Acid Sulfate Soils Management Plan
- Acid Sulfate Soils Groundwater Management Plan.

Both Management Plans are required to follow Guidelines provided by DWER and include details of the following:

- Results of the Investigation
- Extent and scope of the disturbance activities
- Explicit soil management details including excavation, handling, storage, neutralization and disposal.

The relevant Guidelines to be followed include:

- DWER Acid Sulfate Soils Guidelines, treatment and management of soils and water in acid sulfate soil landscapes.
- In addition all fill that is to be used in the project area shall not be sourced from an acid sulfate soil moderate or high risk area.

13.6.1 ASS groundwater management plan

The ASS Groundwater Management Plan is required to support any application for a Construction Dewatering Licence from DWER. It should provide the following:

- Detailed estimates of location of extraction
- Extent of the influence of extraction
- Treatment and disposal of potentially contaminated groundwater.

Existing or purpose built monitoring wells should be used to confirm that there is no sign of impact on the groundwater ecosystems.

14. Contaminated soils management

14.1 Objectives

The objective is to ensure that impacts to the environment and human health from existing soil contamination or contaminated soil moved or disposed during construction of the project are minimised.

14.2 Potential impacts

Potential impacts of contaminated soils during construction include:

- Contamination of previously uncontaminated sites through the transfer of contaminated soil from one part of the project area for use as fill elsewhere
- Introduction of contaminants into the project area through the importation and use of contaminated fill
- Exposure to contaminants such as asbestos through the excavation of previously dumped rubbish containing contaminants.

14.3 Scope

Contaminated soils are unlikely to be encountered during construction. In the event they are encountered, contractors are required to ensure appropriate management will be undertaken. Relevant aspects may include asbestos and spills of hazardous materials (namely diesel fuel (refer Section 20).

14.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of contamination on the project are presented in Table 9.

Table 9 Key legislation that applies to contamination management

Reference	Relevant Condition	Limit/Requirement
Contaminated Sites Act 2003 and associated regulations	Provides for the identification, recording, management and remediation of contaminated sites	Reporting of potential new contaminated sites where applicable. Approval of Acid Sulfate Soil Management Plan
Environmental Protection (Unauthorised Discharges) Regulations 2004	Provides for the identification, recording, management and remediation of contaminated sites	Prevent and / or report any unauthorised discharges
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment	Approval to undertake an assessed proposal, with conditions

14.5 Commitments

The Shire or its designated consultant shall develop a site specific Remediation and Validation Plan for the removal of contaminated soils on site, and which should be incorporated into the Construction and Demolition Management Plan. Contractors shall implement the Remediation and Validation Plan management procedures covering all the aspects that are included in this section of the EMP and which will be submitted to the Superintendent for approval. These procedures will ensure impacts of existing contamination and contaminated soil moved or disposed during redevelopment of the project area are minimised. This plan shall be implemented for the duration of the construction.

14.6 Management measures

Where contaminated soils are encountered, the Shire or its designated consultant shall develop a site specific Remediation and Validation Plan for the removal of contaminated soils on site and which should be incorporated into the Construction and Demolition Management Plan. The Remediation and Validation Plan is required to follow Guidelines provided by the DWER and include details of the following:

- Extent and scope of the disturbance activities
- Results of the validation sampling following removal of impacted soil
- Water runoff from contaminated land and stockpiles must be contained, treat or disposed to ensure there is no pollution of land or waterways
- If evidence suggests potential for contamination during excavations (e.g. presence of fill material, previously dumped rubbish, building rubble, odours, soil staining), works are to cease immediately and the Superintendent notified
- Should potential asbestos containing materials be encountered during construction activities, these wastes shall be removed and disposed of by a suitably qualified asbestos removal contractor
- Guidelines for management of vehicle traffic, noise dust and other environmental considerations
- Explicit soil management details including excavation, handling, storage and disposal.

15. Fire management

15.1 Objectives

To minimise the risk of fire and to be able to respond effectively should a fire occur during construction.

15.2 Potential impacts

Potential impacts from fire during construction include:

- Loss, degradation or fragmentation of habitat
- Increased occurrence of weeds and other impacts on flora and fauna.

15.3 Scope

During construction, some activities have the potential to create ignition sources (e.g. welding). There is also a risk due to vehicle movement, hot works/sparks, vegetation clearing, careless disposal of matches/cigarette butts and poor litter and waste management.

The works must be managed by the Contractor to minimise the risk of fire ignition. Fire protection measures must also include response and emergency procedures. Fire management measures are required to prevent impact on people, property and the surrounding environment.

15.4 Legal and other requirements

Local authority, FESA and DBCA fire management requirements will be complied with where relevant. This includes consideration of the following legislation presented in Table 10.

Table 10 Key legislative requirements for fire management.

Document Reference	Relevant Condition	Limit/Requirement
Bush Fires Act 1954	Provides for fire management and the control of fire in rural areas.	Compliance with the Act to manage fire risk and control.
Conservation and Land Management Act 1984	Provides for the use, protection and management of certain public lands and waters and the establishment of responsible authorities.	Permission to undertake activities impacting on DBCA managed properties and compliance with management plans.

15.5 Commitments

The Contractor shall implement Fire Management procedures including, but not limited to, all the aspects that are covered in this section of the EMP. This plan shall be implemented for the duration of the construction.

15.6 Management measures

- The Shire, FESA and DBCA fire management requirements will be complied with where relevant
- All personnel will be reminded of the risks of fire and given appropriate training for dealing with fire risk

- Appropriate fire protection procedures and facilities for hazardous materials (diesel fuel) are to be considered within a Dangerous Goods Compliance Review and will be met
- Care will be taken with the placement of potential ignition sources (such as machinery)
- Naked flames are only to be allowed where absolutely necessary and are to be kept away from easily ignited substances such as flammable liquids, leaf and wood piles
- No smoking is allowed within the project area
- Suitable waste disposal and collection facilities should be provide across the site
- All staff will be educated on locations for additional emergency water sources that are only to be used for fire suppression.

16. Waste management

16.1 Objectives

To minimise the risk of pollution to be able to respond effectively during construction.

16.2 Potential impacts

Potential impacts from waste during construction include:

- Contamination of soil and water and impacts to flora and fauna from incorrect disposal
- Unnecessary load on landfill availability through the generation of excess general and construction wastes.

16.3 Scope

During construction, the majority of activities undertaken at the site will have the potential to create wastes that fall into the following categories or waste streams. The works must be managed by the Contractor to minimise the risk of pollution and contamination of the receiving environment as a result of poor waste management.

16.3.1 Solid waste streams

- Aerosol cans
- Batteries
- Cables and electrical wire
- Construction debris
- Contaminated protective clothing (including gloves and disposable overalls)
- Contaminated rags
- Fluorescent bulbs
- Materials stored on site for which future use or means of disposal is not apparent
- Medical wastes
- General wastes (including food scraps, paper and plastic)
- Oil filters
- Paint waste
- Pallets
- Paper and cardboard
- Radiation sources (e.g. smoke detectors, neutron probe waste)
- Redundant equipment and plant
- Scrap metal.

Of these wastes, the following maybe recycled:

- Aerosol cans
- Batteries
- Pallets
- Scrap metal
- Cardboard
- Paper
- Rags.

16.3.2 Liquid waste streams

- Sewage
- Contaminated stormwater and firewater runoff
- Coolants and corrosion inhibitors
- Degreasers and detergents
- Dewatering water

- Waste oil.

Of these wastes, the following maybe recycled:

- Chemical contaminated water
- Waste oil
- Mine dewatering water.

16.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of waste on the project are presented in Table 11.

Table 11 Key legislation that applies to waste management

Reference	Relevant Condition	Limit/Requirement
Environmental Protection (Controlled Waste) Regulations 2004	Regulates the transportation and disposal of controlled wastes	Disposal and transport of Controlled Wastes in accordance with requirements of the regulations
Environmental Protection (Unauthorised Discharges) Regulations 2004	Regulations to prevent the release of contaminants into the environment	Prevent and / or report any unauthorised discharges
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment	Approval to undertake an assessed proposal, with conditions

16.5 Commitments

Waste management procedures should be developed to ensure an efficient and integrated approach is incorporated into the collection, handling, treatment and disposal of wastes generated during the completion of the construction works. The waste management procedures should be developed around the tenants of Zero Harm and the hierarchy of waste management as follows:

- Reduce – Via prevention or elimination of waste products
- Reuse – Find a secondary use for a waste product
- Recycle – Alternative use for waste product which may include reprocessing of product.

The Waste Minimisation and Management procedures should include, but are not limited to, all the aspects that are covered in this section of the EMP. This plan shall be implemented for the duration of the construction.

16.6 Management measures

Management measures to be undertaken during the construction of the project include but are not limited to:

- All staff shall undergo site inductions that include suitable information with respect to waste management and disposal across the site and for the duration of the works

- Clearly labelled and covered waste disposal bins/facilities shall be set up/positioned across the site for all waste types/streams
- Waste collection arrangements shall be established with licenced contractors for the removal of waste from the site at regular intervals/frequency
- The site shall be inspected on a regular basis for litter.

17. Noise and vibration management

17.1 Objectives

To minimise the impacts of construction noise and vibration on occupants of the Byford Town Centre Local Structure Plan area and to comply with all relevant statutory guidelines and acceptable standards.

17.2 Potential impacts

Potential impacts of noise and vibration during construction include:

- Increased noise and vibration impacts to sensitive receivers
- Increased noise impacts to sensitive receivers due to increased construction traffic and traffic diversions
- Displacement of fauna due to noise and vibration emissions
- Damage to adjacent properties due to vibration emissions.

17.3 Scope

Noise and vibration generated during future development may have a nuisance impact on nearby areas. As the work is being completed within the area of the existing Byford town centre, the risk of disturbance from noise is considered to be high.

Noise and vibration will be managed by the contractor to ensure all relevant statutory guidelines and acceptable standards are met. The meeting of these standards will be verified and contingency measures determined.

17.4 Legal and other requirements

State and Commonwealth legislation that applies to the management of noise and vibration on the project are presented in Table 12.

Table 12 Key legislation and standard that apply to noise and vibration management

Reference	Relevant Condition	Limit/Requirement
Environmental Protection (Noise) Regulations 1997	Regulations that set noise limits for industry and methods for assessing and controlling noise.	Approval of out of hours noise management required.
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment.	Approval to undertake an assessed proposal, with conditions.
Australian Standard 2436-2010	Standards that provide methods for assessing and controlling noise and vibration.	Control of noise and vibration.

17.5 Commitments

The Contractor shall implement Noise and Vibration Management procedures covering, but not limited to, all the aspects in this EMP. The procedures shall be implemented for the duration of the construction.

17.6 Noise management measures

The Contractor shall ensure they:

- Maintain and do not modify acoustic treatments on vehicles or machinery, i.e.: do not remove mufflers, and carry out regular inspections of the machinery to ensure treatments are in place
- Undertake construction activities within the standard construction hours
- Place any static equipment that generates noise (e.g. generators and compressors) will be located as far as practicable from nearby noise sensitive receivers
- Include education on the importance of minimisation of noise and vibration during construction and methods for minimising noise and vibration impacts in the site induction.

The Contractor will minimise the effects of noise on the occupants of adjacent properties by:

- Communicating to the Superintendent on occasions when major noise generation is likely to occur and limiting the working hours on those activities
- Ensuring all equipment is serviced and maintained according to manufacturer's recommendations, or more frequently if required to minimise noise generated
- Early consultation must be conducted with community stakeholders on the likely impact of activities likely to cause disruption
- Selection of machinery and operational practices will be undertaken to produce the lowest practical level of noise and vibration. All machinery will be fitted with exhaust mufflers
- Use of croakers in the place of reversing beepers will be considered at least in areas of close proximity to noise sensitive receivers (i.e. nearby residents) and for out of hours works
- Appropriate site access routes and staff parking will be determined which will minimise noise and vibration impacts on the neighbouring community
- All machines, equipment, plant and vehicles proposed for the Works shall be of types complying with Worksafe Western Australia requirements for noise abatement. The operation of such machines, equipment, plant and vehicles shall be certified to be within the limits of the Environmental Protection (Noise) Regulations 1997
- In areas where noise exceeds the specified levels, prominent warning signs shall be displayed and hearing protection shall be provided to all onsite workers
- Utilising the information above, a combined register including date and time of all incidents and complaints must be maintained by the Contractor. The register must also include how the issue was rectified. A complaints communication phone line will be set up and publicised by the Contractor. All complaints on noise will be responded to within 2 hours.

17.7 Vibration management measures

The risks of damage from vibration occur when excavation, heavy equipment and material movement and compaction occur in close proximity to structures. To manage risks of vibration damage and complaint, the Contractor will adhere to the following:

- Provide adequate and ongoing communications with residents regarding the timing of works, type of works and possible times of high impact
- Ensure that vehicles and equipment are appropriately sized to satisfactorily undertake the work
- Unload, store, and manoeuvre construction materials as far as possible from buildings that may be susceptible to vibration damage
- Vibration complaints will be addressed within 24 hours unless otherwise explained to the complainant.

Utilising the information above, a combined register including date and time of all incidents and complaints must be kept by the Contractor. The register must also include how the issue was rectified.

18. Air quality management

18.1 Objectives

To minimise impacts on local air quality and protect the surrounding land users such that emissions will not adversely impact upon their welfare and amenity or cause health problems. This is to be carried out by implementing mitigation strategies against air pollution.

18.2 Potential impacts

Potential impacts during construction include:

- Reduced air quality and impacts on human health from elevated dust levels and particulate / gaseous emissions
- Nuisance dust or odour emissions
- Dust deposition on flora and vegetation.

18.3 Scope

Dust nuisance may occur during clearing, earthworks and construction. The impact of dust is likely to cause problems such as unpleasant visual amenity and health impacts. Temporary air pollution can also occur from minor emissions from construction vehicle exhausts.

Contractors are responsible for ensuring activities with the potential to affect air quality are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

18.4 Legal and other requirements

State and Commonwealth legislation that apply to the management of air quality on the project is presented in Table 13.

Table 13 Key legislation that applies to air quality management

Reference	Relevant Condition	Limit/Requirement
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment	Approval to undertake an assessed proposal, with conditions

18.5 Commitments

The Contractor shall implement Air Quality Management procedures that include, but are not limited to, the aspects contained in the EMP. The procedures shall be implemented for the duration of the construction works.

18.6 Management measures

18.6.1 Dust

Inevitably, a certain amount of dust will be produced during dry weather conditions by construction traffic, clearing and soil stripping procedures but every effort will be made to keep this to a minimum.

The following management measures for dust shall be implemented:

- Localised spraying may be used to dampen the dust down from stockpiles and vehicle parking areas, avoiding runoff
- Any deposits of mud and dust on the roads will be removed regularly using road brushes and vacuum road sweepers
- Vehicular speed will be restricted within the construction areas at all times to minimise dust
- Stockpiles of spoil, topsoil and mulch material will be kept to a maximum height of 1.2 m and flattened in the centre
- Temporary mulching (possibly using crushed rock, cleared vegetation) may be used to reduce dust lift on side tracks, laydown, or parking areas
- Trucks carrying fill to and spoil from the site will be covered
- Surface stabilisation equipment (e.g. sprayers and machinery) and materials shall be available to commence operation on site within 48 hours of being required to do so by the Superintendent
- Exposed soil that has the potential for generating dust will be rehabilitated or stabilised as soon as possible after construction work is completed
- Any complaints regarding dust will be attended to as soon as possible with the actions and outcomes documented in the Complaints Register.

18.6.2 Emissions other than dust

The following management measures for emissions other dust shall be implemented:

- As far as practicable, electric pumps will be used for static plant, such as dewatering pumps. Where this is not possible, diesel powered plant shall be located on site as far removed from positions of public exposure as possible
- Diesel powered plant shall be regularly serviced and any unacceptable exhaust emissions rectified as soon as possible.

19. Traffic and public safety management

19.1 Objectives

To ensure the traffic created by and related to the town centre construction is effectively managed and impacts on local residents, businesses and road users are minimised.

To ensure traffic is managed in such a way as to minimise the potential for accidents and other safety risks.

19.2 Potential impacts

The increased traffic will result in some short-term adverse impacts and because local residents have limited experience of such traffic conditions, an increased risk of incident.

19.3 Scope

The Byford Town Centre development will occur in and around the existing town centre. The construction traffic will comprise transport trucks carrying demolished and excavated materials, construction related materials, construction equipment (e.g. excavators, graders, rollers), personal vehicles and delivery vehicles during construction and earth moving equipment during reinstatement.

Contractors are responsible for ensuring activities with the potential to affect traffic and public safety are effectively managed. This includes monitoring to ensure appropriate guidelines are adhered to and contingency measures are implemented, if required.

19.4 Legal and other requirements

State and Commonwealth legislation that apply to the management of traffic and public safety on the project are presented in Table 14.

Table 14 Key Legislative requirements for Traffic and Public Safety

Reference	Relevant Condition	Limit/Requirement
Local Government Act 1995	Provides for the closure or partial closure of local government roads and thoroughfares for repairs, maintenance and other requirements.	Approval for partial or full closure of local government roads required.
Main Roads Act 1930	Provides for the management, construction, maintenance and repair of roads.	Approval for partial or full closure of roads required. Approval for oversize vehicles required.
WorkSafe Occupational Safety and Health Regulations 1996	Provides for workplace safety requirements, plant design and general duties applying to plant, hazardous substances and performance of high risk work.	Minimum requirements for specific hazards, work and administrative practices in relation to work safety and health.

Road Traffic Act 1974	Provides for the regulation and control of all road users.	

19.5 Commitments

The Contractor shall develop and implement Traffic and Public Safety Management procedures. These shall include, but are not limited to, the measures contained within this management plan.

The Shire will be consulted prior to construction with regards to any traffic movements that may affect the flow of local traffic. Main Roads Western Australia will be consulted prior to construction with regards to any traffic movements that may affect the flow of main road traffic, for example for the South West Highway.

19.6 Management measures

19.6.1 Traffic management

- In areas where the construction traffic intersects with existing roads traffic management measures will be agreed with the Shire to minimise the localised short term impacts
- Public notification of construction activities, will be given prior to commencement of works in each area
- Appropriate approvals or permits will be obtained (including Shire and Main Roads WA)
- Road access shall be maintained in the project area via signed detours and/or single lane access
- When construction work is being undertaken within or adjacent to designated road reserves, road signs will be located on local and main roads
- Any material spilled from haulage vehicles leaving the project area will be cleaned up as soon as possible. Appropriate signage will be used/erected during this cleanup process.

19.6.2 Public safety management

- Where there is any risk of public injury, e.g. open trenches or dewater pits, the construction area will be fenced or otherwise cordoned off
- Machinery and plant will be kept in locked compounds when the construction area is not in use
- Spoil and mulch heaps shall be no higher than 1.2 m
- Advisory warning boards shall be placed on fenced construction zones and compounds. The warning boards shall state the nature of the hazard and give a staffed contact telephone number for emergencies.

20. Hazardous materials management

20.1 Objectives

Prevent any environmental, health or safety impacts from contaminated or waste materials generated, exposed or stored at the project area.

20.2 Potential impacts

Incorrect storage and management of hazardous materials can result in spill or discharge to the environment, resulting in potential impacts on:

- Soil and water quality
- Flora and vegetation
- Fauna
- Community
- Air quality

20.3 Scope

The demolition of existing infrastructure has the potential to generate or expose contaminated or hazardous materials and this potential must be managed. The contractor must ensure appropriate management of any hazardous materials removed/used during construction to minimise the risk of spillages or escape of hazardous materials. Management must include the disposal of hazardous material generated or exposed in a safe manner in accordance with any relevant regulations.

20.4 Legal and other requirements

State and Commonwealth legislation that apply to the management of hazardous materials on the project are presented in Table 15.

Table 15 Key legislation that apply to hazardous materials management

Reference	Relevant Condition	Limit/Requirement
Contaminated Sites Act 2003 and associated regulations	Provides for the identification, recording, management and remediation of contaminated sites	Reporting of potential new contaminated sites where applicable. Approval of Acid Sulfate Soil Management Plan
Dangerous Goods Safety Act 2004 and associated regulations	Provides for the safe storage, handling and transport of dangerous goods	Dangerous Goods Licences
Environmental Protection (Unauthorised Discharges) Regulations 2004	Provides for the identification, recording, management and remediation of contaminated sites	Prevent and / or report any unauthorised discharges

Reference	Relevant Condition	Limit/Requirement
Environmental Protection (Controlled Waste) Regulations 2004	Regulates the transportation and disposal of controlled wastes	Disposal and transport of Controlled Wastes in accordance with requirements of the regulations
Environmental Protection Act 1986	Prevention, control and abatement of environmental harm and conserving, preserving, protecting, enhancing and managing the environment	Approval to undertake an assessed proposal, with conditions

20.5 Commitments

The Contractor shall implement Hazardous Materials Management procedures to to minimise or prevent risk to the environment. These shall include, but not be limited to, the aspects contained in this management plan.

20.6 Management measures

20.6.1 Hazardous material uncovered

Management measures to be implemented in the event of hazardous material being uncovered during construction include, but are not limited to:

- Any soil or groundwater which has unusual colouration or odour will be collected using appropriate protective equipment and tested by a NATA accredited laboratory. Upon receipt of the results from the testing laboratory the material will be accordingly managed (i.e. will be removed from the project area to a certified landfill of the appropriate class or will be treated onsite until acceptable levels are reached)
- Where suspected asbestos is uncovered, appropriate asbestos testing and removal methods must be employed. A suitable asbestos management plan should be developed by the Contractor for use should asbestos be encountered.

20.6.2 Use and storage of hazardous materials

Management measures for the use and storage of hazardous materials includes, but is not limited to:

- Standard construction site risks posed by use and storage of fuels will be managed through good housekeeping with a spill management procedure in the unlikely event that an accident occurs
- All vehicle servicing be carried out off site at depots or in controlled hardstand areas on site if necessary
- Hardstands will have sufficient bunding and sump capacity to collect water from a 1 in 1 year rainfall event.

20.6.3 Removal

Where known areas of hazardous materials are known, a licenced removal company should be employed to appropriately isolate and remove the substance.

21. Incident management

21.1 Objectives

The Shire and Superintendent will ensure any incident that may have a negative impact on the surrounding environment or community is appropriately reported, managed and rectified. Following an incident, appropriate management measures will be implemented to prevent such incidents reoccurring.

21.2 Potential impacts

The completion of construction works for the Byford Town centre development has the potential to create incidents that may impact on the environment or the local community. Incidents have the potential to impact:

- Soil and water quality
- Flora and vegetation
- Fauna
- Heritage
- Air quality
- Community.

21.3 Scope

For the purpose of this EMP, an incident is defined as any exceedance of environmental limits, criteria, standards, specification requirements or laws and or any occurrence that threatens the safety of an individual or an individual is injured.

Contingency procedures and management strategies shall be in place to prevent the occurrence of controllable incidents and to reduce impacts on people, property or the environment should an incident occur. Management measures shall also be implemented to prevent the reoccurrence of such incidents and shall be in accordance with the standard Contractors Response procedures.

The Construction Contractor will provide a suitable Incident Report and Response Form that is acceptable to Shire.

Reporting an environmental incident will include:

- Reporting of the incident in an incident log
- Time limits for incident reporting
- Structure and content of incident reports
- Assessment of the significance of each incident
- Discontinuation of the work which gave rise to the incident until a suitable management measure has been implemented
- Reporting incidents to regulatory authorities and stakeholders
- Remediation/mitigation of impacts.

21.4 Legal and other requirements

Conditions of State and Commonwealth legislation that apply specific criteria to the management of incidents on the project is presented in Table 16.

Table 16 Key legislation that apply specific criteria to incident management.

Document Reference	Relevant Condition	Limit/Requirement
Biodiversity Conservation Act 2016	Provides for the conservation and protection of Western Australia's biodiversity.	Licence to take protected flora and fauna, consent to take rare or endangered flora
Environmental Protection Act 1986	Preventing, controlling and abating environmental harm and conserving, preserving, protecting, enhancing and managing the environment.	Approval to undertake an assessed proposal.
Conservation and Land Management Act 1984	Provides for the use, protection and management of certain public lands and waters and the establishment of responsible authorities.	License/permit to undertake activities impacting on DWER managed properties and compliance with management plans
Environment Protection and Biodiversity Conservation Act 1999	Provides for the protection of MNES.	Approval required for activities likely to have a significant impact on any matter of national environmental significance.

21.5 Commitments

The Contractor shall implement Incident Management procedures to ensure compliance with legal and other requirements and to minimise or prevent risk to the environment. These shall include, but not be limited to, the aspects contained in this management plan.

21.6 Management measures

The following incident management measures shall be put in place by the Contractor:

- The Contractor shall provide and advertise a telephone number for public reporting of incidents for the duration of the construction works
- The Contractor shall undertake daily examination of the project area so that any incidents are identified as quickly as possible
- In the event of an environmental incident the Contractor shall produce an Environmental Incident Report, which shall include:
  - The cause of the incident
  - Corrective actions undertaken
  - Measures required to prevent the recurrence of the incident.
- The Environmental Incident Report will be provided to the Shire and Superintendent within 48 hours of the incident occurring. The Shire and Superintendent will undertake a review and summary of the incident

- The corrective strategies that were implemented will be assessed to determine whether successful mitigation had occurred
- The incident and corrective measures undertaken will be reported to the relevant agencies or other stakeholders
- The Contractor shall also prepare a summary report of any environmental incidents and the responsive actions taken. The Shire and Superintendent will review all incident reports and prepare a summary of the incidents, responsive actions taken and the effectiveness of the actions
- All documentation and reports relating to the incident, including the original Incident Report, any other relevant reports, correspondence with relevant agencies and subsequent audits, will be filed and retained.

22. Auditing, review and revision

Compliance audits will be undertaken regularly by both the Contractor (First Party Audits) and on behalf of the Shire (Second Party Audits). These will determine whether the EMP is achieving its objectives and will allow the refining of operations to ensure these goals are met. The auditing program shall be defined through Audit Plans prepared prior to construction and implemented throughout the construction.

22.1 Auditing

During the construction phase, the Contractor will maintain a high level of onsite supervision, either through their own resources or via the use of external consultants. Periodic audits and inspections will be undertaken by the Shire and/or its appointed consultants against the environmental management requirements specified in this EMP, the Contractor's CEMP and applicable conditions, procedures and protocols set out during approval of the project.

Copies of audit reports containing key audit findings will be provided to the Superintendent who will subsequently be required to develop appropriate corrective or preventive actions to address any identified non-conformances with the Contractor.

The Contractor is also required to undertake internal audits and inspections to determine the environmental performance of both their own activities, and those of their subcontractor(s). Copies of environmental audits and inspections, including identified corrective and preventive actions shall be forwarded to the Shire as outlined in Table 2.

22.2 Review and revision

There must be a continuous review of the EMP to ensure that environmental objectives are being met and to ensure that the relevant environmental issues are being appropriately managed.

The EMP will be continually reviewed and revised during construction, based on feedback from the audits and from day-to-day operations. Reviewing of the EMP will determine whether the system is functioning adequately, which areas of the system need improvement and any alternative procedures that may be more effective than those currently in place.

The Contractor will liaise with the Superintendent's Representative during the construction to enable continual revision of the EMP. There will be a final revision post construction, in order to document and summarise the operation of the system.

23. References

Shire of Serpentine Jarrahdale 2016, Natural Assets Management Plan, Shire of Serpentine Jarrahdale, Western Australia.

Shire of Serpentine Jarrahdale 2017, Council Policy 2.1.10 – Control of Energy and Water Efficiency, Shire of Serpentine Jarrahdale, Western Australia.

Shire of Serpentine Jarrahdale 2017, Council Policy 2.3.1 – Control of Weeds, Shire of Serpentine Jarrahdale, Western Australia.

Shire of Serpentine Jarrahdale 2018, Local Planning Policy 2.4 – Water Sensitive Urban Design Guidelines, Shire of Serpentine Jarrahdale, Western Australia.

Shire of Serpentine Jarrahdale 2018, Local Planning Policy 4.13 – Revegetation Policy, Shire of Serpentine Jarrahdale, Western Australia.

Shire of Serpentine Jarrahdale 2018, Local Planning Policy 4.16 – Landscape and Vegetation Policy, Shire of Serpentine Jarrahdale, Western Australia.

Shire of Serpentine Jarrahdale 2019, Local biodiversity Strategy, Shire of Serpentine Jarrahdale, Western Australia.

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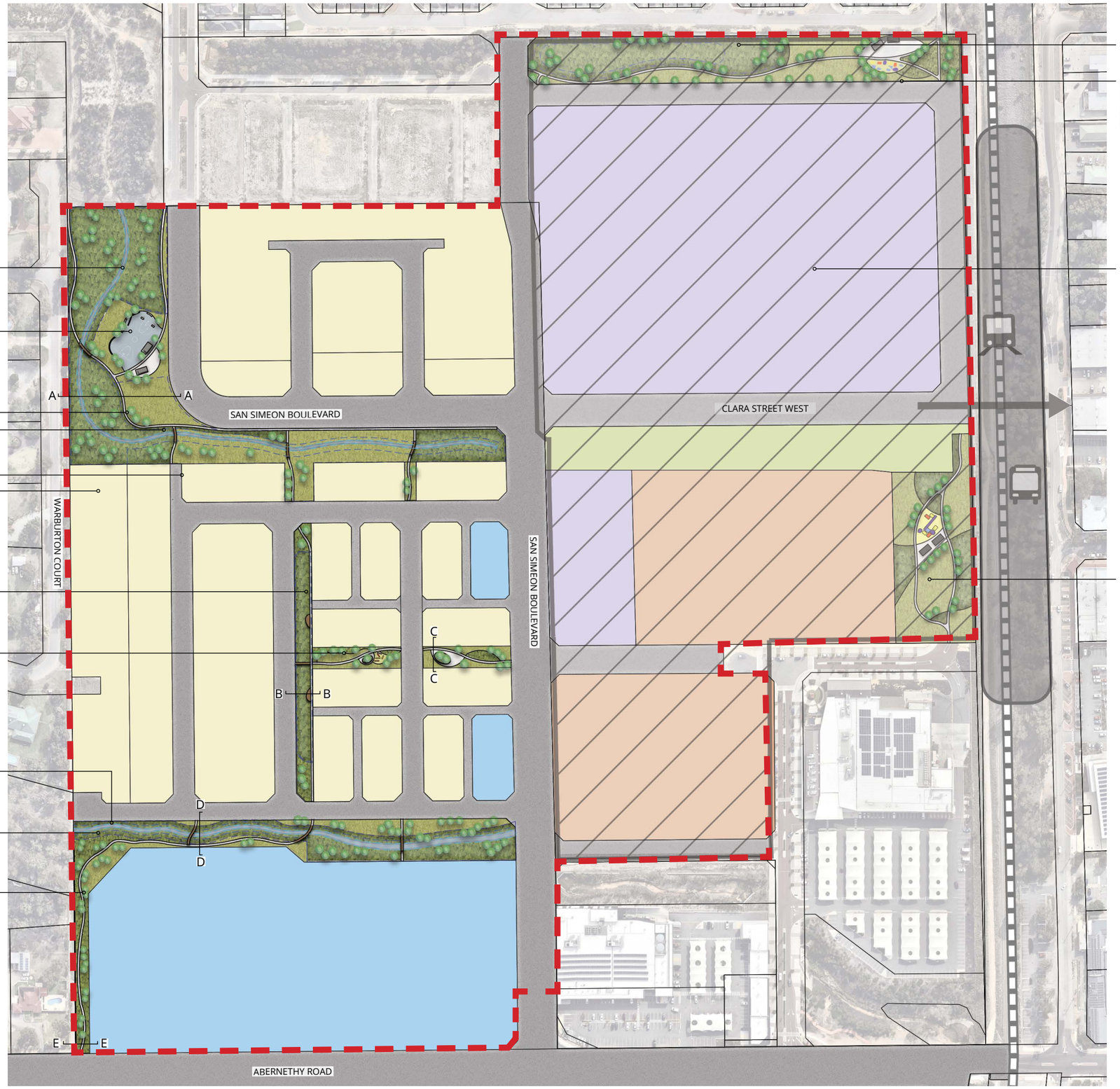
12528115-16229-10/https://projectsportal.ghd.com/sites/pp18_05/byfordtowncentreenvi/ProjectDocs/12528115-REP_GHD_Byford Town Centre Environmental Management Plan.docx

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	Rachel Champion	J Tindiglia		J Tindiglia		19/05/2020

www.ghd.com



open drainage swale to capture 1:1 and 1:5 year rain events

central picnic area with basketball court, skateable furniture and picnic facilities (subject to detailed investigations)

footpath network

open turf area containing 1:100 year rain event

pedestrian boardwalk

vegetated drainage basin containing 1:5 and 1:100 year rain events

vegetated drainage basin containing 1:5 and 1:100 year rain events

public open space including young children's play space (subject to detailed investigations)

open drainage swale to capture 1:1 and 1:5 year rain events

vegetated drainage basin containing 1:5 and 1:100 year rain events

pedestrian access way with boundary wall to adjacent residential lot

vegetated drainage basin containing 1:5 and 1:100 year rain events

public open space including picnic facilities and young children's play space (subject to detailed investigations)

indicative metronet station precinct (subject to further detailed design)

public open space including picnic facilities and children's play space (subject to detailed investigations)

LEGEND

- 1:1 year TWL line
- 1:5 year TWL line
- 1:100 year TWL line
- Housing lots
- Town centre
- Commercial
- Mixed use
- Multiple use corridor
- Public open space (community purposes)

LOT 1 ABERNETHY RD

LANDSCAPE MASTERPLAN

DWG **AR-SK-01**
REV **H**
DATE **04.08.21**
SCALE **1 : 3000 @ A3**

emerge ASSOCIATES

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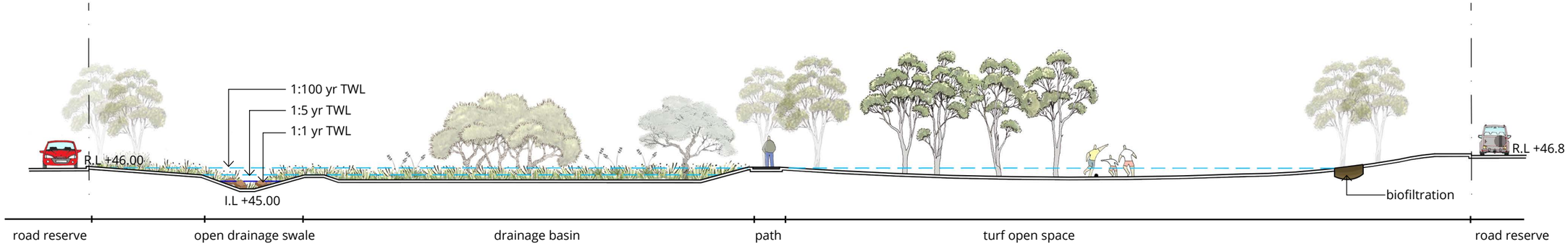
1:250 @ A3



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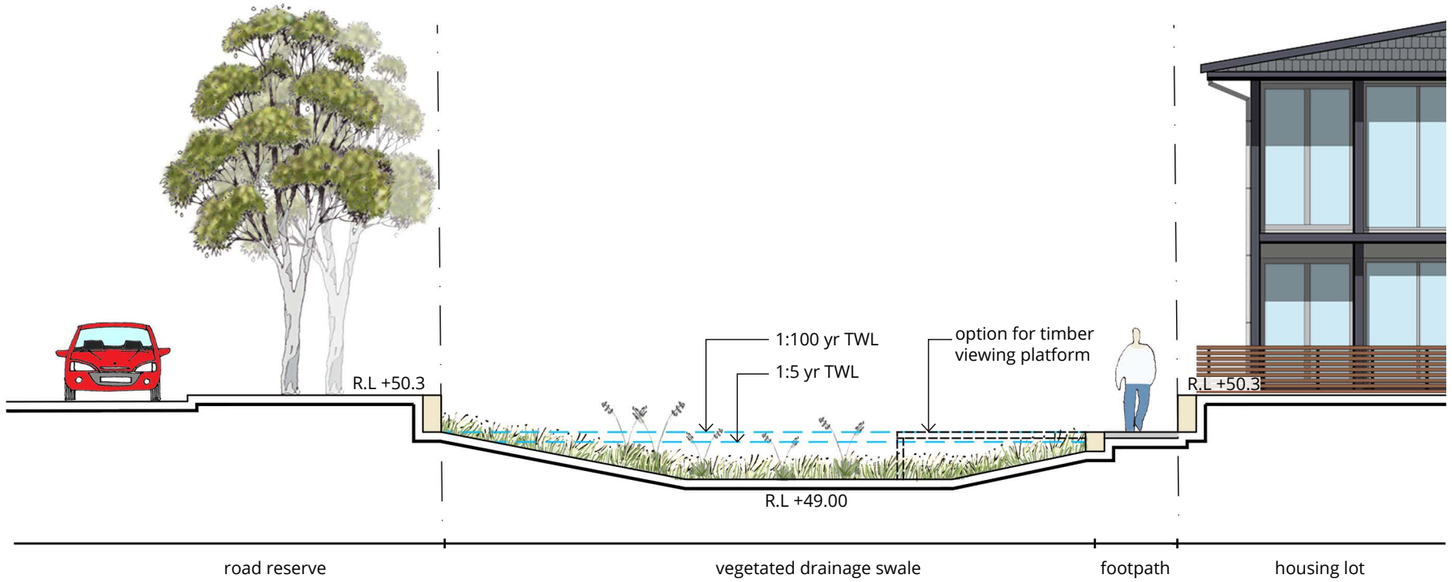

LOT 1 ABERNETHY RD
LANDSCAPE SECTIONS

DWG **AN-SK-02**
REV **E**
DATE **05.08.21**

emerge ASSOCIATES

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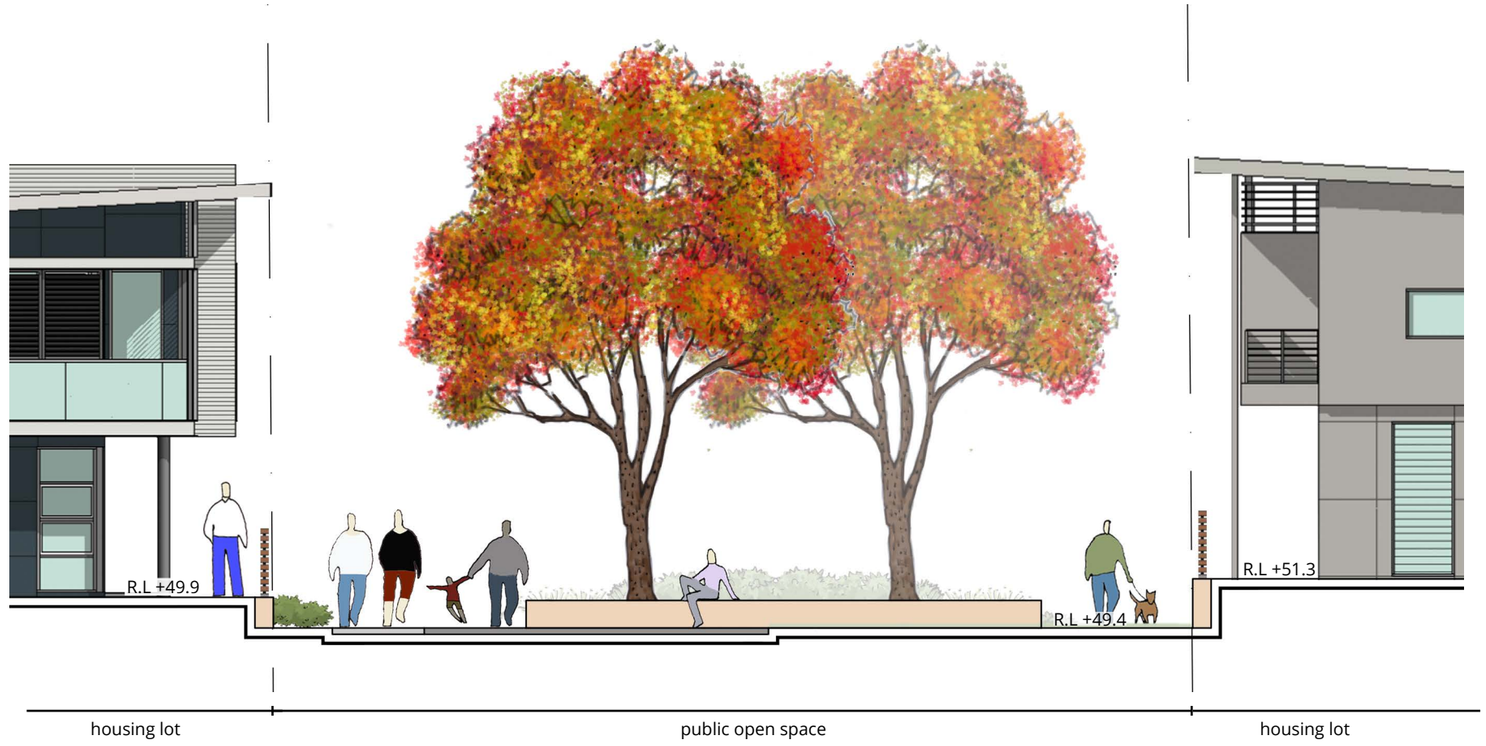

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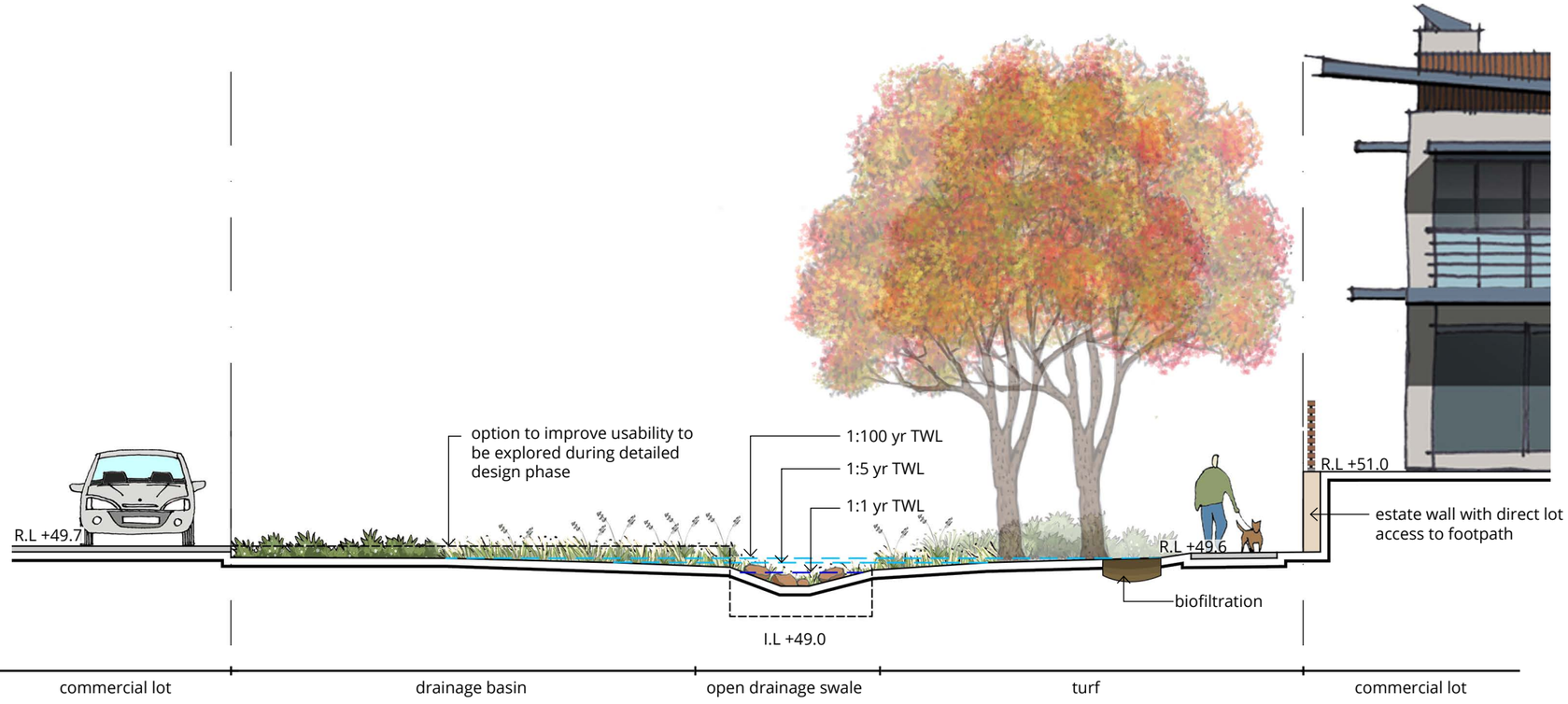

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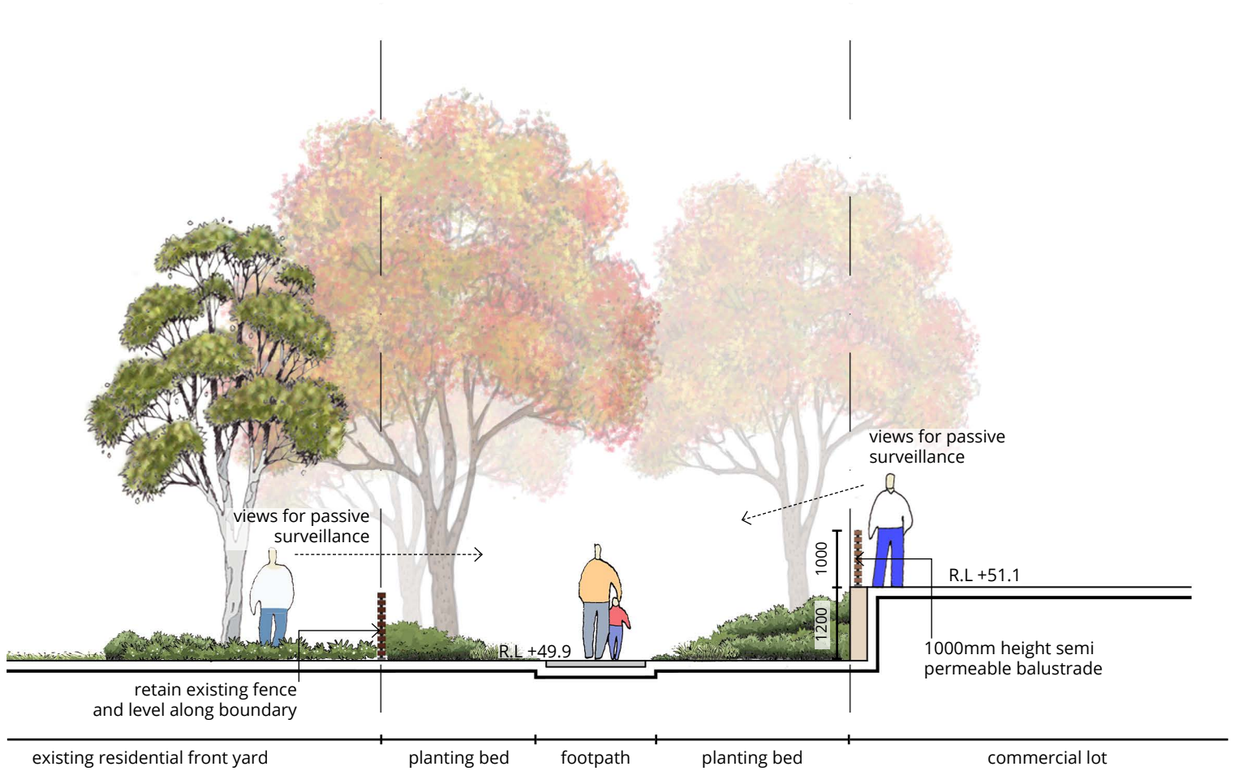
REV **E**
DATE **05.08.21**

emerge ASSOCIATES

SECTION EE



LOT 1 ABERNETHY RD

LANDSCAPE SECTIONS

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DATE **16.03.21**
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0 0.5 1.0 1.5 2.0 2.5 m

emerge ASSOCIATES

Transport Impact Assessment

TIA-LSP Lot 1 Abernethy Road, Byford

CW1064600

Prepared for

Aigle Royal Developments

19 October 2021

Cardno

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Effective Date 19/10/2021

Approved By:

Ray Cook
Manager – Traffic and Transport

Date Approved 19/10/2021

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A	27/06/19	For Issue	ND	SJL
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C	31/01/2020	For Issue	ND	SJL
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F	4/05/2020	For Issue	BS	SJL
G	27/04/2021	LSP Amendment	BS	SJL
H	3/06/2021	Minor Update	BS	SJL
I	19/10/2021	Minor update	BS	SJL

Table of Contents

Appendices

Tables

Figures

1 Introduction

1.1 Background

Cardno was commissioned by *Aigle Royal Developments* ('the Client') to prepare a Transport Impact Assessment for the proposed Local Structure Plan (LSP) ('the Site' or 'the Structure Plan') for Lot 1, Abernethy Road in Byford.

This report has been prepared in accordance with the *Western Australian Planning Commission (WAPC) Transport Impact Assessment Guidelines Volume 2 – Planning Schemes, Structure Plans & Activity Centre Plans (2016).* This report will support the detailed structure planning for the locality by evaluating the sufficiency of existing and proposed intersection treatments across the Structure Plan Area.

1.2 Site Location and Description

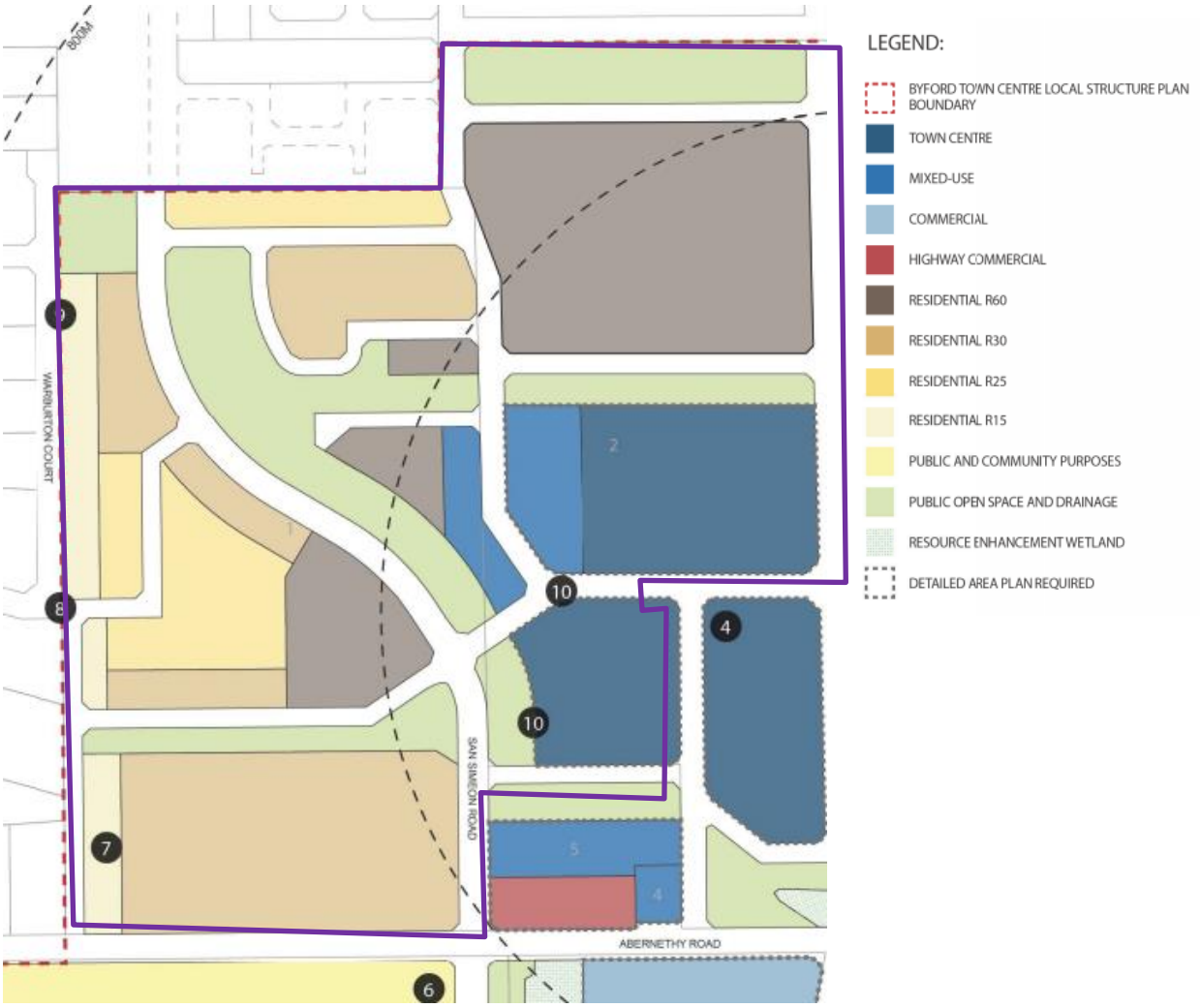
The Structure Plan is located on Lot 1 and Lot 2, Abernethy Road, in Byford within the *Shire of Serpentine Jarrahdale* covering an area of approximately 35 hectares. **Figure 1-1** shows the location of the Site and the study area within the structure plan.

Figure 1-1 Aerial Image

Source: Nearmap

The current *Byford Town Centre Local Structure Plan* is shown in **Figure 1-2**. Under the current structure plan, the Site is zoned for R60, R30, R25 and R15 residential uses and other town centre and mixed use land uses as shown in **Figure 1-2**. **Figure 1-3** shows the current Byford Town Centre Concept Plan.

Figure 1-2 Local Structure Plan



Source: Local Structure Plan, December 2015

Figure 1-3 Byford Town Centre Concept Plan

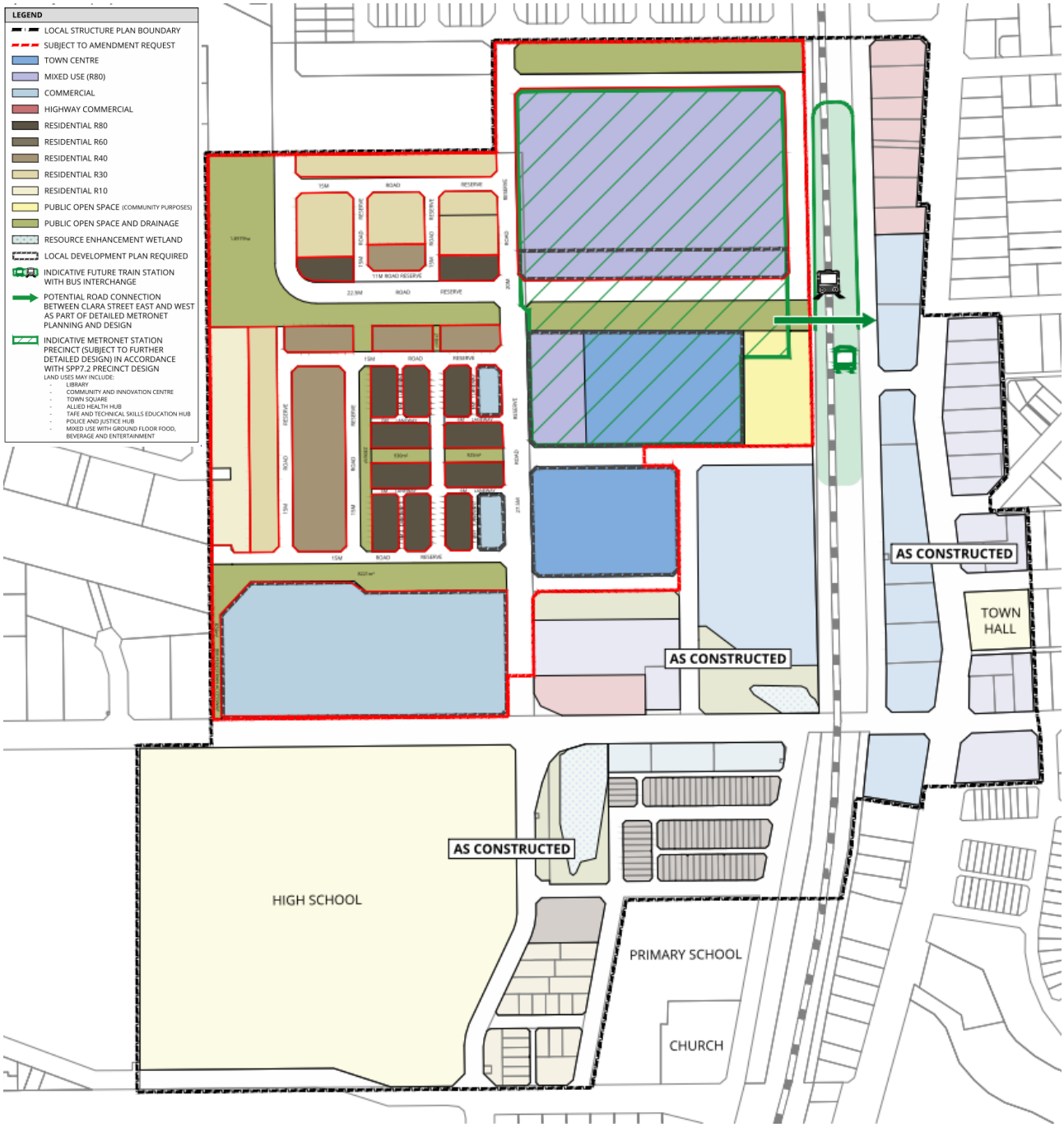
Source: Local Structure Plan, December 2015

2 Structure Plan Proposal

2.1 Proposed Land Use

The proposed indicative structure plan is shown in **Figure 2-1.** As shown, the proposal includes new road connections within the Site, improving the connectivity and addition of new increased residential density, mixed-use and commercial developments.

Figure 2-1 Proposed Structure Plan



Source: Rowe Group Design – 8861_CON10C_20210413

The proposal includes potential commercial/retail development area of approximately 45,000m^2 and approximately 800 residential dwellings with public open spaces and internal road extensions and connections to external road network.

2.2 Proposed Access Arrangement and Road Hierarchy

The following access points have been proposed (See **Figure 4-1**):

- Extension of San Simeon Boulevard onto Abernethy Road through the LSP.
- Clara Street West connection onto San Simeon Boulevard extension.
- Potential connection of Clara Street West with Clara Street East as part of detailed Metronet Planning and Design.

Figure 2-2 shows the road hierarchy as per *WAPC Liveable Neighbourhoods January 2009.* The road layout will mainly consists of Access Streets A and B and Neighbourhood Connectors A which are suited to higher density residential areas (R30 to R40+).

Commercial car parking is expected to be provided within the individual sites. Visitor parking for residential dwellings may be facilitated by on-street parking public parking areas located in close proximity of high density lots. On-street parking will be provided where appropriated which is to be determined during the subdivision stage.

Figure 2-2 Proposed Road Hierarchy

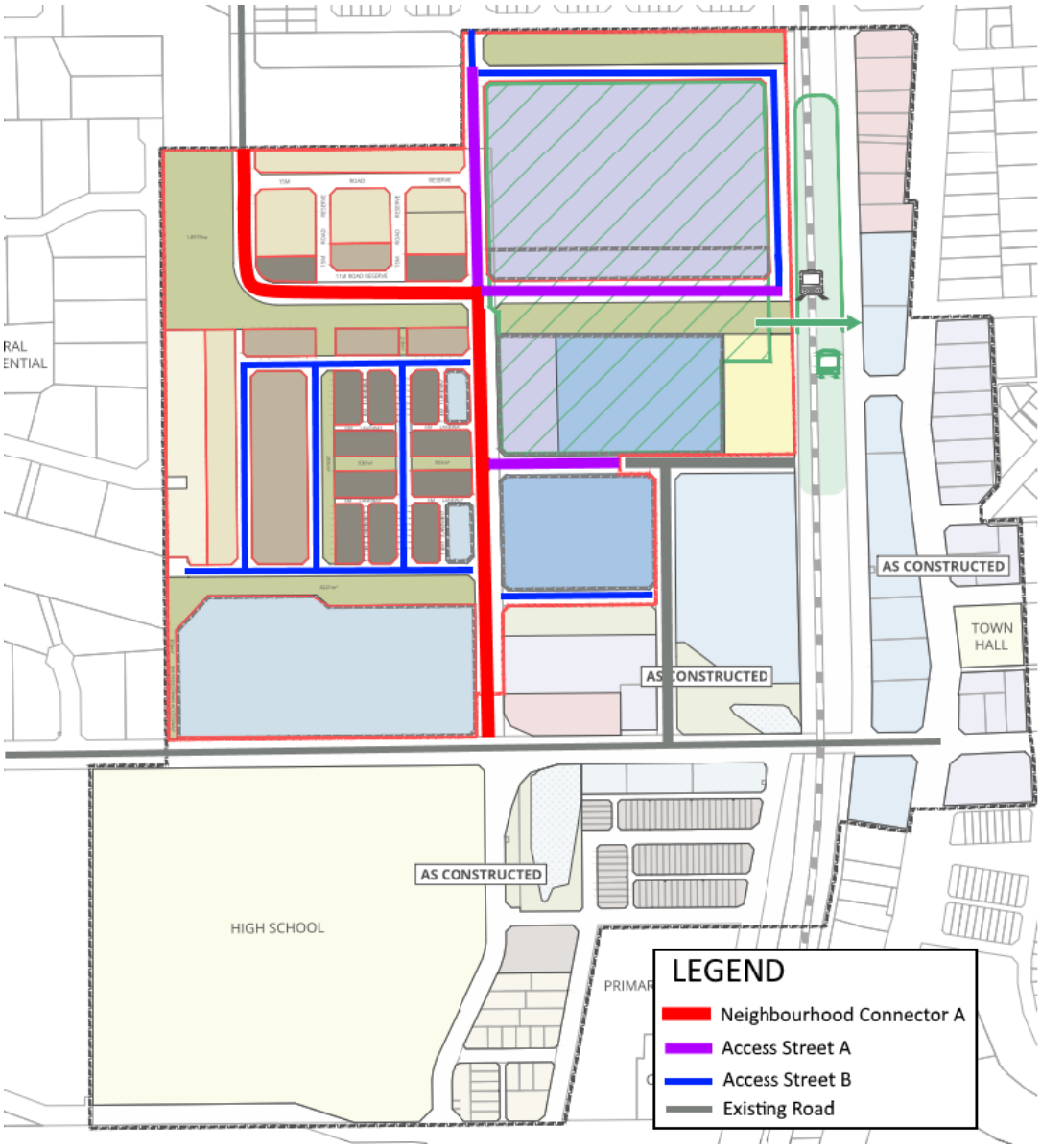


Figure 2-3 to **Figure 2-5** show the potential road cross sections of the access streets and neighbourhood connectors. The laneways are normally designed to allow vehicle access into garages at the property boundary and sufficient sightlines are required to footpaths.

Figure 2-3 Road Cross Sections – Neighbourhood Connector A

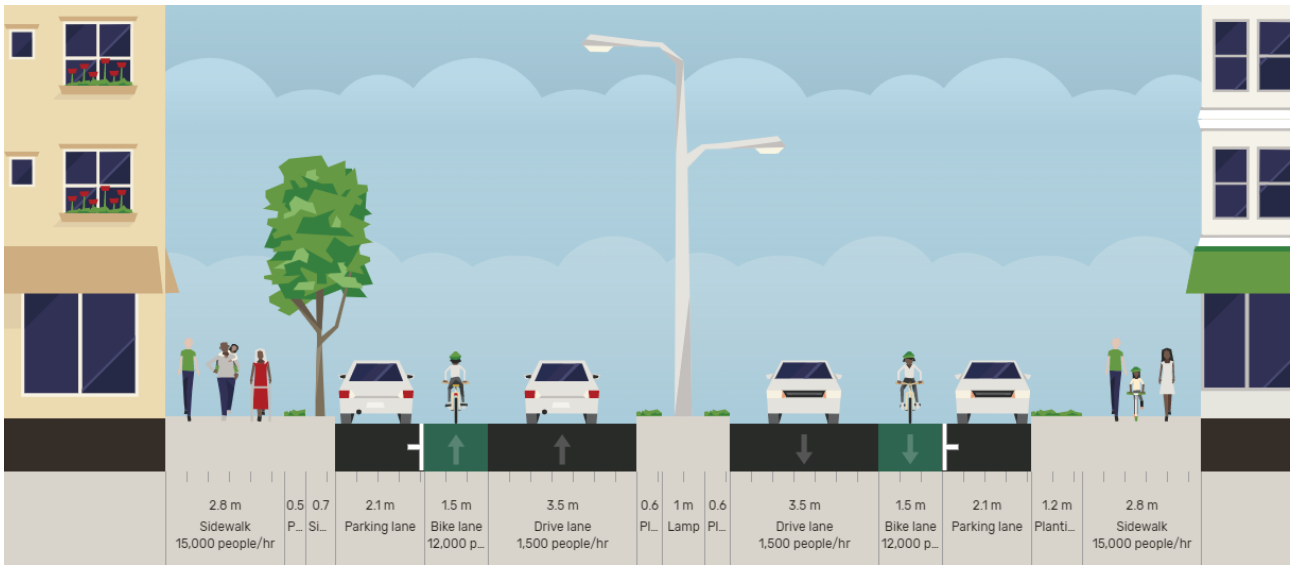


Figure 2-4 Road Cross Section – Access Street A

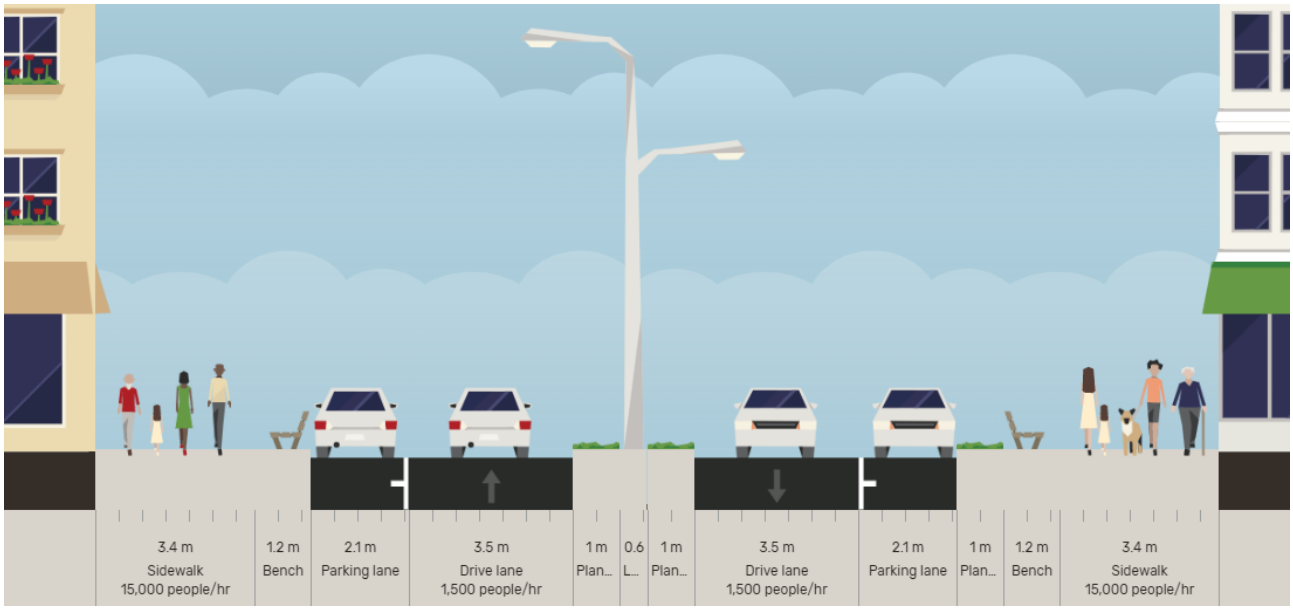
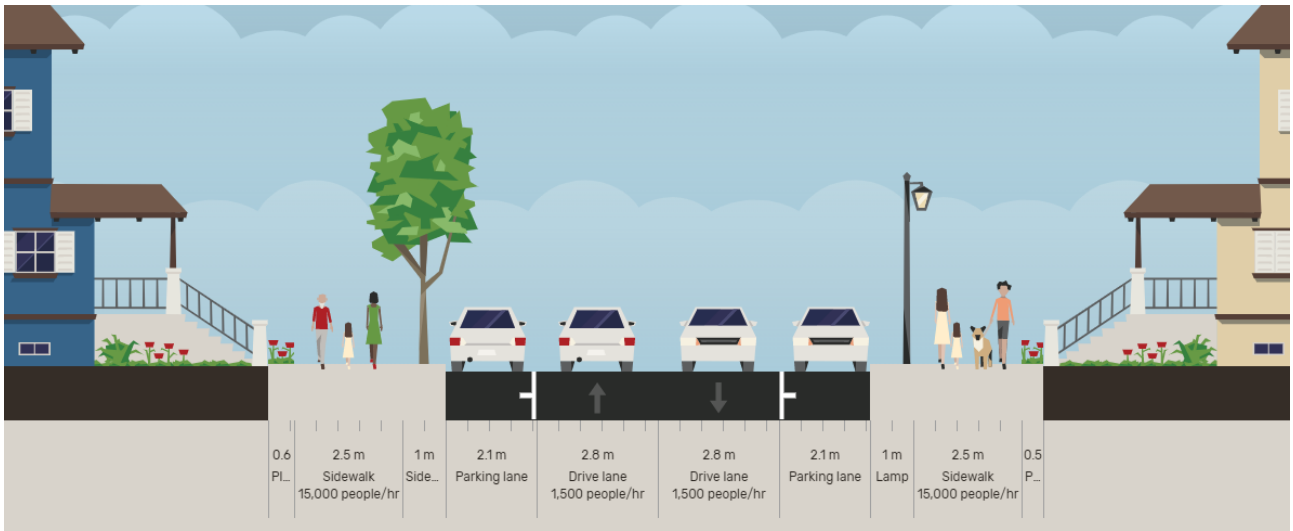


Figure 2-5 Road Cross Section – Access Street B

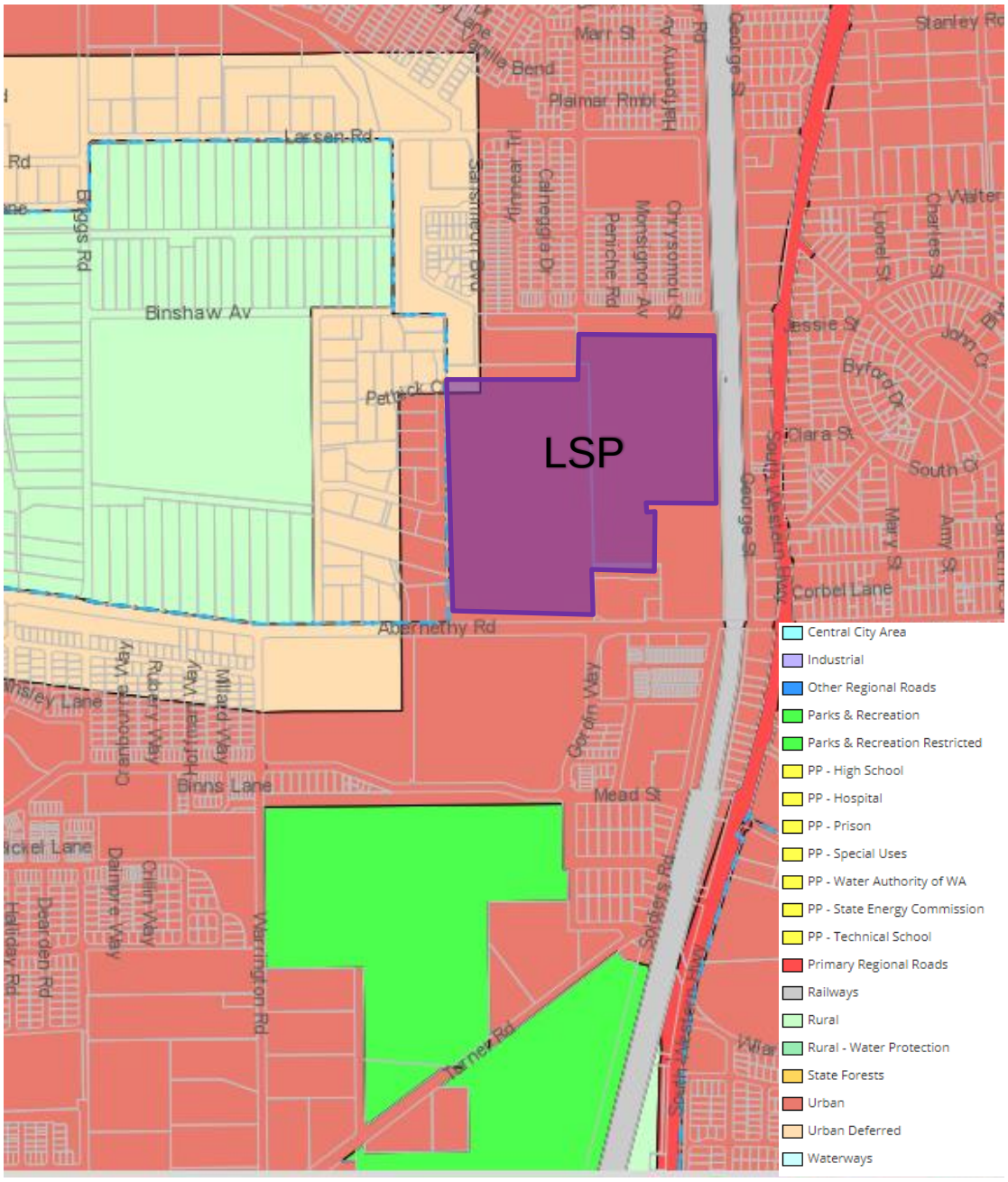


3 Existing Situation

3.1 Existing Land Uses

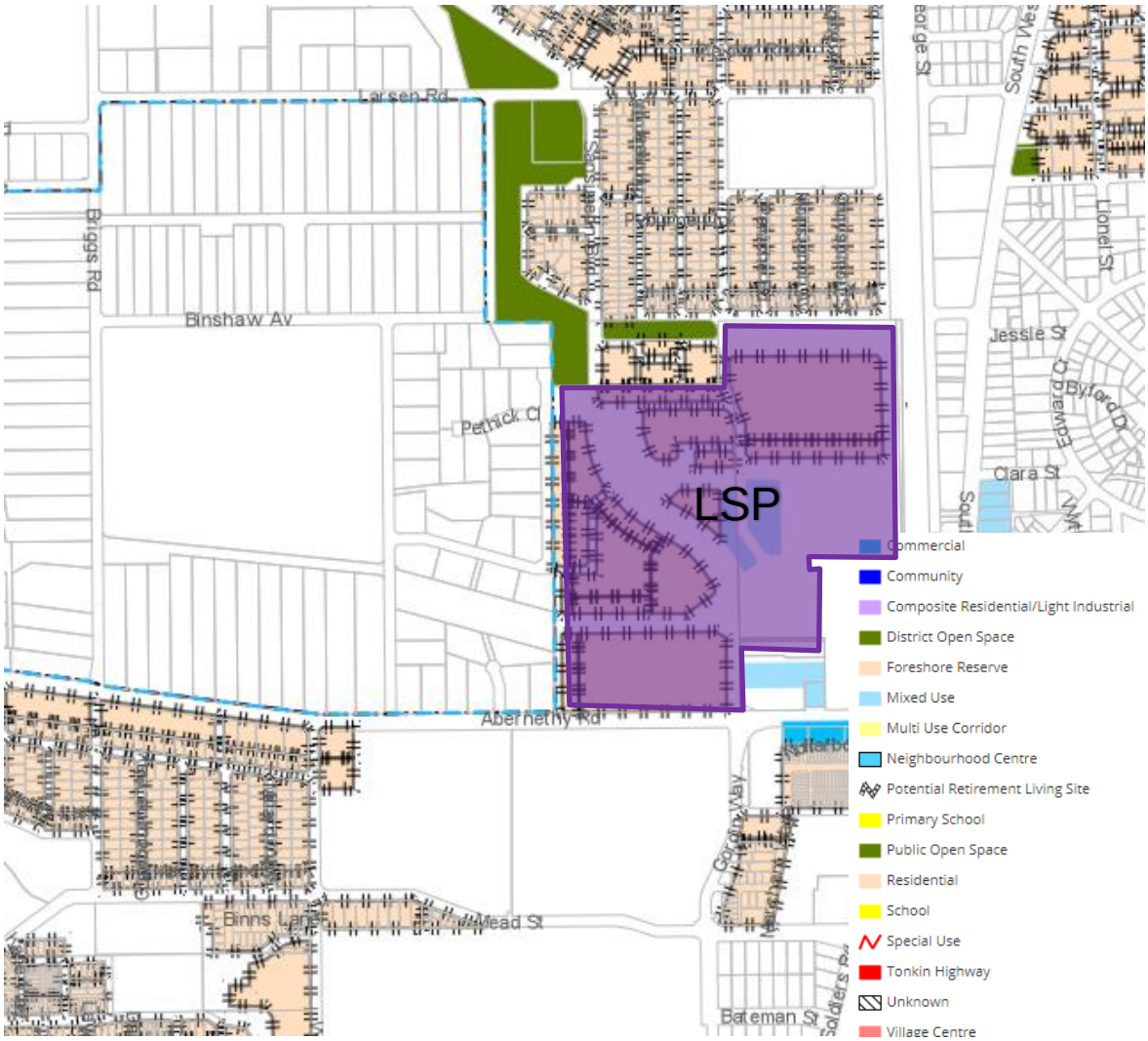
The site is predominantly zoned as urban at present under the Metro Region Scheme shown in **Figure 3-1** and is zoned as 'Residential' under the Local Structure Plan as shown in **Figure 3-2**.

Figure 3-1 Zoning



Source: Metro Region Scheme

Figure 3-2 Zoning

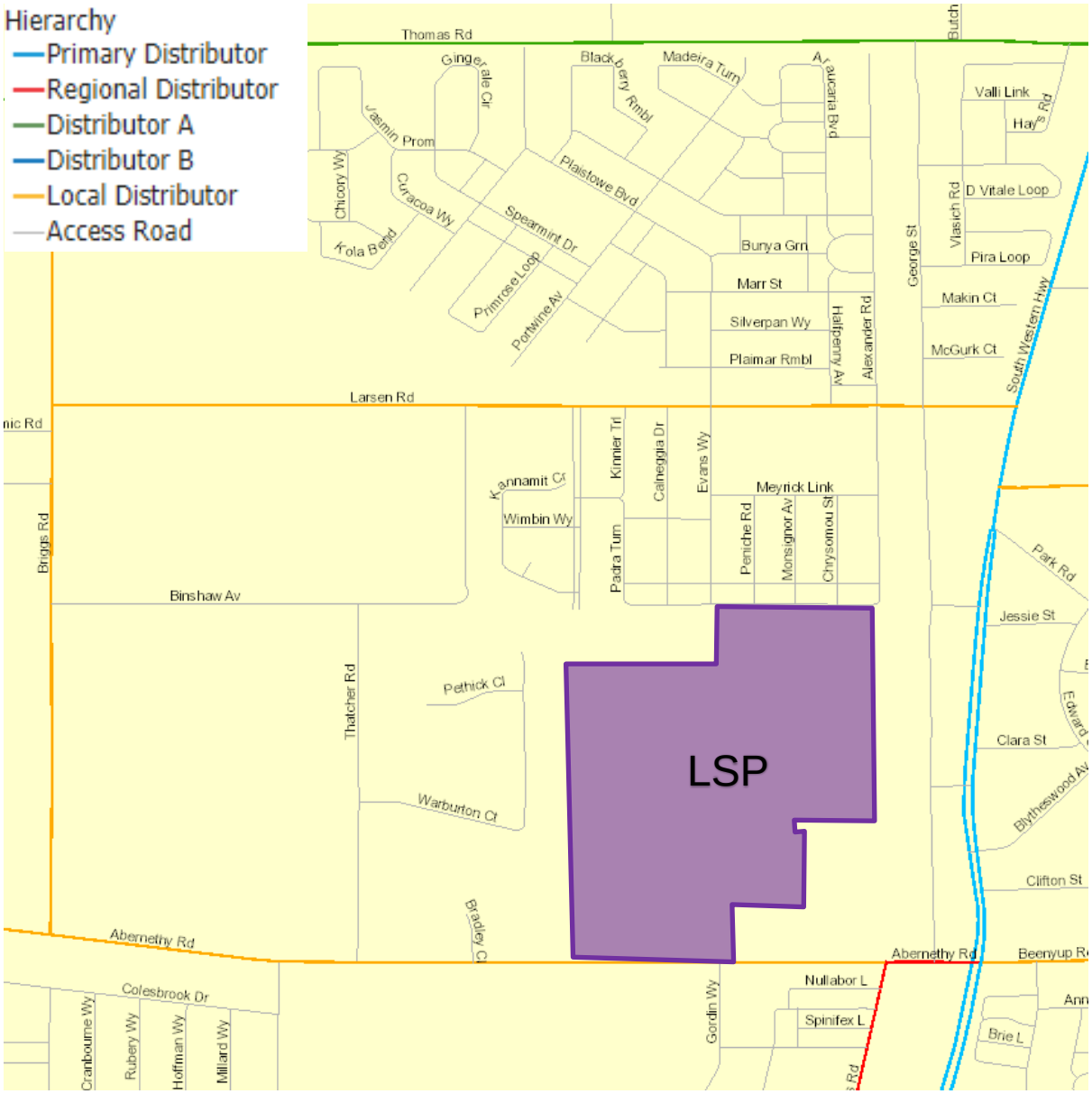


Source: Local Structure Plan

3.2 Existing Road Network

The layout and classification of the roads under the *Main Roads WA Road Hierarchy* surrounding the Site is presented in **Figure 3-3**

Figure 3-3 Road Hierarchy



Source: Main Roads WA

The characteristics of the surrounding road network are presented in **Table 3-1.**

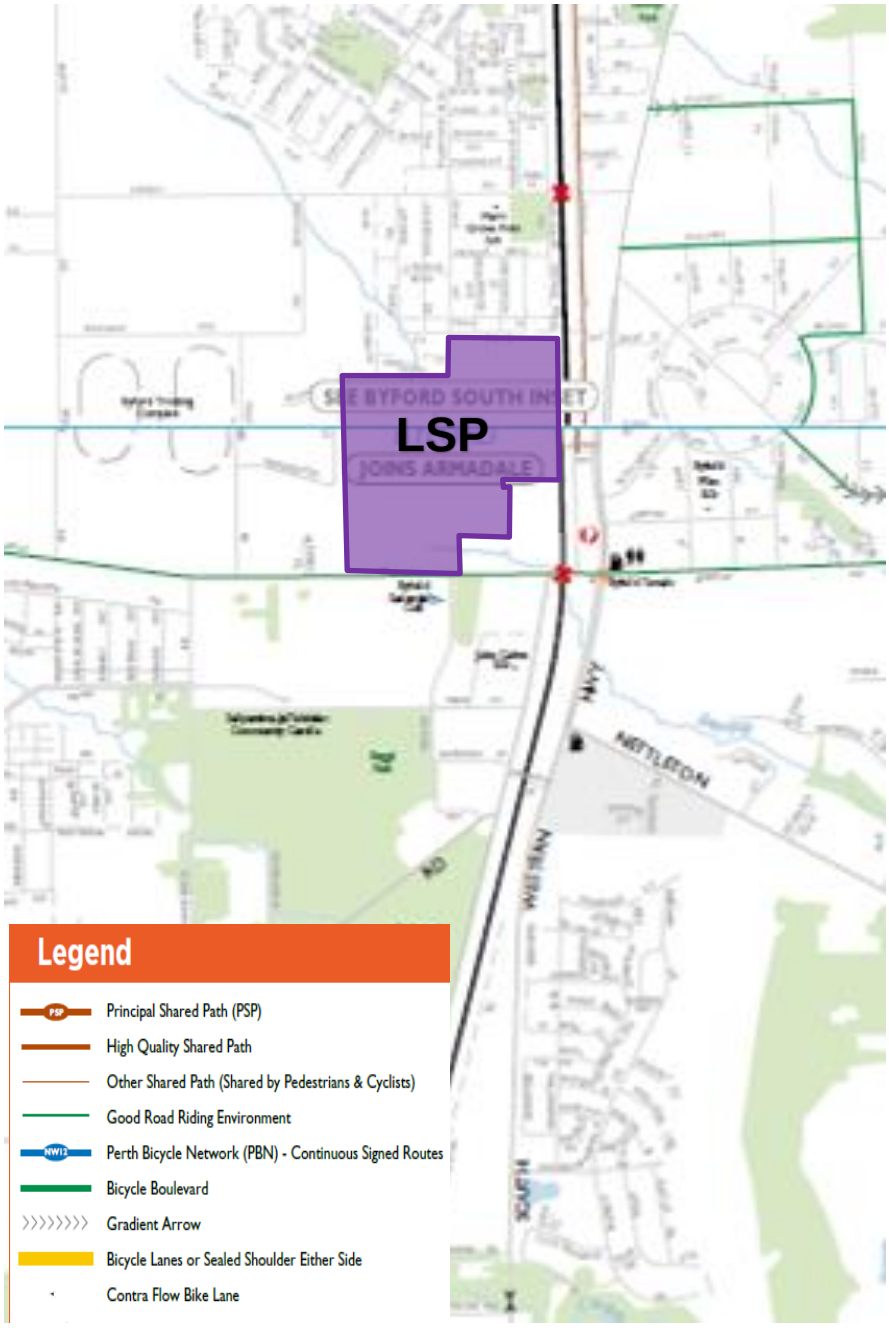
Table 3-1 Road Network Description

Road Name	Road Hierarchy	Jurisdiction	Road Network			
			No. of Lanes	No. of Footpaths	Width (m)	Posted Speed Limit (km/h)
Warburton Court	Access Road	Local Govt.	2	0	6	50
Abernethy Road	Local Distributor	Local Govt.	2 -4	2	9 – 24 (3-6m median)	60
Gordin Way	Access Road	Local Govt.	2	2	7	50
San Simeon Boulevard	Access Road	Local Govt.	2	1	16 (6m median)	50

3.3 Existing Pedestrian/Cycle Network

Existing pedestrian and cycle network are as per **Figure 3-4**. As shown, Abernethy Road is presented as a good road riding environment in the Department of Transport Perth Comprehensive Bike Map. Following the duplication of Abernethy Road, shared paths and seal shoulders are provided along Abernethy Road which will provide a safer riding environment. Shared paths are also available along George Street. Footpaths links will be provided along roads within the LSP connecting with external paths to facilitate pedestrians and cyclists' movements to the nearby facilities and schools.

Figure 3-4 Existing Pedestrian/Cycle Network

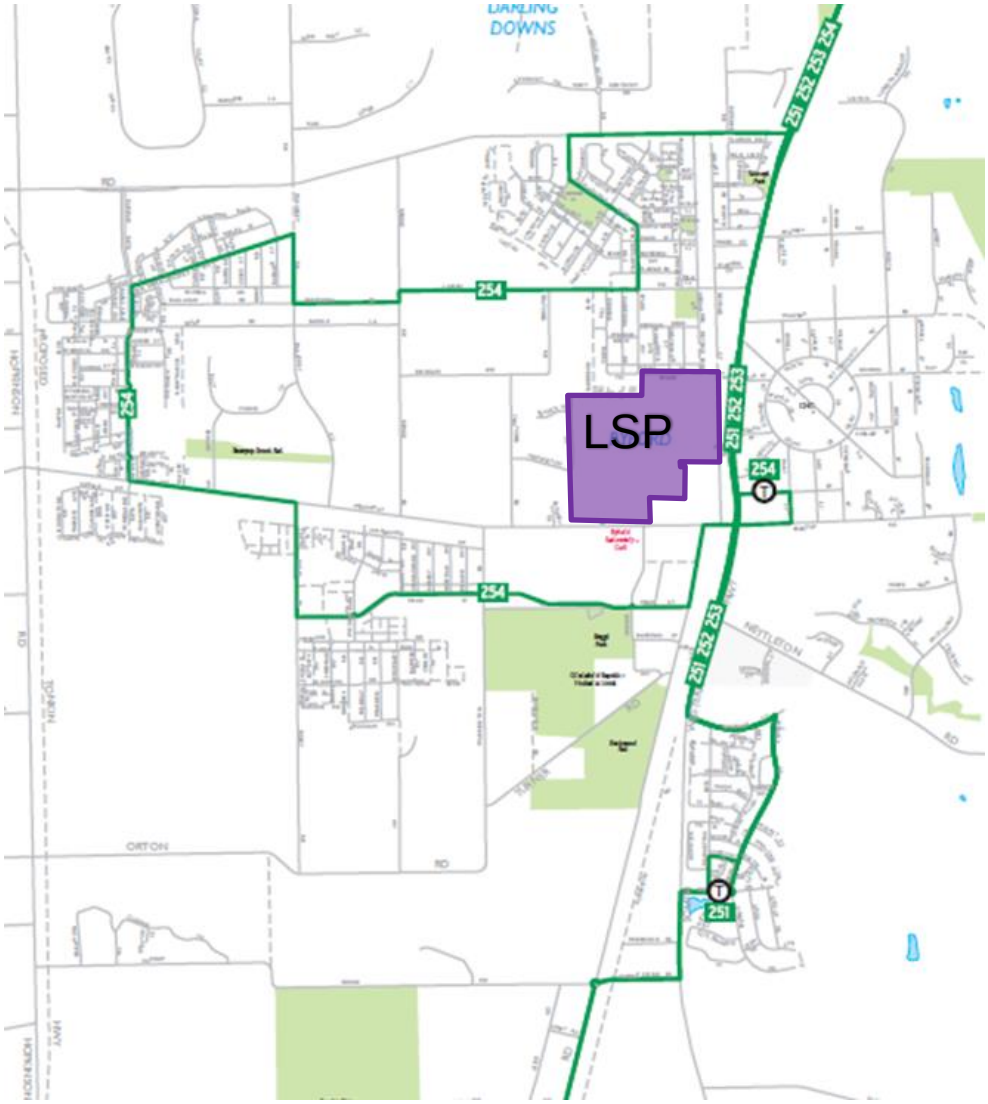


Source: Department of Transport

3.4 Existing Public Transport Services

The existing public transport services surrounding the Site are as shown on **Figure 3-5**. The nearest bus stop is approximately 6-minute walk away (500 m) located on Soldiers Road serving routes 254 to Armadale Station. Another bus stop is located on South Western Highway 10 minutes' walk away (approximately 600 m) served by bus routes 251, 252 and 253. All three of the routes run to Armadale station and route 251 runs to Byford, 252 to Mundijong and route 253 runs to Jarrahdale but only on school holidays. **Table 3-2** shows the bus route frequency.

Figure 3-5 Existing Public Transport



Source: Transperth

Table 3-2 Bus Route Frequency

Bus Route	Route Description	Frequency	
		Weekdays	Weekends
251	To Armadale Station	60-120 minutes (6:33 AM – 11:54 AM)	120 minutes (10:39AM – 6:09PM)
252	To Armadale Station	30-120+ minutes (8:07 AM – 6:54 PM)	120+ minutes (8:39AM – 2:39PM)
253 (mostly operates on school days only)	To Armadale Station	30-120+ minutes (7:03 AM – 8:23 AM)	7:39 AM Service Only
254	To Armadale Station	15-60 minutes (6:17 AM – 7:11 PM)	60 minutes (7:09AM – 5:09PM)

3.5 Existing Traffic Situation

3.5.1 Existing Traffic Volumes

Traffic volumes for the weekdays and the weekend were sourced from *Matrix Traffic Counts* and is given in **Table 3-3**.

Table 3-3 Traffic Volumes

Road Name	Date	Weekday AM Two-Way Traffic	Weekday PM Two-Way Traffic
Abernethy Road (East of Gordin Way)	2018	621	1,810
Abernethy Road (West of Gordin Way)	2018	623	1,767

3.5.2 Crash Assessment

A search of the *Main Roads WA Reporting Centre* for crash data was undertaken. This search covered recorded crashes between 1 January 2016 and 31 December 2020, for the following road sections:

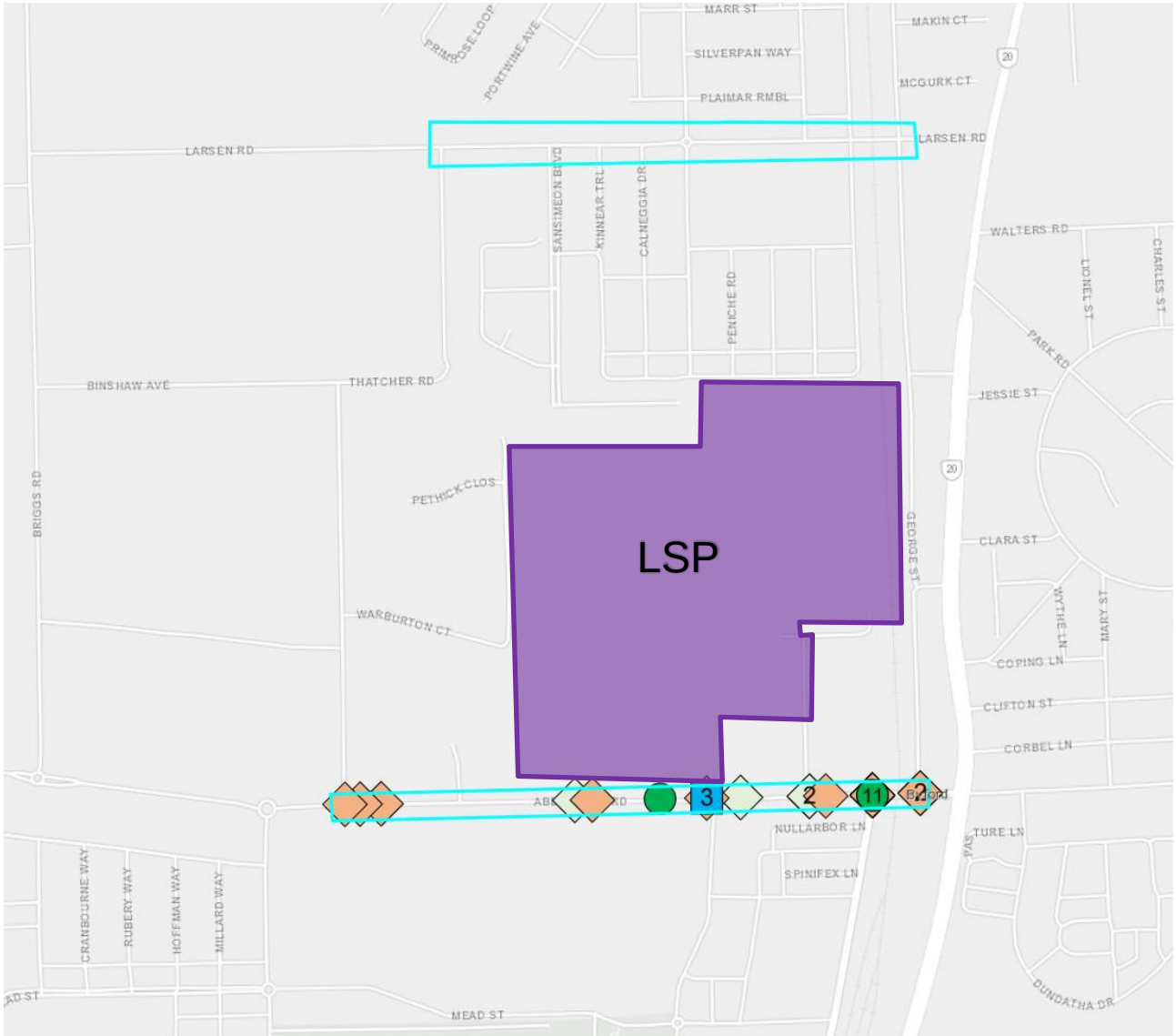
- Abernethy Road (between George Street and Bradley Cl); and
- Larsen Road (between Thatcher Road and George Street)

The crash data outputs are summarised as follows:

- There were no recorded crashes along Larsen Road – between Thatcher Road and George Street
- There were 26 crashes recorded along Abernethy Road – between George Street and Bradley Cl
- One crash required Hospital attention, and 4 required Medical attention
- Majority of the crashes (11) occurred at the intersection of Soldiers Road / Abernethy Road

The crash locations extracted from the *MRWA Crash Map* is shown in **Figure 3-6**.

Figure 3-6 MRWA Crash Map



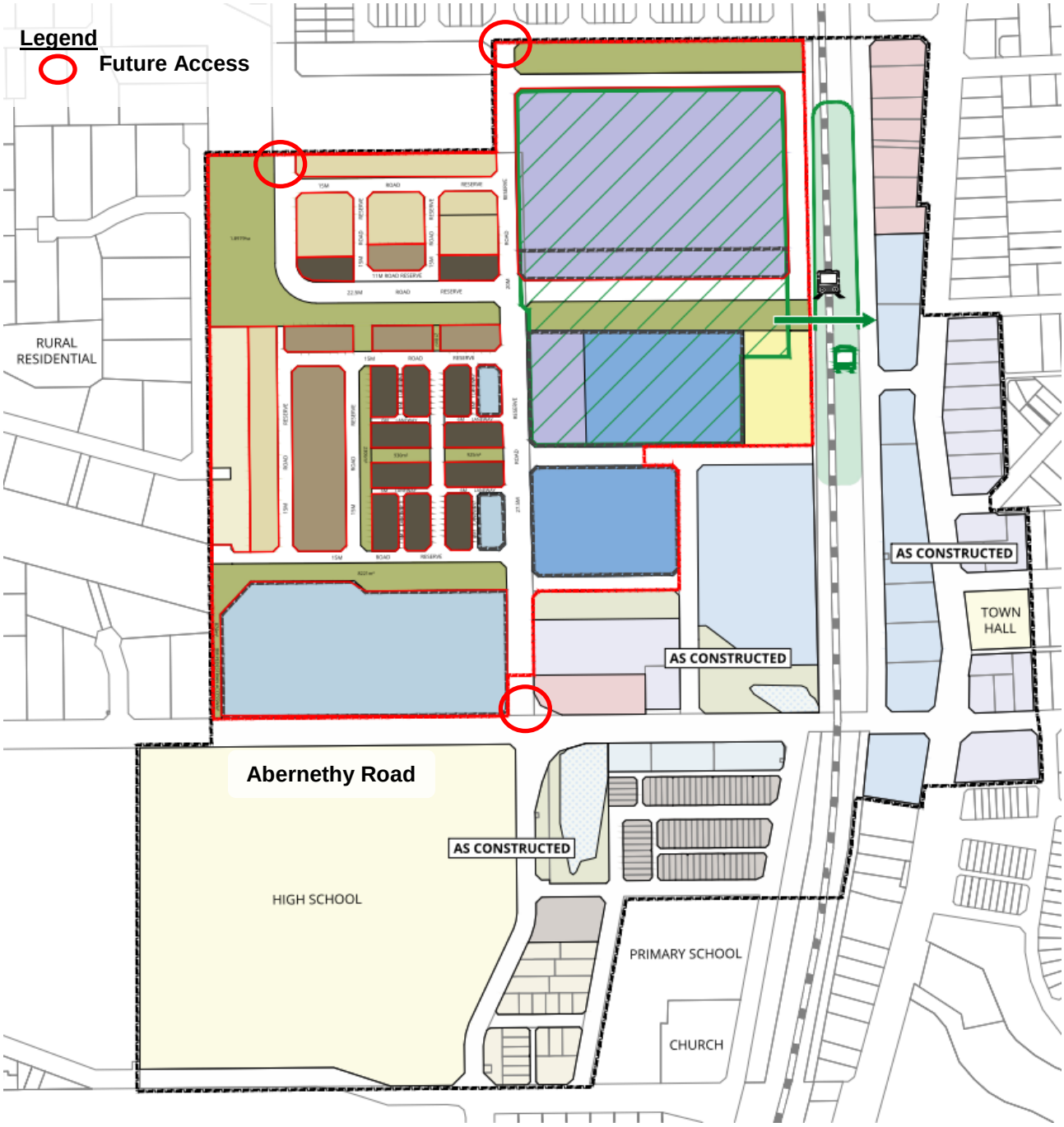
4 Proposed Internal Transport Networks

4.1 Changes to Existing Internal Road Network

New access roads will be constructed within the proposed structure plan to improve connectivity between the commercial and residential components of the Site and the external road network as shown in **Figure 4-1**.

Accesses to the north will connect onto the existing Sansimeon Bvd extension and Evans Way. The LSP will connect onto the existing Abernethy Road / Gordin Way roundabout to provide southern access. The LSP will also connects onto the existing Pioneer Road, which would be used as a secondary southern access. Additionally, there could be a potential connection between Clara Street West and Clara Street East. However, this would require detailed planning of the Railway Station.

Figure 4-1 Future Internal Road Network



4.2 Existing Pedestrian and Cycle Network Changes

Cardno has contacted the relevant authorities and was advised there were no proposed pedestrian/cycle network changes however the surrounding area is likely to go through many future changes. This is further discussed in **Section 4.6**.

4.3 Existing Public Transport Network Changes

Cardno has contacted the Public Transport Authority and was not advised of any proposed public transport network changes. The changes for the whole area are discussed in **Section 4.7.**

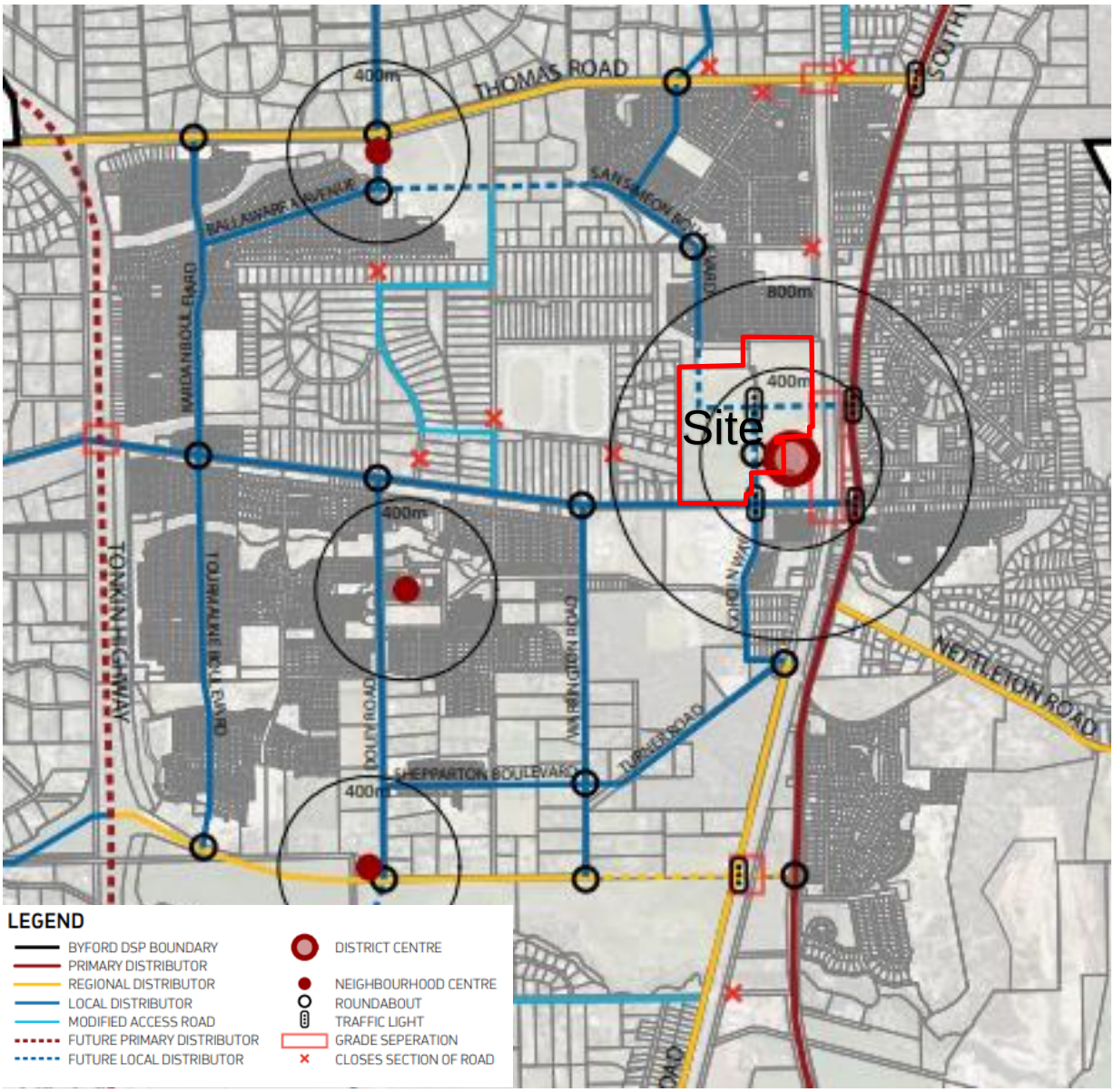
4.4 Intersection Controls

The intersection of Clara West and San Simeon Boulevard are required to be designed as a roundabout of at least 15m outside radius as per *Liveable Neighbourhoods Element 2 R66* and in accordance with approved standards and PTA requirements. The 3 way give-way controlled intersection of Abernethy Road and Gordin Way was proposed to be re-designed to a four-way signalised intersection with the addition of a northern leg (San Simeon Boulevard) however it has now been constructed as a four-way intersection controlled by a roundabout. It should be noted that due to the chosen geometry of the now existing roundabout, widening of the northern approach leg on San Simeon Boulevard to allow for separate right and left turning lanes is not able to be accommodated without encroaching onto the adjacent Woolworths site.

4.5 Changes to Existing External Road Network

As per the *Byford District Structure Plan*, the changes to the road network beyond the local structure plan area are as shown on **Figure 4-2.** This includes new and upgraded primary distributor and integrator arterial roads such as the extension of Tonkin Highway and the extension of Gordin Way to San Simeon Boulevard controlled by a roundabout at the intersection of Abernethy Road. As part of Detailed Metronet Planning and Design, a potential connection between Clara Street East and Clara Street West has been planned.

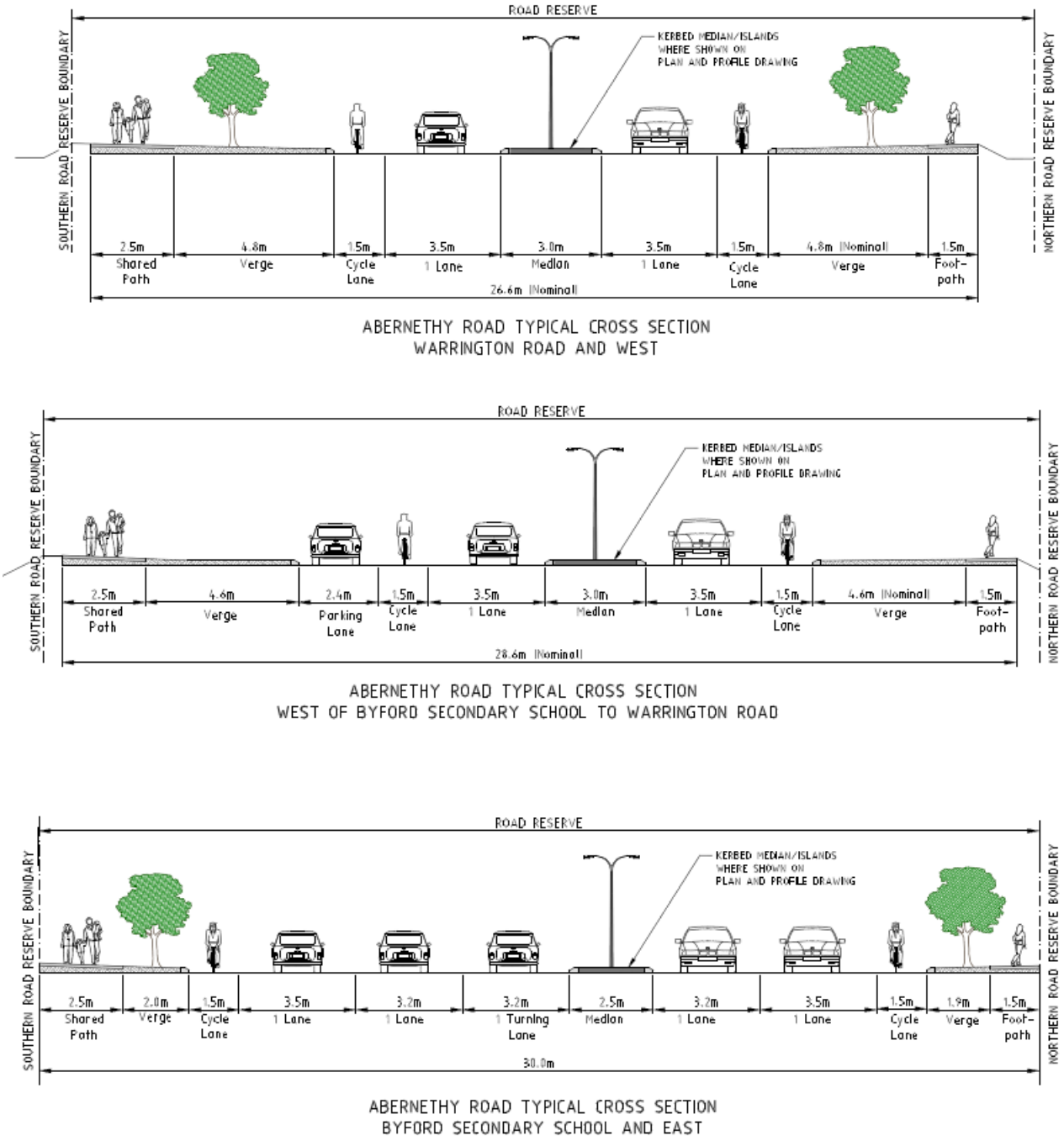
Figure 4-2 Changes to External Road Network



Source: Byford District Structure Plan December 2018

Figure 4-3 shows the road cross sections of the proposed Abernethy Road upgrade.

Figure 4-3 Proposed Abernethy Road Cross Sections

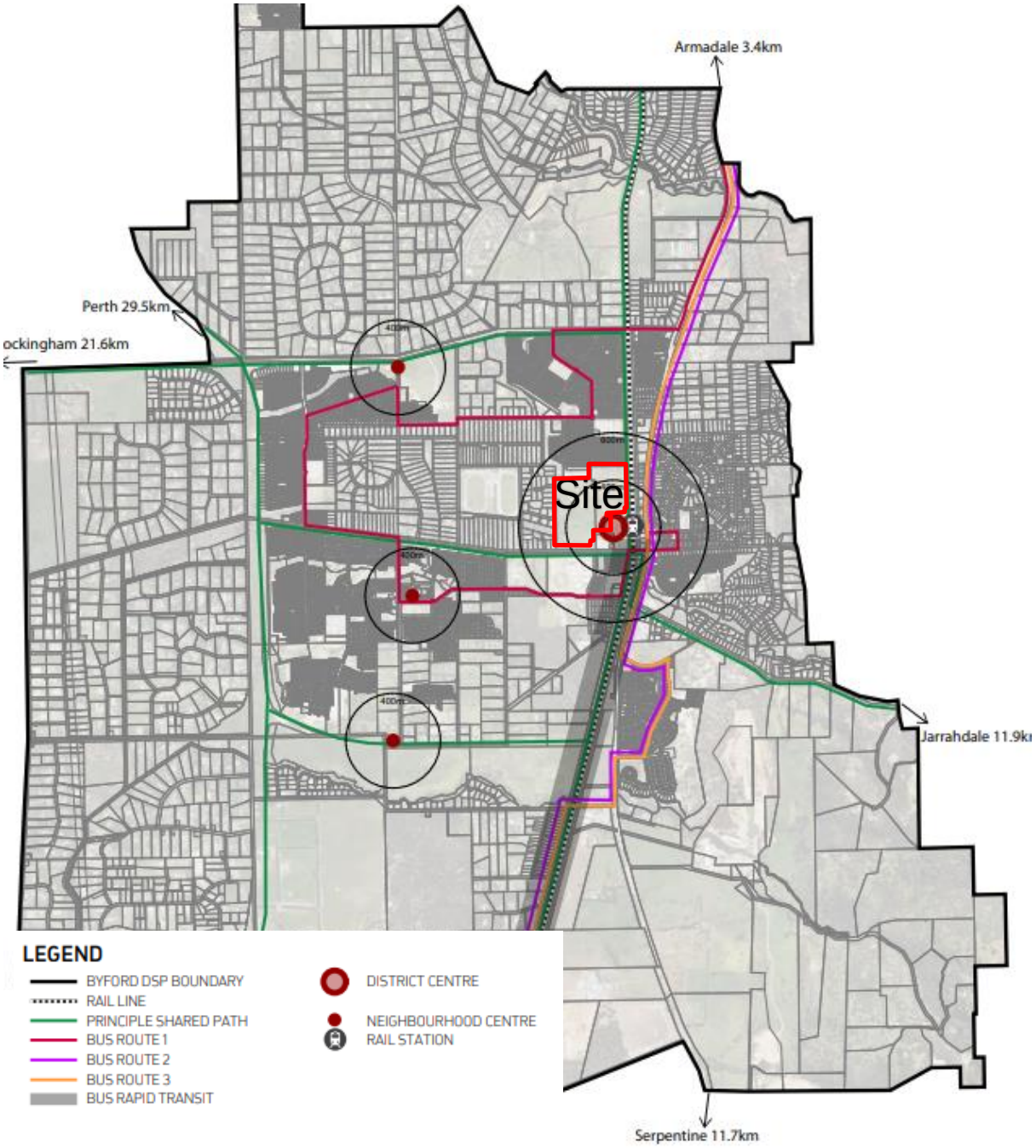


Source: Shire of Serpentine Jarrahdale

4.6 Pedestrian and Cycle Network Changes

Figure 4-4 shows the proposed active transport for the area surrounding the local structure plan. As per the *Byford District Structure Plan* a Principal Shared Path is to run along Abernethy Road. These routes will include dedicated cycle infrastructure that is integrated with the existing Perth Bicycle Network.

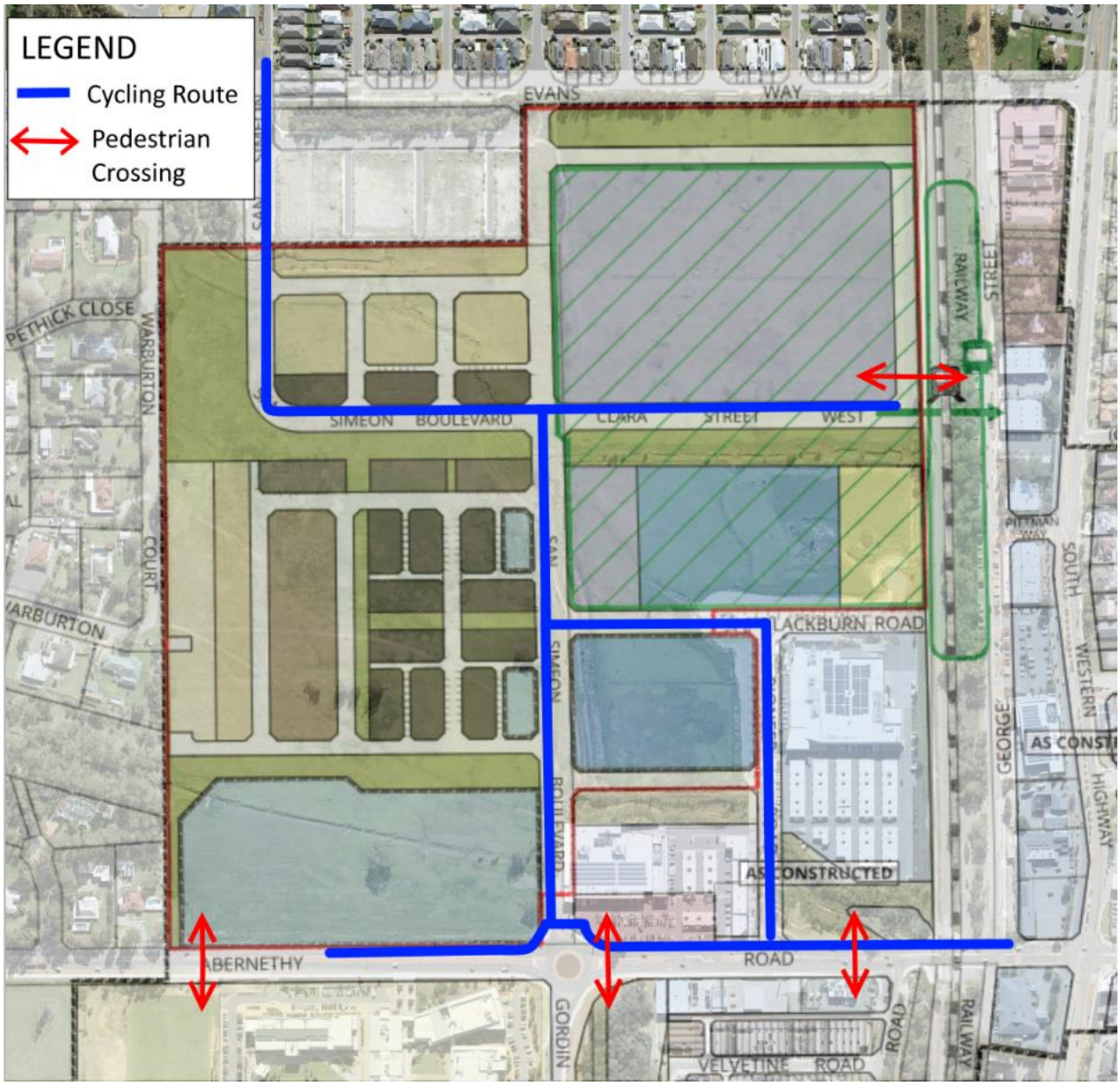
Figure 4-4 Proposed Active Transport



Source: Byford District Structure Plan, December 2018

The potential pedestrian crossings connecting between the LSP and adjacent road network, and internal cycling route within the LSP is illustrated in **Figure 4-5.**

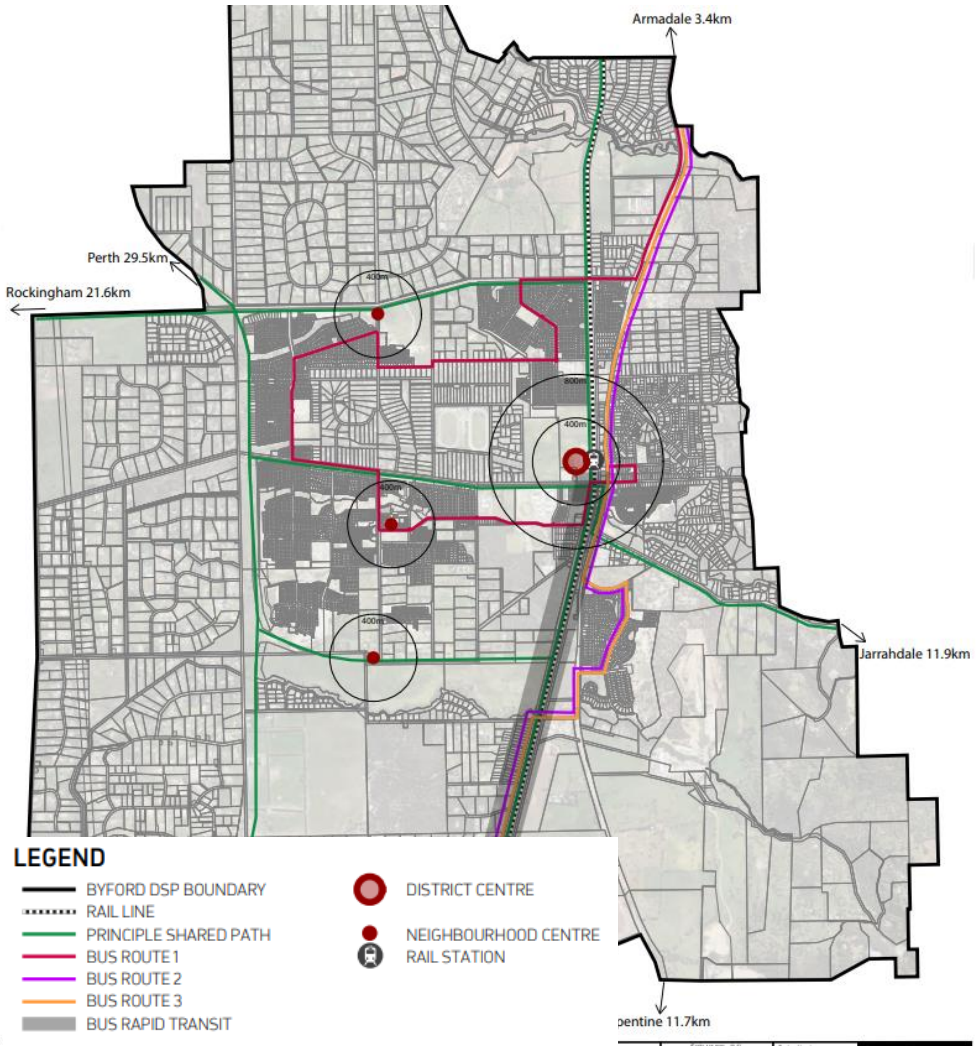
Figure 4-5 Internal Pedestrian and Cycling Facilities



4.7 Public Transport Network Changes

Figure 4-6 shows the changes to the external active transport network and public transport network according to the *Byford District Structure Plan*. Passenger rail expansion to Byford is proposed under the Stage 1 Metronet proposal to extend the Armadale Train Line to Byford. The passenger rail will be supported by a network of feeder bus services to reduce the number of car trips generated by the district.

Figure 4-6 Changes to External Public Transport and Active Transport Network



Source: Byford District Structure Plan, December 2018

According to the Metronet project web page, the concept design is underway for the Byford Rail Extension, which will look at:

- a new ground level Byford Station within the future Town Centre, approximately 400 metres north of Abernethy Road;
- up to 600 passenger parking bays, new bus interchange and a new pedestrian connection across the rail line accessible from the station;

At this time, no proposed layout of the station is currently available on the project page. Due to this uncertainty, it is recommended that a further Traffic Assessment be undertaken to specifically consider the requirements and impacts generated by the Train Station, once the final station configuration is determined. The assessment should consider the needs for connecting bus services, passenger vehicle parking needs and universal pedestrian and cyclist access. Road Safety Audits undertaken during the various design stages of the station project would also be beneficial.

5 Integration with Surrounding Area

5.1 Surrounding Attractors/Generators

The future generators for the Site include the surrounding residential areas and the schools, particularly generating traffic to the commercial and retail components of the Site.

The attractors include the surrounding supermarkets and other retail/food and beverage and commercial stores located in the Byford Town Centre. The schools including the Byford Secondary College, Byford John Calvin School and Salvado Catholic College which may be an attractor for families residing within the proposed LSP. The future Byford train station will also become an attractor once constructed.

5.2 Proposed Changes to Surrounding Land uses

The surrounding area is to remain as rural and urban development whilst increasing the density codes around the Town Centre.

5.3 Level of Accessibility

Access into the structure plan area will be via new access roads from Abernethy Road and other future road connections as discussed in **Section 4.1**.

5.4 Travel Desire Lines between the Structure Plan and Surrounding Land Uses

The main travel desire lines between the LSP and the surrounds will be likely via the Abernethy Road, to the east and west of the Site and South Western Highway for north and south access, via San Simeon Boulevard / Larsen Road intersection to the north, and San Simeon Boulevard / Abernethy Road intersection to the south.

The traffic generation of the Site is not expected to have significant impact on the existing road network. The existing road network will be able to cater for the travel desire lines between the Site and the surrounding land uses.

Pedestrian desire lines will follow a similar route, with the bulk of pedestrian traffic accessing the LSP via the path links along Abernethy Road, with a 1.5m foot path currently existing within the northern verge and a 2.5m shared path within the southern verge.

Adjacent to the LSP site, Abernethy road is predominately a single lane in each direction separated with a 3.0m wide median. Future widening to 4 lanes is expected. Pedestrian crossing points exist at the western end of the LSP frontage, at both east and west approaches to the San Simeon Boulevard / Abernethy Road roundabout and further crossing points to the east near Pioneer Road and Soldiers Road.

It is expected that traffic volumes along Abernethy Road will increase from around 900 vph during the PM peak 2 way flow to 1457 vph by 2031. Assessment of this scenario against table 2 within the WAPC Transport assessment guidelines shows that pedestrians will start experiencing difficulties in crossing a 4 lane divided road once volumes exceed 1600 vph 2 way flow. As such, Pedestrians crossing mid-block to or from the LSP across Abernethy Road should be able to do so with limited delay.

None of the internal LSP roads are expected to carry sufficient traffic volume to create pedestrian difficulties when crossing during the peaks.

6 Analysis of Transport Network

6.1 Assessment Years and Time Periods

Peak times selected are 8:00 am – 9:00 am and 3:00 pm – 4:00 pm respectively for the morning and afternoon peak periods based on the current network peaks. The following model scenarios have therefore been analysed for the intersection of Abernethy Road/Gordin Way and Abernethy Road/Pioneer Road as part of this assessment:

- Scenario 1 – Existing traffic without proposed development (AM and PM).
- Scenario 2 – 2031 Future traffic with proposed developments (AM and PM).

6.2 Traffic Distribution

Trip generation has been calculated for the proposed development utilising trip generation rates from the *Institute of Transportation Engineers (ITE) "Trip Generation" 10th Ed* and *WAPC Transport Impact Assessment Guidelines Volume 5*. **Table 6-2** provides the trip generation rate during the AM and PM peak hours based on the *WAPC TIA Guidelines'* trip generation rates and **Table 6-3** states the total trip generation for the proposed redevelopment.

The number of future dwellings is yet to be finalised therefore an estimation is made based on the following yield as per R-Codes using the minimum area per dwelling as shown in **Table 6-1**.

R10: average site area of 1000 m^2 per dwelling and minimum of 875 m^2

R30: average site area of 300 m^2 per dwelling and minimum of 260 m^2

R40: average site area of 220 m^2 per dwelling and minimum of 180 m^2

R60: average site area of 150 m^2 per dwelling and minimum of 120 m^2

R80: average site area of 120 m^2 per dwelling and minimum of 100 m^2

Table 6-1 Estimated number of Dwellings

Density Code	Total Area (m^2)	Approximate No. of Dwellings
R10	9,500	11
R30	23,350	90
R40	17,700	99
R80	49,000 + 30,000(mixed use)	490
Total		**690**

Table 6-2 Trip Generation Rate (WAPC TIA Guideline)

Land Use	Yield	ITE Code/Source	AM Peak		PM Peak	
			IN	OUT	IN	OUT
Residential (Dwellings)	~690 dwellings	WAPC	0.2	0.6	0.5	0.3
Commercial (per 100m^2 GFA)	~515 (00's)m^2	WAPC	1.6	0.4	0.4	1.6
Retail (Non-Food) * (per 100 m^2 GFA)	~158 (00's)m^2	WAPC	1	0.25	2	2
Retail (Food) * (per 100 m^2 GFA)	~119 (00's)m^2	WAPC	2	0.5	5	5

The land use yield for non-residential developments are estimated to be 70% of the total land use area shown within the LSP. This is expected to take into consideration of the potential non-trading area such as car park, alfresco, back-of-house and storages. It is expected that 30% reduction of the land use yield would still be considered as robust assessment.

Table 6-3 Total Trip Generation

Land Use	AM Peak		PM Peak	
	In	Out	In	Out
Residential	192	576	480	288
Commercial	342	86	86	342
Retail (Non-Food) *	220	55	440	440
Retail (Food) *	190	48	475	475
Sub-total	**944**	**764**	**1481**	**1545**
Total	**1,709**		**3,026**	

The proposed structure plan represents a total two-way trip generation of approximately **1,709 vehicles during the AM peak hour** and **3,026 vehicles during the PM peak hour.**

It is noted that the Byford Train Station will be constructed in the near future as part of Metronet network upgrades, located to the east of the LSP along South Western Highway. Due to the close proximity of the future train station, it is expected that a proportion of the vehicular trips generated by the Site will be shifted to public transport upon the completion of the Byford Station.

For the purpose of this assessment, a 5% reduction to the total vehicle trips generated by the LSP has been applied. This reduction would result in a net trip generation of **1,623 vehicles and 2,875 vehicles during both AM** and **PM peak hours respectively.**

The daily trip generation of the LSP has been derived from the peak hour traffic generation, summarised in **Table 6-4**.

Table 6-4 Estimated Daily Trips Generation

Land Use	Daily Trip Generation
Residential	~5,000 VPD
Commercial	~4,500 VPD
Retail (Non-Food) *	~4,000 VPD
Retail (Food) *	~ 3,000 VPD
Total	**~16,500 VPD**

6.3 LSP Traffic Distribution

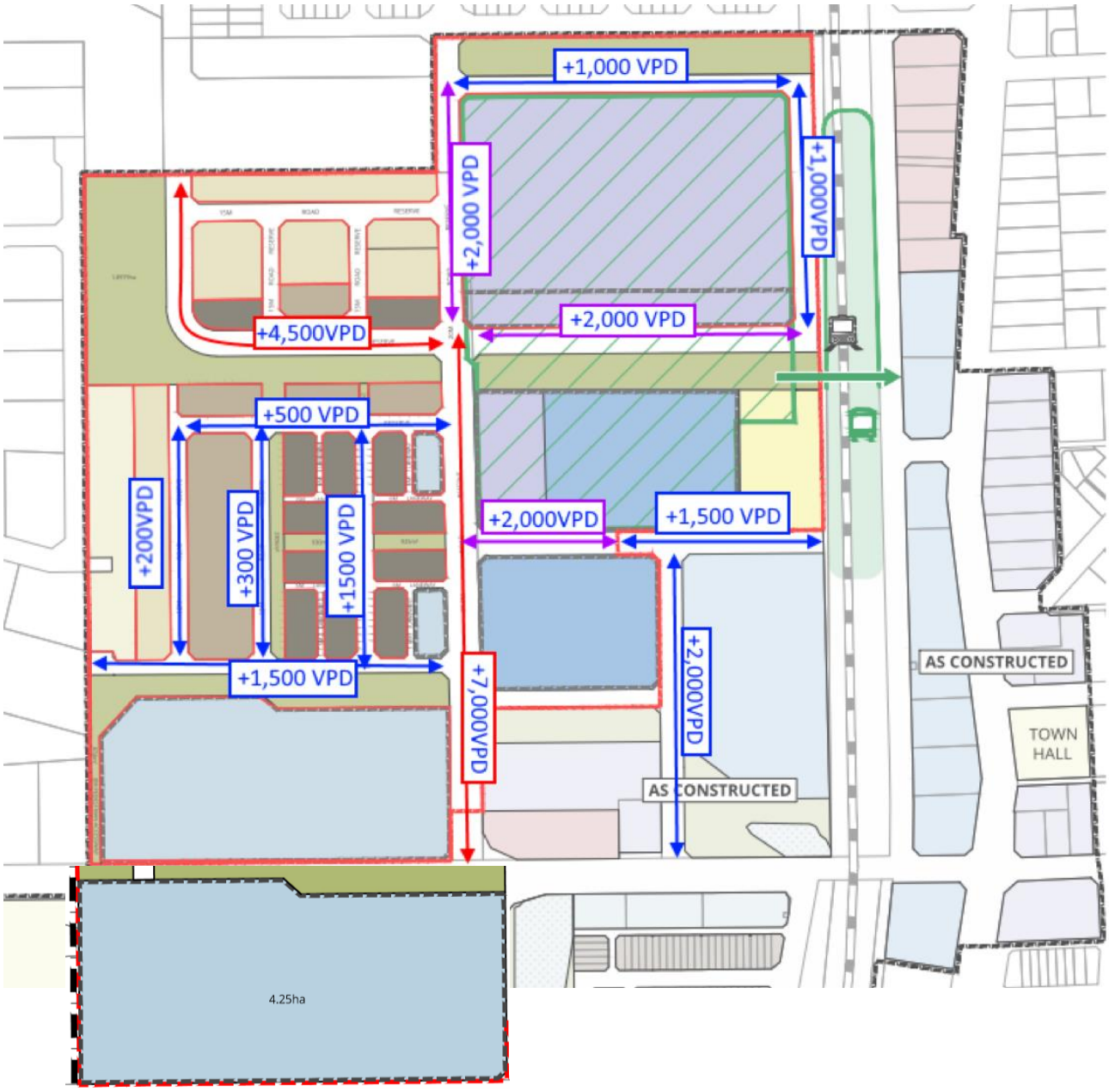
Due to the mixed-use nature of the LSP, it is expected that a proportion of the trips within the LSP will be reciprocal trips, or internal trips (residents visiting non-residential developments within the LSP). For the purpose of this assessment, 25% and 20% of the total trips generated by the residential development and non-residential development are accounted. The anticipated distribution of the trips generated by the LSP is summarised in **Table 6-5**.

Table 6-5 Anticipated trip distribution

	North	South	West	East	Internal
Residential	25%	15%	15%	20%	25%
Commercial	30%	10%	25%	25%	20%
Retail (non-food)	30%	10%	25%	25%	20%
Retail (food)	30%	10%	25%	25%	20%

Figure 6-1 shows the estimated daily traffic generated by the LSP distributed onto surrounding roads.

Figure 6-1 Estimated Daily Traffic Volume and Distribution

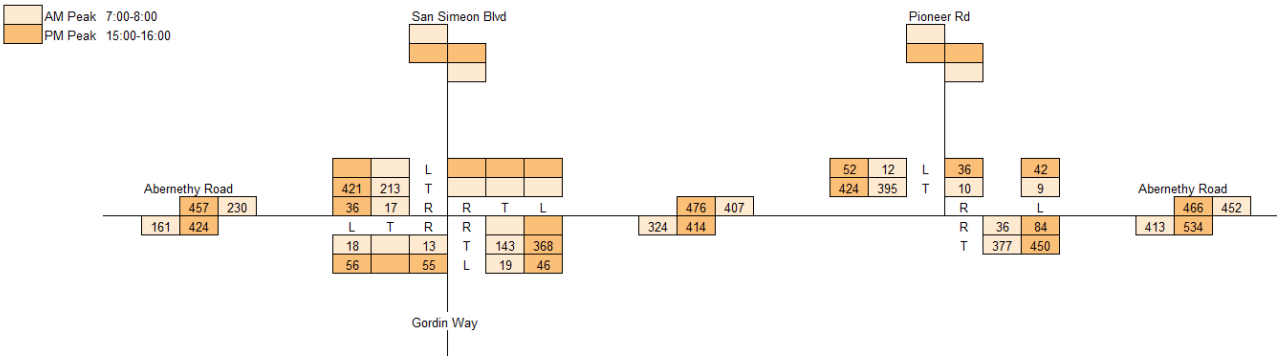


6.4 Traffic Distribution

The existing background traffic data was obtained from the *Matrix Traffic Survey* which assisted in the traffic analysis of the intersection of Abernethy Road and Gordin Way and the intersection of Abernethy Road and Pioneer Road.

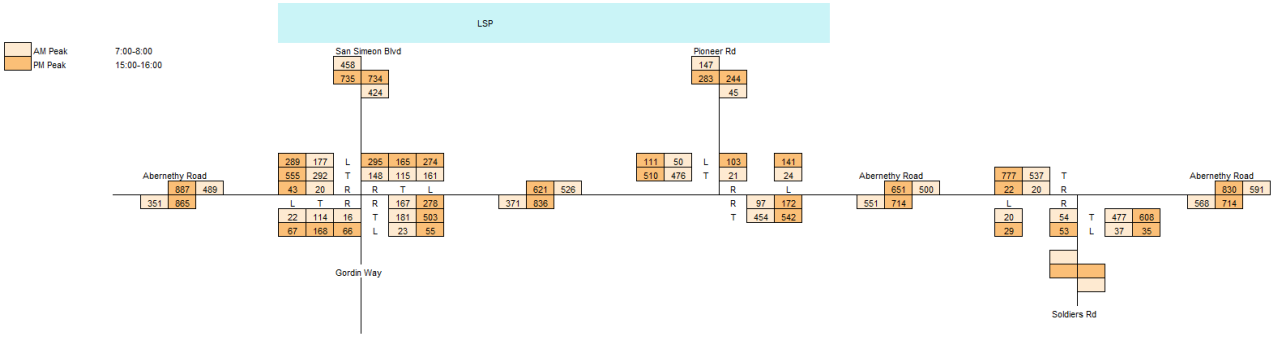
Figure 6-2 shows the adopted background traffic volumes for the AM and PM peak operation hours of the intersections.

Figure 6-2 Existing 2019 Traffic Distribution without Development



Traffic generated was analysed for the development with an assumed completion of full buildout year of 2031. The annual traffic growth of the background traffic is derived from *Main Roads ROM* data which assisted in the traffic analysis and distribution.

Figure 6-3 2031 Traffic Distribution with Development Traffic



6.5 Key Assumptions

The following assumptions were made for the analysis:

- Existing background traffic counts were obtained from Matrix Traffic Survey.
- The annual traffic growth rate along Abernethy Road is derived from the Mainroads ROM data (2021 plot).
- The full development of the LSP is assumed to be completed by 2031.
- When Matrix traffic survey was conducted, the layout of the key intersection did not consist of San Simeon Boulevard, therefore traffic volumes on the northern road (San Simeon Boulevard) of the intersection were not available. San Simeon Boulevard currently only provides access to Woolworths supermarket therefore the trip generation rates from the *Institute of Transportation Engineers (ITE) "Trip Generation" 10th Ed* were used to calculate the vehicular trips to Woolworths from the surrounding road network. This was then used as the background traffic volume on San Simeon Boulevard.
- The directional split of traffic to and from Woolworths was assumed based on the anticipated driver behaviour/tendencies with consideration for the location of major arterial roads, location of key generator/attractors and travel time/distance.
- The number of future dwellings is unknown therefore an estimation is made based on R-Codes using the minimum area per dwelling. The total number of residential dwellings is estimated to be approximately 960 dwellings.
- The Gross Floor Area used to calculate the traffic generation for retail and commercial developments are estimated to be 70% and 50% of the gross area shown in the LSP respectively.
- The peak periods were 8:00 to 9:00 am and 3:00 to 4:00 pm as per the network peak provided on Mainroads Traffic Map.
- For robust assessment, majority of the southern traffic is assumed to access the LSP via the Abernethy Road San Simeon Blvd / Gordin Way intersection.

6.6 Intersection Performance

SIDRA results for each approach are presented below in the form of Degree of Saturation (DOS), Average Delay, Level of Service (LOS) and 95th Percentile Queue. These characteristics are defined as follows:

- **Degree of Saturation (DOS)**: is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The theoretical intersection capacity is exceeded for an un-signalized intersection where DOS > 0.80;
- **95% Queue**: is the statistical estimate of the queue length up to or below which 95% of all observed queues would be expected;
- **Average Delay**: is the average of all travel time delays for vehicles through the intersection. An unsignalised intersection can be considered to be operated at capacity where the average delay exceeds 40 seconds for any movement; and
- **Level of Service (LOS)**: is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. The different levels of service can generally be described as shown in **Table 6-6.**

Table 6-6 Level of Service (LOS) Performance Criteria

LOS	Description	Signalised Intersection	Unsignalised Intersection
A	Free-flow operations (best condition)	≤10 sec	≤10 sec
B	Reasonable free-flow operations	10-20 sec	10-15 sec
C	At or near free-flow operations	20-35 sec	15-25 sec
D	Decreasing free-flow levels	35-55 sec	5-35 sec
E	Operations at capacity	55-80 sec	35-50 sec
F	A breakdown in vehicular flow (worst condition)	≥80 sec	≥50 sec

6.7 SIDRA Analysis

It is expected that the intersection is currently performing satisfactorily. Hence, it is not included within this assessment. The SIDRA analysis is conducted for the ultimate scenario when full development of the LSP is expected (2031).

The following presents the analysis of the intersection in the future scenario with the development traffic. The intersection of Abernethy Road and Gordin Way has recently been constructed as a roundabout. **Figure 6-4** shows the layout of the intersection in the future and **Table 6-8** shows the results of the analysis. **Table 6-7** shows the SIDRA summary result of Abernethy Road / Pioneer Road Intersection to the east of Abernethy Road / Gordin Way intersection.

Figure 6-4 SIDRA Layout of Abernethy Road/Gordin Way/ San Simeon Boulevard

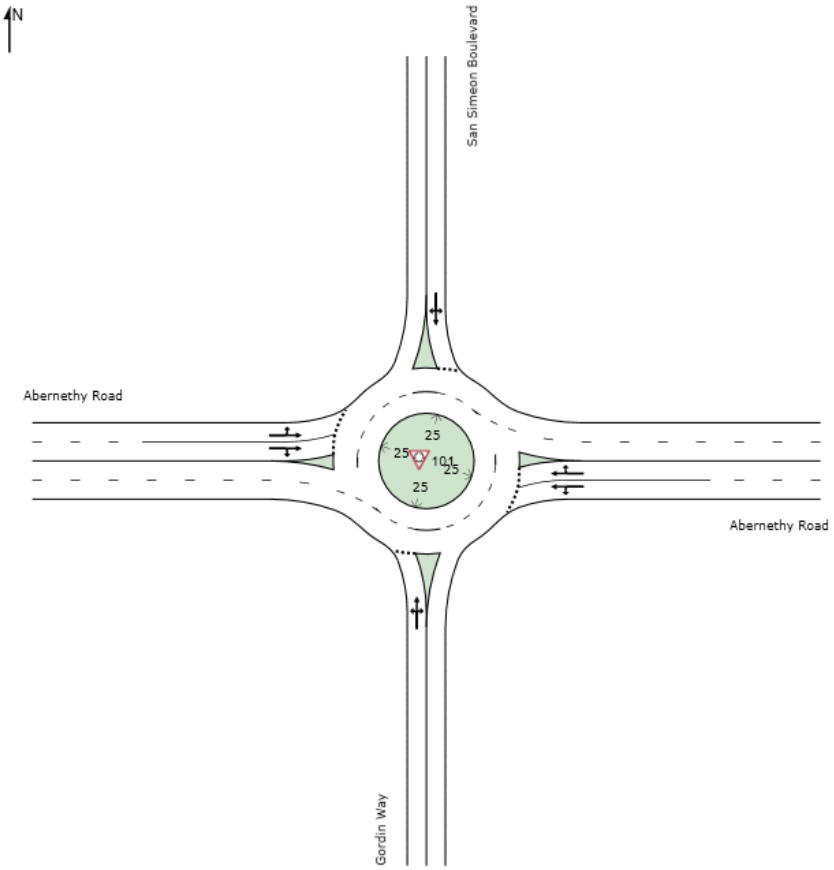


Table 6-7 SIDRA Results - 2031 Traffic with Development - Abernethy Road and Pioneer Road Intersection

Intersection Approach		PM Peak				SAT Peak			
		DOS	Delay (s)	LOS	95% Queue (m)	DOS	Delay (s)	LOS	95% Queue (m)
East: Abernethy Road	T	0.119	0	A	0	0.143	0	A	0
	R	0.138	9.2	A	1.7	0.254	9.7	A	0.6
North: Pioneer Road	L	0.027	6.5	A	0.4	0.128	5.1	A	0.22
	R	0.037	8	A	0.3	0.226	10.2	B	0.68
West: Abernethy Road	L	0.142	5.5	A	0	0.169	5.5	A	0
	T	0.142	0	A	0	0.169	0	A	0
All vehicles		0.142	1.3	A	1.7	0.254	2.6	A	0.13

Table 6-8 SIDRA Results – 2031 Traffic with Development - Abernethy Road and Gordin Way Intersection (2031 + DEV)

Intersection Approach		AM peak				PM Peak			
		DOS	Delay (s)	LOS	95% Queue (m)	DOS	Delay (s)	LOS	95% Queue (m)
South: Gordin Way	L	0.174	4.4	A	2.1	0.516	8.6	A	9
	T	0.174	4.3	A	2.1	0.516	8.5	A	9
	R	0.174	9.3	A	2.1	0.516	13.5	B	9
East: Abernethy Road	L	0.169	4.9	A	2.5	0.489	6.8	A	11
	T	0.169	4.9	A	2.5	0.489	7	A	11
	R	0.169	10.2	B	2.4	0.489	12.5	B	10.6
North: San Simeon Boulevard	L	0.443	4.3	A	7	0.985	34.7	C	73
	T	0.443	4.2	A	7	0.985	34.6	C	73
	R	0.443	9.2	A	7	0.985	39.6	D	73
West: Abernethy Road	L	0.221	5	A	3.1	0.484	7	A	9.8
	T	0.221	5.2	A	3.1	0.484	7.3	A	0
	R	0.221	10.3	B	3.1	0.484	12.7	B	9.7
All vehicles		0.443	6	A	7	0.985	15.9	B	73

6.7.2 Summary of SIDRA Results

- The SIDRA analysis showed that the Abernethy Road / Pioneer Road intersection would perform satisfactorily in the AM and PM peak with Level of Service A.
- The SIDRA analysis showed that the San Simeon Boulevard / Abernethy Road / Gordin Way intersection would perform at an acceptable overall Level of Service A in the AM peak. However, the PM peak would perform at an overall Level of Service B, with the worst Level of Service D for right turning traffic on the northern leg.
- This is mainly due to the commercial and retail traffic expected to exit right-out of the LSP onto the residential developments to the west of the LSP.

Overall, the LSP would result in acceptable level of traffic impact to the surrounding road network, particularly to the San Simeon Boulevard / Abernethy Road / Gordin Way roundabout intersection. The assessment is considered to be very robust as it is assumed that all developments within the LSP would have the same PM peak, which is not accurate in reality.

Given uncertainty with regard to the final configuration of the future Byford Train Station, further modelling of the roundabout at San Simeon Boulevard / Gordin Way / Abernethy Road may be required beyond 2031 to determine if intersection modifications are required to maintain a minimum LOS D. This may include signalisation, subject to Main Roads approval.

7 Summary

This report has been prepared in accordance with the *Western Australian Planning Commission (WAPC) Transport Impact Assessment Guidelines Volume 2 – Planning Schemes, Structure Plans and Activity Centres*.

The following conclusions have been made in regards to the proposed development:

- The proposed structure plan comprises of new road connections, and additional residential, retail and commercial developments.
- The LSP benefits from good existing riding environment along Abernethy Road and aims to provide good shared path pedestrian and cycling facilities.
- The LSP has good access to public transportation, with the provision of bus stops located 6-minute walk away (500 m) located on Soldiers Road serving routes 254 to Armadale Station. Another bus stop is located on South Western Highway 10 minutes' walk away (approximately 600 m away) served by bus routes 251, 252 and 253 to Armadale Station.
- Trip generation and distribution has been undertaken for when the LSP is fully developed.
- Based on SIDRA analysis, during the full build-out of the LSP, the intersection of Abernethy Road and Gordin Way is expected to be slightly impacted during the peak periods. However, the roundabout intersection is still expected to operate with an acceptable Level of Service.
- The intersection of Abernethy Road and Pioneer Road is expected to operate at an acceptable Level of Service A and B during the full build-out of the LSP.
- Overall the proposed LSP would result in minor impact to the surrounding intersections and road network. However, the impact is within manageable Level of Service, and would generally occur during the peak periods only.

APPENDIX

A

WAPC CHECKLIST

Item	Provided	Comments/Proposals
Summary		
Introduction/Background	Section 1	
Structure plan proposal	Section 1	
▪ regional context	Section 1	
▪ proposed land uses	Section 2	
▪ table of land uses and quantities	Section 2	
▪ major attractors/generators	Section 5	
▪ specific issues	Section 3	
Existing situation		
▪ existing land uses within structure plan	Section 3	
▪ existing land uses within 800 metres of structure plan area	Section 3	
▪ existing road network within structure plan area	Section 3	
▪ existing pedestrian/cycle networks within structure plan area	Section 3	
▪ existing public transport services within structure plan area	Section 3	
▪ existing road network within 2 (or 5) km of structure plan area	Section 3	
▪ traffic flows on roads within structure plan area (PM and/or AM peak hours)	Section 6	
▪ traffic flows on roads within 2 (or 5) km of structure plan area (AM and/or PM peak hours)	Section 3	
▪ existing pedestrian/cycle networks within 800m of structure plan area	Section 3	
▪ existing public transport services within 800m of structure plan area	Section 3	
Proposed internal transport networks		
▪ changes/additions to existing road network or proposed new road network	Section 4	
▪ road reservation widths	Section 2, 4	
▪ road cross-sections & speed limits	Section 2, 4	
▪ intersection controls	Section 4	
▪ pedestrian/cycle networks and crossing facilities	Section 4, 5	
▪ public transport routes	Section 4	
Changes to external transport networks		
▪ road network	Section 4	
▪ intersection controls	Section 4	
▪ pedestrian/cycle networks and crossing facilities	Section 4	
▪ public transport services	Section 4	
Integration with surrounding area		
▪ trip attractors/generators within 800 metres	Section 5	
▪ proposed changes to land uses within 800 metres	Section 5	
▪ travel desire lines from structure plan to these attractors/generators	Section 5	
▪ adequacy of external transport networks	Section 5	
▪ deficiencies in external transport networks	Section 5	

▪ remedial measures to address deficiencies	N/A	
Analysis of internal transport networks		
▪ assessment year(s) and time period(s)	Section 6	
▪ structure plan generated traffic	Section 6	
▪ extraneous (through) traffic	Section 6	
▪ design traffic flows (ie. total traffic)	Section 6	
▪ road cross-sections	Section 6	
▪ intersection controls	Section 6	
▪ access strategy	Section 4	
▪ pedestrian / cycle networks	Section 4	
▪ safe routes to schools	Section 5	
▪ pedestrian permeability & efficiency	Section 4	
▪ access to public transport	Section 4	
Analysis of external transport networks		
▪ extent of analysis	Section 6	
▪ base flows for assessment year(s)	Section 6	
▪ total traffic flows	Section 6	
▪ road cross-sections	Section 6	
▪ intersection layouts & controls	Section 6	
▪ pedestrian/cycle networks	Section 6	
Conclusions	Section 7	

12 May 2021

Your Ref:
Our Ref: H18079Av6

Department of Water and Environmental Regulation
107 Breakwater Pde
Mandurah WA 6210

ATTENTION: Mark Hingston

Dear Mark,

RE: ABERNETHY RD LOCAL WATER MANAGEMENT STRATEGY ADDENDUM

This local water management strategy (LWMS) addendum has been prepared by Hyd2o on behalf Aigle Royal in support of the revised local structure plan (LSP) that has been prepared for the site.

The approved *Byford Town Centre Local Water Management Strategy* (LWMS)(GHD, 2014) was prepared for the site which outlines the overall water management strategy for the area including principles, objectives, description of the pre-development environment, a water conservation strategy, groundwater management strategy, monitoring and implementation.

This addendum seeks to update the LWMS to align the stormwater management strategy with both the updated LSP and the *Byford District Water Management Strategy* (DWMS) (Urbaqua, 2018).

The DWMS provides the overall approach to water management for the site with associated arterial drainage modelling. This addendum seeks to provide support for the revised LSP and bring stormwater management principles for the site both in line with the overarching DWMS and utilising the current Australian Rainfall and Runoff (ARR)(Geoscience Australia, 2016) design rainfalls and temporal patterns.

1. STORMWATER MANAGEMENT STRATEGY

Stormwater management will be undertaken consistent with DWER water sensitive design practices. The system will consist of lot soakwells, subsoil drainage, piped road drainage system, biofiltration areas, and both Oaklands Drain and Beenyup Brook realigned and reconfigured as a living stream to provide water quantity and quality treatment for stormwater generated from the proposed development and the external catchment.

Given the size of the site, the LWMS has focused on providing detail associated with modelling of the arterial drainage system and ensuring space requirements for drainage are adequately provided in POS. There will be opportunities for median swales and other WSUD measures in wider road reserves and within MUCs and these measures will be appropriately investigated at UWMP stage as detailed engineering progresses.

Key elements of the proposed system refine the strategy presented in the DWMS (Urbaqua, 2018) which are reflected in the LSP including:

- Maintenance of existing surface water flow paths for Beenyup Brook and Oaklands Drain (both the North and South branches).

- Creation of a link to divert flows from Beenyup Brook towards Oakland Drain to assist with alleviating flooding downstream as outlined in the DWMS (Urbaqua 2018).
- Discharge from the site provided in the DWMS are 11.5 m^3/s at Oaklands Drain and 3.5m^3/s at Beenyup Brook for the 1% AEP.
- There are no offline stormwater detention areas proposed for the site. Subdivisional drainage will utilise the online storage of the district drainage network as the critical duration from the subdivision is1hr whereas the critical duration for the regional flows provided by Urbaqua is 3hrs.
- The combination of regional and local food storage within the living stream is proposed to minimise the overall stormwater impact on POS and improve the characteristics of multiple use corridors and the living stream configuration.
- Should the design of the commercial area along Abernethy Rd propose an access road a culvert should be sized to convey the roadside drainage within the UWMP.

This stormwater management concept and post development catchment mapping for the LSP is shown in Figure 1 and Figure 2. This approach is considered the most efficient for the site in terms of maximising usable POS within the established MUCs within the site. The realignment of Beenyup Brook and Oaklands Drain (South) has been undertaken consistent with upstream and downstream planning. Oakland Drain North design is consistent with what is presented in the DWMS.

2. STORMWATER MODELLING

Stormwater modelling for the site was performed using XP-Storm to determine flood storage requirements and provide an assessment of drainage requirements to support the proposed LSP.

The design storms modelled by XP-Storm were calculated internally by the model with reference to the methodology in ARR 2016 and the Bureau of Meteorology Computerised Design IFD Rainfall System. The rainfall temporal pattern was assumed to be spatially uniform across the catchment.

Storm durations modelled ranged from 15 min to 72 hours and are inclusive of all temporal patterns consistent with ARR 2016.

External flows from the site were input as user generated hydrographs and provided to Hyd2o by Urbaqua (with the exception of Oaklands Nth where steady state flows were used for modelling). The hydrographs provided by Urbaqua included post-development subdivisional flows of the Byford Townsite and regional flows for Oakford Drain and Beenyup Brook. They consisted of the 1% and 20% AEP flows. The hydrographs provided also utilised the rainfall data from ARR 2016.

The methods above were run simultaneously to simulate the impact and timing of the subdivisional drainage and the regional drainage to appropriately size flood storage infrastructure cognisant of the different critical durations of the catchments.

The following runoff rates have been used in modelling of the 20% and 1% average exceedance probability (AEP) event (also in Table 1).

- Road and road reserve 80%
- R30 and R40 lots 40%
- R60, R80, Town Centre, Mixed Use and Commercial Areas 80%
- R10 lots 20%
- Public Open Space 20%

3. FLOOD PROTECTION (1% AEP EVENT)

Modelled flood protection storage volumes and areas are detailed in Table 2 and Figure 2 shows the extent of inundation of POS area for various flood management events. The impact of the TWL is shown accurately and to scale in all figures relative to the total POS area and plans based on the proposed widths of the living stream.

All living streams and their flood protection functionality are modelled to suit the arterial drainage strategy and are sized to convey, detain and/or redirect flows from outside the study boundary. The flows generated from the subdivision post development are small in comparison to the design of the MUC corridors which convey flows of approximately 18 m^3/s. As such there are no stormwater basins proposed as part of the development and all subdivisional flows will be managed in the MUC area.

Table 1 provides the results from modelling of post development catchments based on the proposed structure plan. The results indicate that the critical duration storm event is 1 hr and temporal pattern 8. Consistent with ARR methodology the median result is chosen as the critical duration The peak flows generated from each subcatchment vary from 0.92 m^3/s to 0.14 m^3/s. The total flow generated from the subdivision post development in the 1% AEP is 3.8 m^3/s.

Figure 2 shows the extent of inundation for the 1% AEP event. The total area within the site required for flood storage up to the 1% AEP event is approximately 2.77 ha. This modelling is representative of running the post development scenario for the subdivision concurrently with the hydrographs from the external catchment (Urbaqua, 2018)

It is not the intent to construct a linear trapezoidal drain within this space. The final flood attenuation area configuration, location, and elevations will be documented in future UWMPs and will be dependent on final earthworks, drainage, and road design levels for the development. The conceptual landscape plans are provided as Attachment 1.

Refinements to catchment areas in this report are likely to occur as detailed design proceeds, and modelling will be updated accordingly during the UWMP process.

The minimum building floor levels will comply with Department of Water and Environmental Regulation and Shire of Serpentine Jarrahdale requirements for a 0.5m clearance above estimated 1% AEP flood levels.

4. SERVICEABILITY (20% & 10% AEP Event)

Modelled storage volumes, areas, flood rise and inverts are detailed in Table 2 and Figure 2 for the 20% flood event, showing the extent of inundation of MUC area. The total area required for the 20% event is approximately 1.79 ha of the total site area.

The level of service for the town centre and commercial spaces is the 10% AEP event. The detailed engineering design at UWMP stage for these areas should consider that road surfaces and public areas need to be free of standing water up to the 10% AEP. Detailed modelling of each subdivision/commercial area should be undertaken as part of the UWMP.

5. ECOLOGICAL PROTECTION (1 EY Event, 15 mm)

Storm volumes for ecological protection based on the first 15 mm event are provided in Table 1 to provide a guide for storage requirements. Volumes will be refined at UWMP stage on the basis of more detailed modelling in parallel with engineering design, with final adopted batters and ultimate configurations to be determined in consultation with SSJ. Locations for proposed 15mm areas are shown in Figure 2 with a concept of the storage areas provided as Figure 6 and in landscape masterplan.

The locations and volumes above are considered a maximum required. As much of the first 15mm will be managed through incorporation of tree pits, median swales and storage in carpark areas. It is expected that commercial and town centre areas will have the ability to manage the first 15mm within carparking areas either within landscaped swales, and/or underground storages. Details of these efforts will be included within a UWMP.

The total estimated area required for management of the first 15mm of site runoff is 0.03ha (686 m^3 assuming 0.5m depth). All biofiltration areas will be underlain by PRI amended soils.

Hyd2o's current estimate of what would be termed the base flow channel is based on the area which would be expected to be inundated every year (ie effectively a 1 EY inundation level. The dimensions for the baseflow channel are provided in Table 2 below based on the flood hydrographs provided by Urbaqua. Please note that no baseflow channel is proposed for Oaklands Drain south because the 63%AEP flow is low and would result in a channel that would be dry for the majority of the time. Opportunities to define a low-flow section in this channel through landscaping should be investigated as part of a future UWMP.

All biofiltration systems will be designed consistent with the Adoption Guidelines for Stormwater Biofiltration Systems (CRC for Water Sensitive Cities, 2015). Note that the use of 500mm depth has been adopted in Table 1 to minimise the size of the areas within the POS given its MUC characteristics. The sizing and depth presented in this LWMS is for 15mm storage without considering infiltration, indicating a lesser depth will ultimately result once more detailed modelling is performed at UWMP stage and further distributed opportunities for infiltration and treatment are considered (eg road reserves). A concept of biofiltration areas is included in Figure 7 with more detailed plans to be prepared in a subsequent UWMP.

6. GROUNDWATER MANAGEMENT

Groundwater management is proposed using subsoil drainage and importation of fill. An indicative subsoil drainage plan is provided as Figure 3, subsoil outlets are proposed to discharge above the 4EY in flood infrastructure inverts and undergo water quality treatment.

7. MONITORING

Post development groundwater monitoring locations and parameters are detailed in Figure 8 and Table 3.

Department of Water (2012) indicates a minimum of 3 years post development monitoring is required, and defines post development as "from completion of first subdivision to five years after 80 per cent of the development (by land area) has been completed".

The program is therefore designed to operate over a three year post development period, with the timing for commencement of the program to be negotiated at UWMP stage with DWER and the Shire of Serpentine Jarrahdale.

The program may need to be modified when data is collected to increase or decrease the monitoring effort in a particular area, or to alter the scope of the program itself. Any modification to the program would be identified through review of the collected data and would require the agreement of all parties (DWER, Shire of Serpentine Jarrahdale, and developer).

All water quality testing will be conducted by a NATA approved laboratory.

Table 3: Post Development Monitoring Program

Monitoring	Parameter	Location	Method	Frequency and Timing
Groundwater	Water Level (m AHD)	4 site bores + DoW bore	Electrical depth probe or similar	Quarterly
	pH, EC, Nitrogen, Phosphorus	4 site bores	Pumped bore sample	Quarterly (Jan, Apr, Jul & Oct)
Surface Water	pH, EC, TSS Nitrogen Phosphorus	7 locations	Collected grab sample	Nominally 2 times per year in winter when/if water present.
	Flow		Visual Estimate	

Assessment of monitoring outcomes and system performance will be undertaken as part of the annual review and reporting process. Should the system not be functioning in accordance with design a contingency action plan will be implemented, including:

- Assessing if an isolated, development area or regional occurrence.
- Determining if due to the development or other external factors.

- Identify and remove any point sources causing problems.
- Review operational and maintenance practices.
- Consider alterations to POS areas and the stormwater system.
- Consider initiation of community based projects.
- If necessary, inform residents of any required works and their purpose.

As reported in GHD (2014) there is an absence of monitoring data for the site. Therefore a pre-development monitoring program will be implemented to establish a baseline dataset prior to the preparation of the UWMP.

The following interim trigger levels are suggested as presented in GHD (2014) consistent with the ANZECC guidelines (Table 4) until suitable monitoring data is collected.

Table 4: Anzecc Guidelines for Water Quality

Parameter	Unit	ANZECC GUIDELINE
Filterable Reactive Phosphate	ug/L	5
Total Nitrogen	ug/L	350
Total Phosphorus	ug/L	10
Oxides of Nitrogen	ug/L	10
Ammonia	ug/L	10
Electrical Conductivity	mS/cm	0.3-1.5

1. REFERENCES

Ball J, Babister M, Nathan R, Weeks W, Weinmann E, Retallick M, Testoni I, (Editors) Australian Rainfall and Runoff: A Guide to Flood Estimation, © Commonwealth of Australia(Geoscience Australia), 2016.

GHD, 2014 *Report for Byford Town Centre Local Water Management Strategy* Prepared for the Shire of Serpentine Jarrahdale.

Urbaqua, 2018. *Byford District Water Management Strategy.* June 2018

Should you have any queries regarding this report, please do not hesitate to contact Suzanne Smart or Sasha Martens of this office.

Yours sincerely,

Suzanne Smart

Senior Environmental Hydrologist

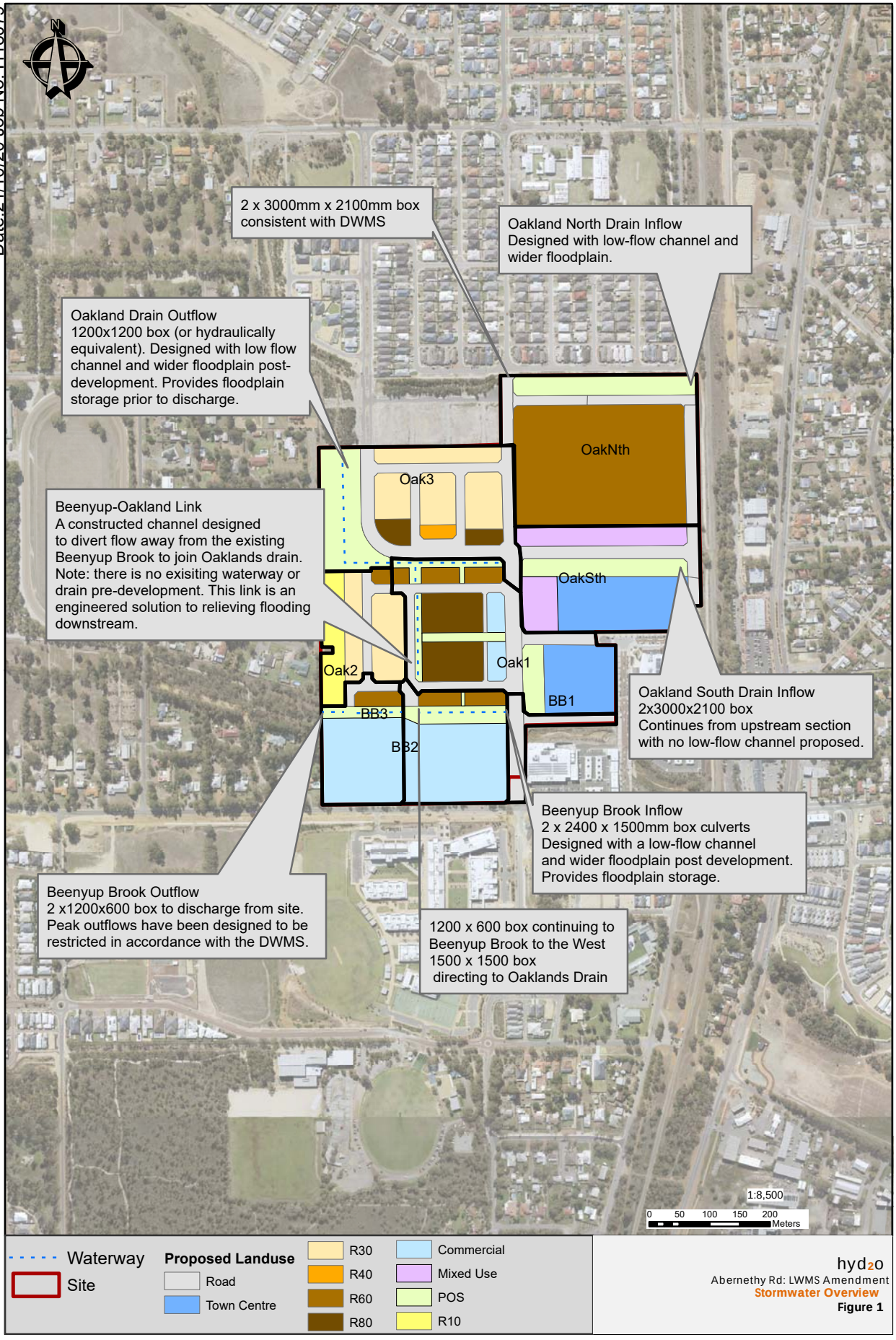
Table 1: Post Development Catchment Characteristics

Catchment & Design Parameters	BB1	BB2	BB3	Oak1	Oak2	Oak3	Oak Sth	Oak Nth
Road and Road Reserve (ha) (0.8)	0.72	0.16	0.23	1.60	0.31	2.12	0.85	1.07
Commercial/Town Centre (0.8) (ha)	0	2.29	1.94	1.76	0	0	1.98	0
R80/R60 (ha) (0.8)	0	0.35	0.20	1.77	0.09	0.39	0	5.73
R30/R40 (ha) (0.4)	0	0	0	0	1.37	2.28	0	0
R10 (ha) (0.2)	0	0	0	0	0.86	0	0	0
POS (ha) (0.2)	0	0.45	0.23	1.12	0	1.60	0.82	1.01
Total Contributing Area (ha)	0.73	3.24	2.60	6.26	2.63	6.39	5.14	7.81
EIA 20% & 1% AEP (ha)	0.58	2.33	1.94	4.33	1.04	3.24	3.62	5.34
15mm event								
Total Storm Volume (m^3) (Road Reserve only at 65% Runoff)	70	15	22	156	30	207	82	104
TWL Area (m^2) (assuming 0.5m depth)	140	30	44	312	60	414	164	208
20% AEP Event								
Peak Outflow (m^3/s)	0.04	0.15	0.13	0.30	0.05	0.17	0.26	0.35
Critical Storm (hr)	1	1	1	1	1	1	1	1
10% AEP Event								
Peak Outflow (m^3/s)	0.06	0.18	0.13	0.38	0.06	0.28	0.31	0.42
Critical Storm (hr)	45min	45min	45min	45min	2	45	1.5	1
1% AEP Event								
Peak Outflow ((m^3/s))	0.14	0.46	0.40	0.92	0.17	0.53	0.80	1.09
Critical Storm	1	1	1	1	1	1	1	1

Table 2: Living Stream Characteristics

Catchment & Design Parameters	BEENYUP BROOK INFLOW	BEENYUP BROOK OUTFLOW	BEENYUP OAKLAND LINK	OAKLANDS STH DRAIN INFLOW	OAKLANDS DRAIN OUTFLOW	OAKLAND NTH DRAIN INFLOW
Living Stream Design						
Upstream invert (mAHD)	50.50	49.00	49.00	51.00	43.40	49.0
Downstream invert (mAHD)	49.50	48.00	46.10	46.50	43.20	44.0
Main Channel Depth (m)	1.0	0.60	1.00	1.20	1.50	0.6
Main Channel Base Width (m)	16	3	2	1	32	4
Side Slopes	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6	1 in 6
Total Width (m)	28	13 5	14	11	50	12
1 EY Event						
Low-Flow Channel Depth (m)	0.5	n/a	n/a	n/a	0.5	0.3
Low-Flow Channel Base Width	8	n/a	n/a	n/a	4	0
Low-Flow Channel Side Slopes	1 in 3	n/a	n/a	n/a	1 in 3	1 in 3
Peak Flow (m^3/s)	6.54	2.54	4.02	1.27	4.86	2.8
20% AEP Event						
Upstream Flood Height (mAHD)	51.05	49.44	49.61	51.25	44.57	49.66
Downstream Flood Height (m)	50.52	48.50	46.81	47.30	44.55	44.25
Total Depth d/s above low flow channel	0.52	0.50	0.71	0.80	0.85	0.3
Volume (m^3)	1455	185	216	450	3773	667
Peak Outflow (m^3)	9.98	3.09	6.78	1.63	7.52	4.0
Critical Storm (hr)	3hr	3hr	3hr	3hr	3hr	3hr
1% AEP Event						
Upstream Flood Height (mAHD)	51.22	49.49	49.77	51.26	44.99	49.86
Downstream Flood Height (m)	51.10	48.56	47.10	47.80	45.03	44.40
Total Depth d/s above low flow channel	1.10	0.56	1.0	1.22	1.28	0.66
Volume (m^3)	2704	240	420	1200	3910	1193
Peak Outflow (m^3/s)	15.65	3.88	11.26	1.99	12.04	8.9
Critical Storm (hr)	3hr	3hr	3hr	3hr	3hr	3hr

Date:21/10/20 Job No. H18079



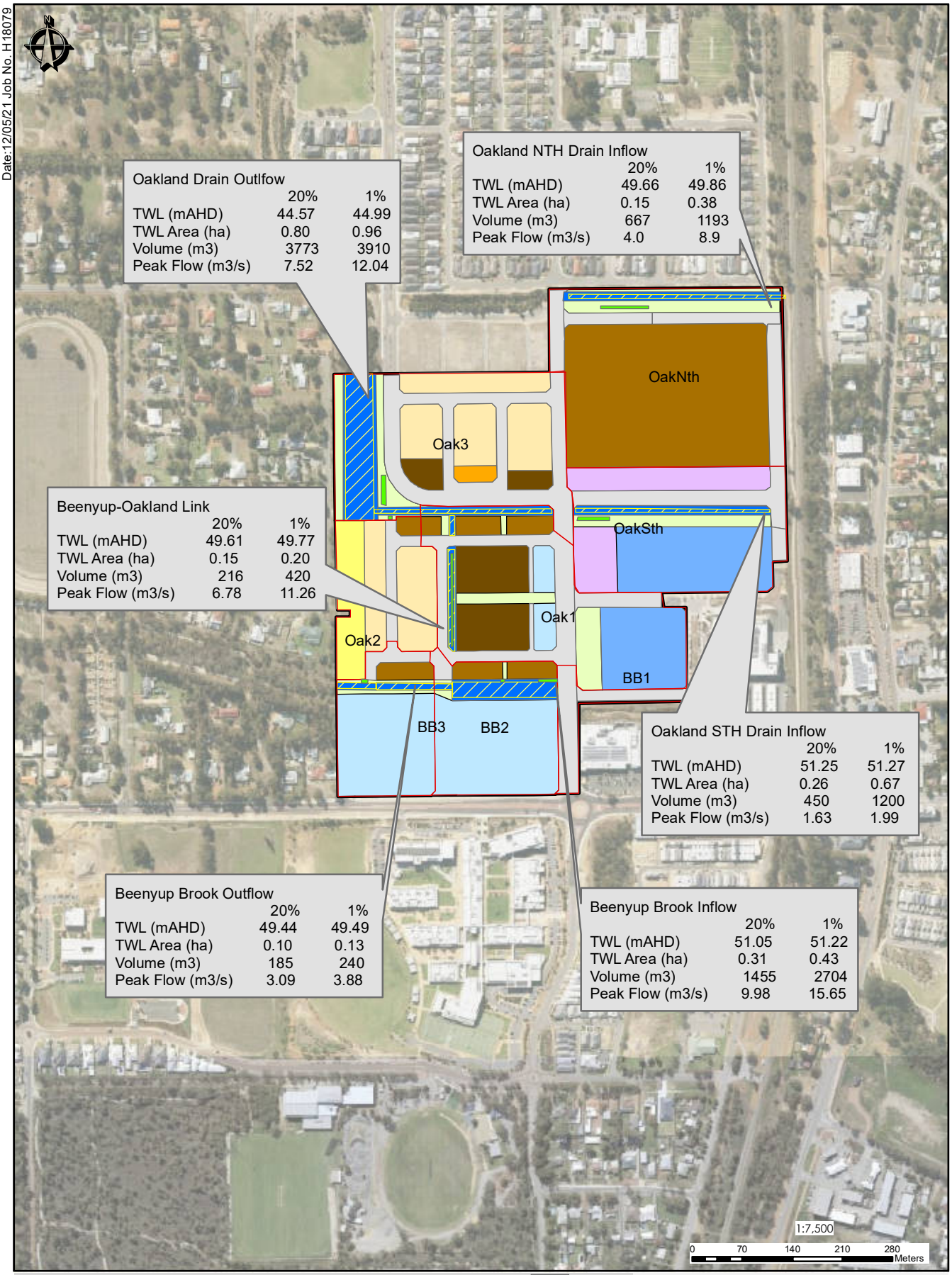
hyd2o

Abernethy Rd: LWMS Amendment

Stormwater Overview

Figure 1

Date:12/05/21 Job No. H18079



20% AEP Flow Area
15mm Area
1% AEP Flow Area
Post Development Catchments

Proposed Landuse
Road
Town Centre
R30
R40
R60
R80
Commercial
Mixed Use
POS
R10

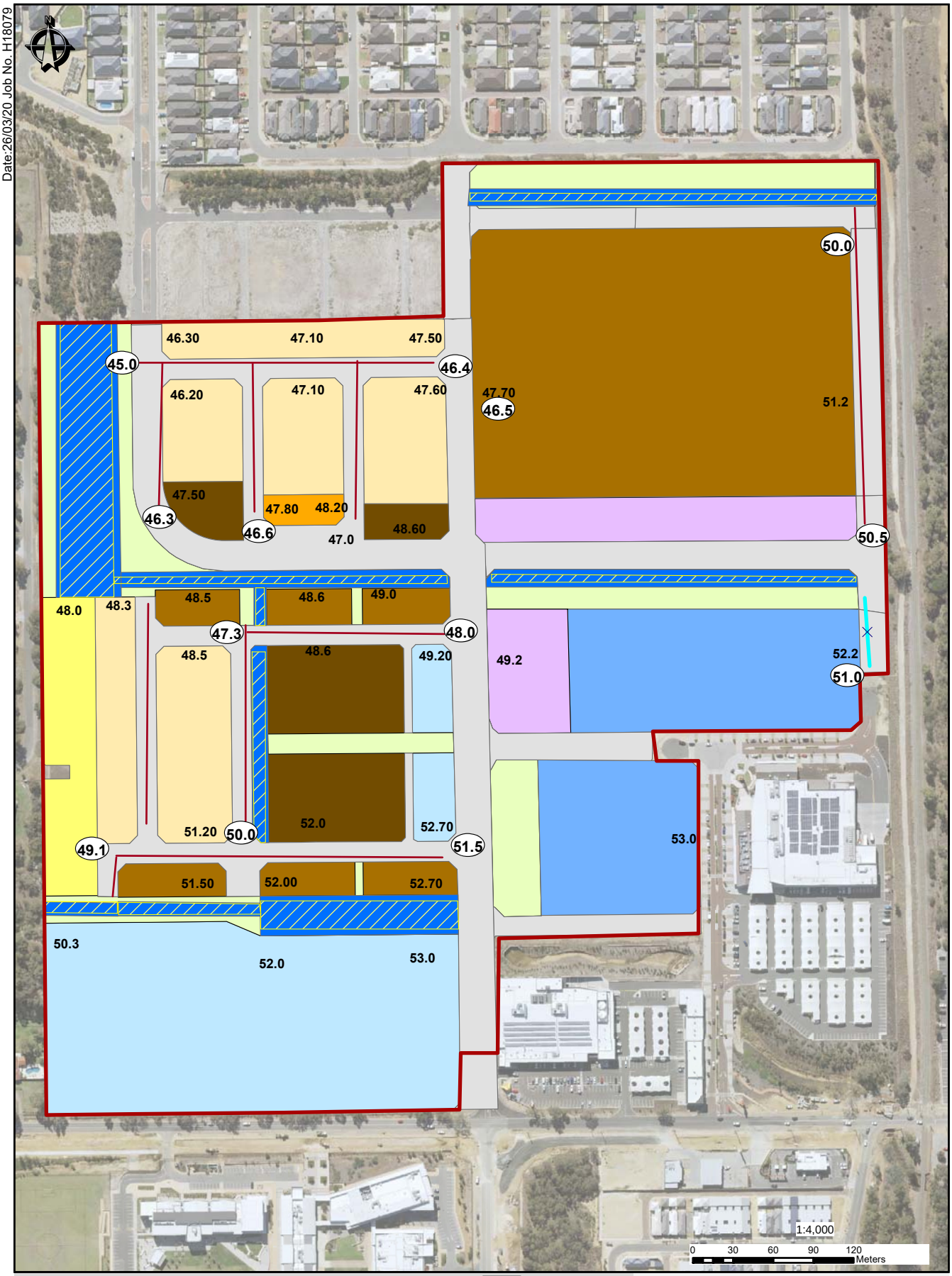
hyd2o

Abernethy Rd: LWMS Amendment

Stormwater Management Plan

Figure 2

Date:26/03/20 Job No. H18079



20 % AEP Flow Area

1 % AEP Flow Area

47.2 Indicative Lot Level

48.2 Indicative Subsoil Invert

Proposed Landuse

Road

Town Centre

R30

R40

R60

R80

Commercial

Mixed Use

POS

R10

hyd2o

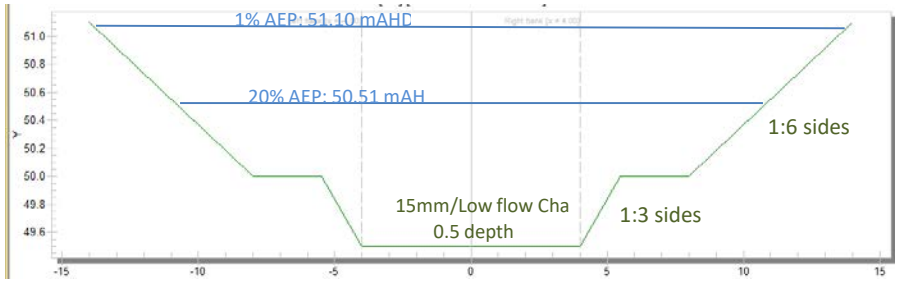
Abernethy Rd: LWMS Amendment

Indicative Subsoil Drainage Plan

Figure 3

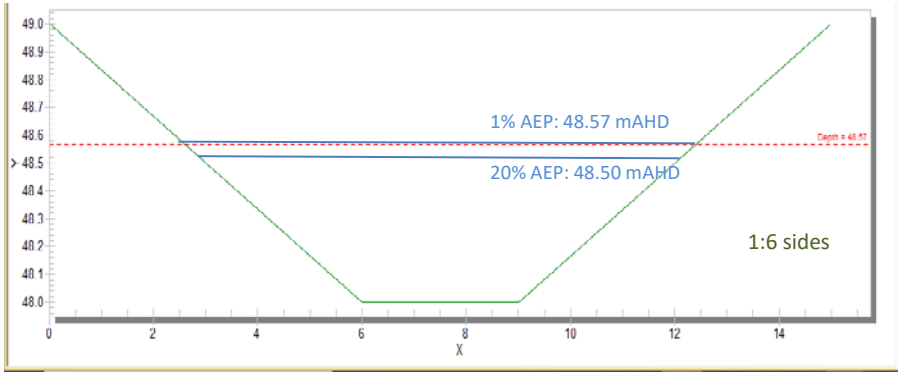
Date :20/10/2020 Job No H18079

Section A- Beenyup Brook



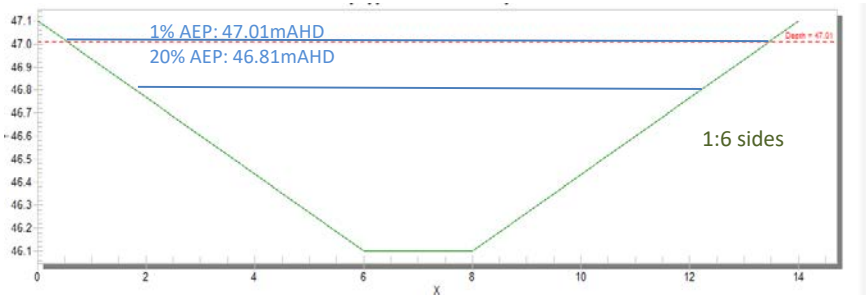
Landscaping to be undertaken in Low Flow Channel and reported in the UWMP

Section B- Beenyup Brook Outflow

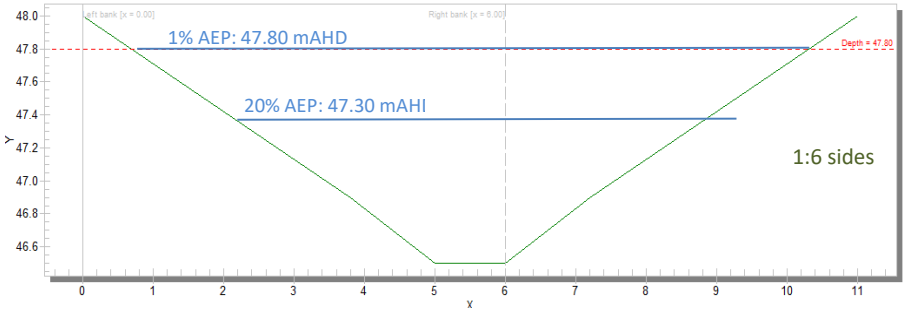


As per the DWMS (Urbaqua 2018) the majority of Beenyup Brook is diverted towards Oaklands drain with flows up to the 1% AEP reduced to aproximately 63 % AEP levels. As such no low flow channel is nominated.

Section C- Beenyup- Oaklands Link



Section D- Oaklands South



No low flow channel has been accounted for since the flow is so minor it would be dry most years.

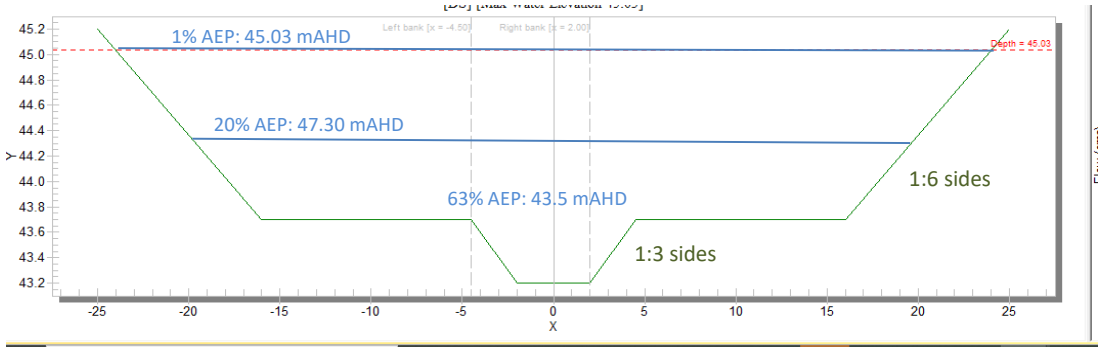
hyd$_2$o

Lot 1 Abernethy Rd LWMS Addendum

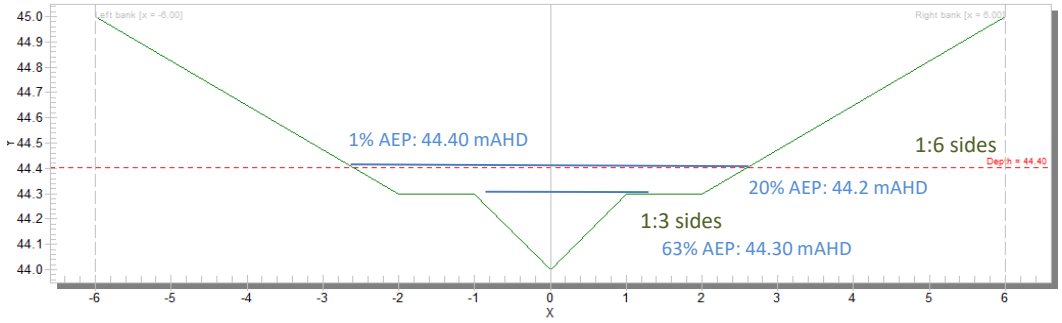
Cross Sections

Figure 4

Section E- Oaklands Outflow

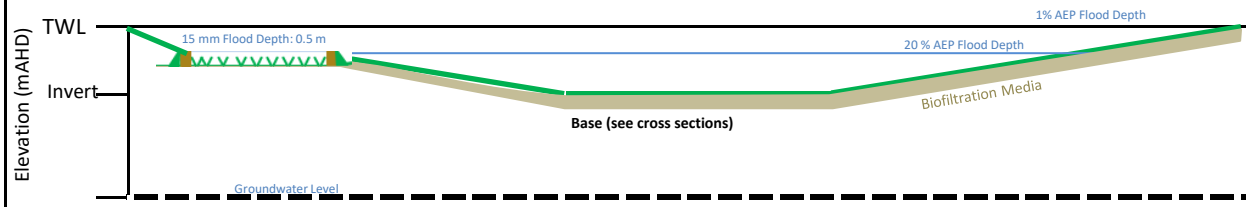


Section F- Oaklands North



Low flow to be appropriately landscaped.

Date: 21/8/2020 Job No. H18079



Note: Cross-sections are not to scale are indicative until further detailed design is undertaken.

hyd$_2$o

Lot 1 Abernethy Rd LWMS Amendment

Conceptual 15mm Area

Figure 6

Date:21/10/20 Job No. H18079

Groundwater Monitoring Location

Surface Water Location

Proposed Landuse

Road

Town Centre

R30

R40

R60

R80

Commercial

Mixed Use

POS

R10

hyd2o

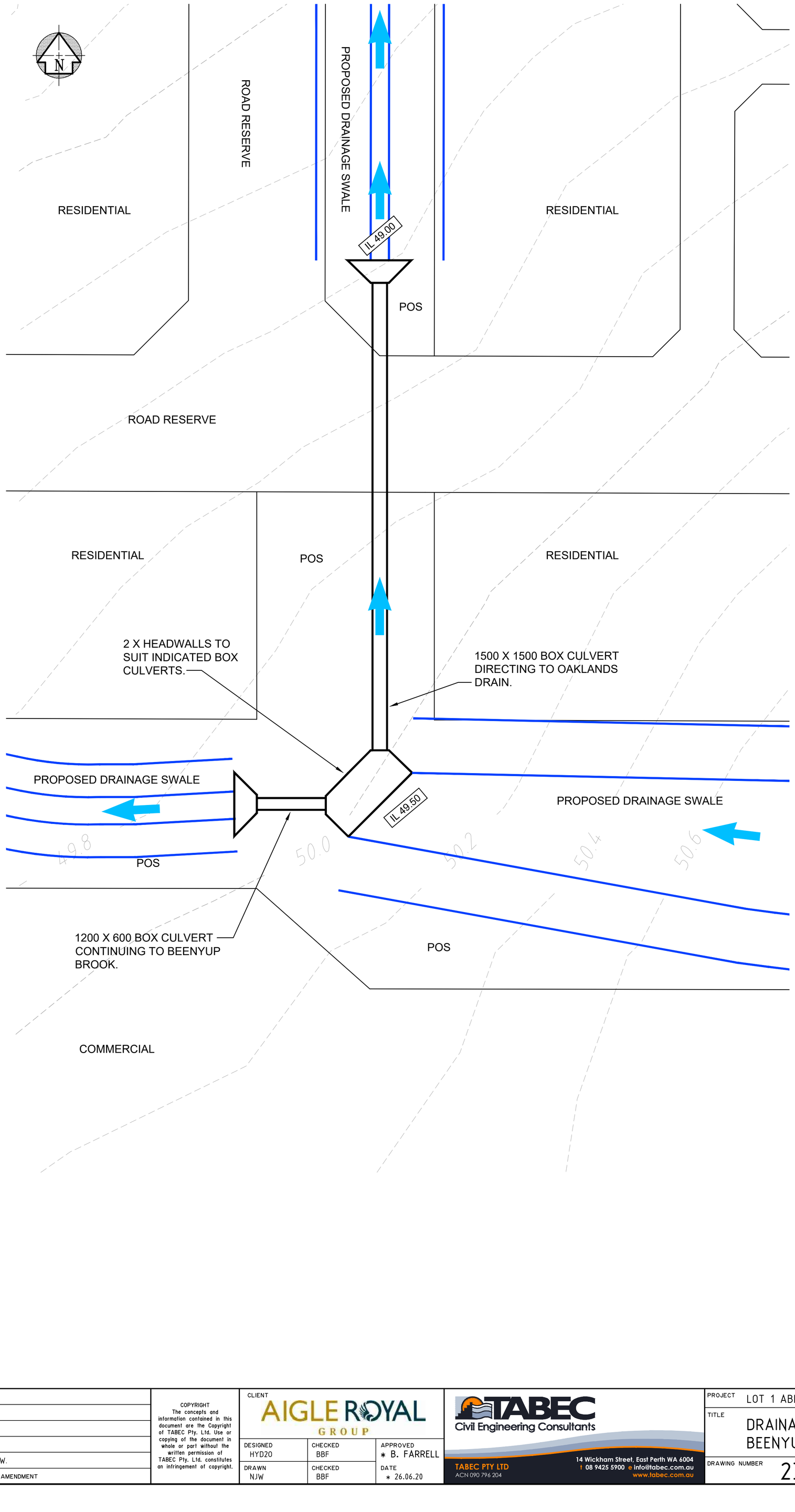
Abernethy Rd: LWMS Amendment

Post-Development Monitoring Plan

Figure 7

LEGEND

- ROAD DRAINAGE FLOW PATH
- 47.6 EXISTING CONTOUR LEVEL (0.2m)
- PROPOSED DRAINAGE CULVERT & HEADWALL



SCALE 1:250 (0, 5, 10, 15)

A1

PRELIMINARY

No.	DATE	DRAWN	APPROVED	AMENDMENT
A	26.06.20	NJW	BBF	PRELIMINARY ISSUE FOR REVIEW.

CLIENT: AIGLE ROYAL GROUP

DESIGNED	CHECKED	APPROVED
HYD20	BBF	* B. FARRELL
DRAWN	CHECKED	DATE
NJW	BBF	* 26.06.20

TABEC Civil Engineering Consultants
TABEC PTY LTD
ACN 090 796 204
14 Wickham Street, East Perth WA 6004
t 08 9425 5900 e info@tabec.com.au
www.tabec.com.au

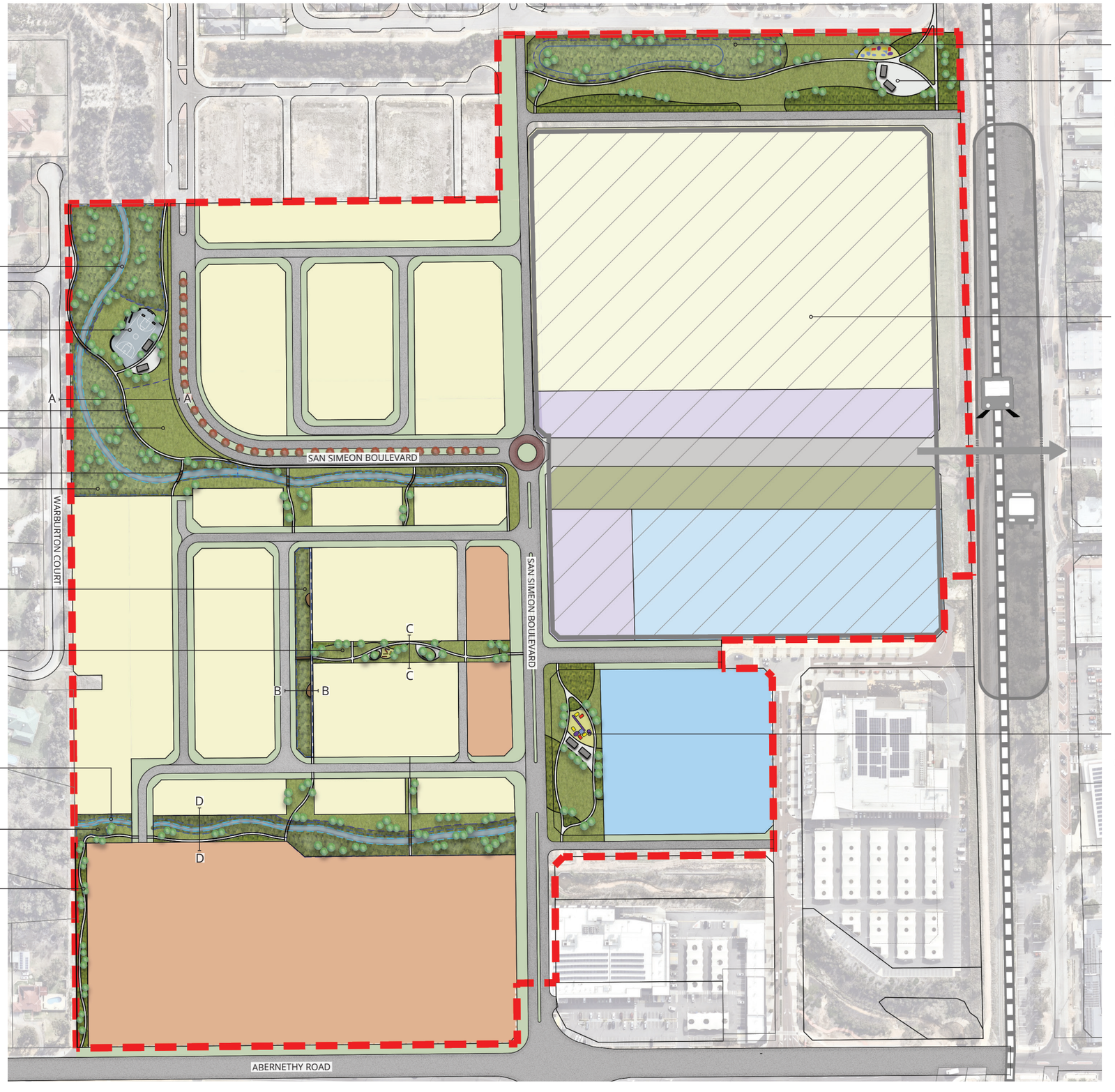
PROJECT: LOT 1 ABERNETHY ROAD - BYFORD

TITLE: DRAINAGE LINK TO DIVERT FLOWS FROM BEENYUP BROOK TO OAKLAND DRAIN

DRAWING NUMBER: 2399-00-SK03

ISSUE: A

J:\2399\Design\CAD\Drawings\Sketches\2399-00-SK03.dwg 26/06/20 12:33:47 nwilkinson



open drainage swale to capture 1:1 and 1:5 year rain events

central picnic area with basketball court, skateable furniture and picnic facilities (subject to detailed investigations)

footpath network

open turf area containing 1:100 year rain event

pedestrian boardwalk

vegetated drainage basin containing 1:5 and 1:100 year rain events

vegetated drainage basin containing 1:5 and 1:100 year rain events

public open space including young children's play space (subject to detailed investigations)

open drainage swale to capture 1:1 and 1:5 year rain events

vegetated drainage basin containing 1:5 and 1:100 year rain events

privately owned pedestrian access way with boundary wall to adjacent residential lot

vegetated drainage basin containing 1:5 and 1:100 year rain events

public open space including picnic facilities and young children's play space (subject to detailed investigations)

indicative metronet station precinct (subject to further detailed design)

public open space including picnic facilities and children's play space (subject to detailed investigations)

LEGEND

- 1:1 year TWL line
- 1:5 year TWL line
- 1:100 year TWL line
- housing lots
- commercial lots
- public open space/drainage
- town centre

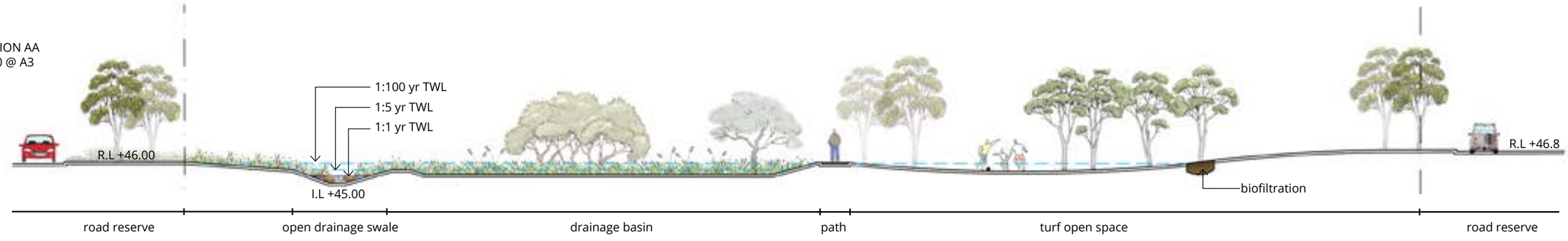
LOT 1 ABERNETHY RD

LANDSCAPE MASTERPLAN

DWG **AR-SK-01**
REV **F**
DATE **05.11.20**
SCALE **1 : 3000 @ A3**

emerge ASSOCIATES

SECTION AA
1:250 @ A3



SECTION BB
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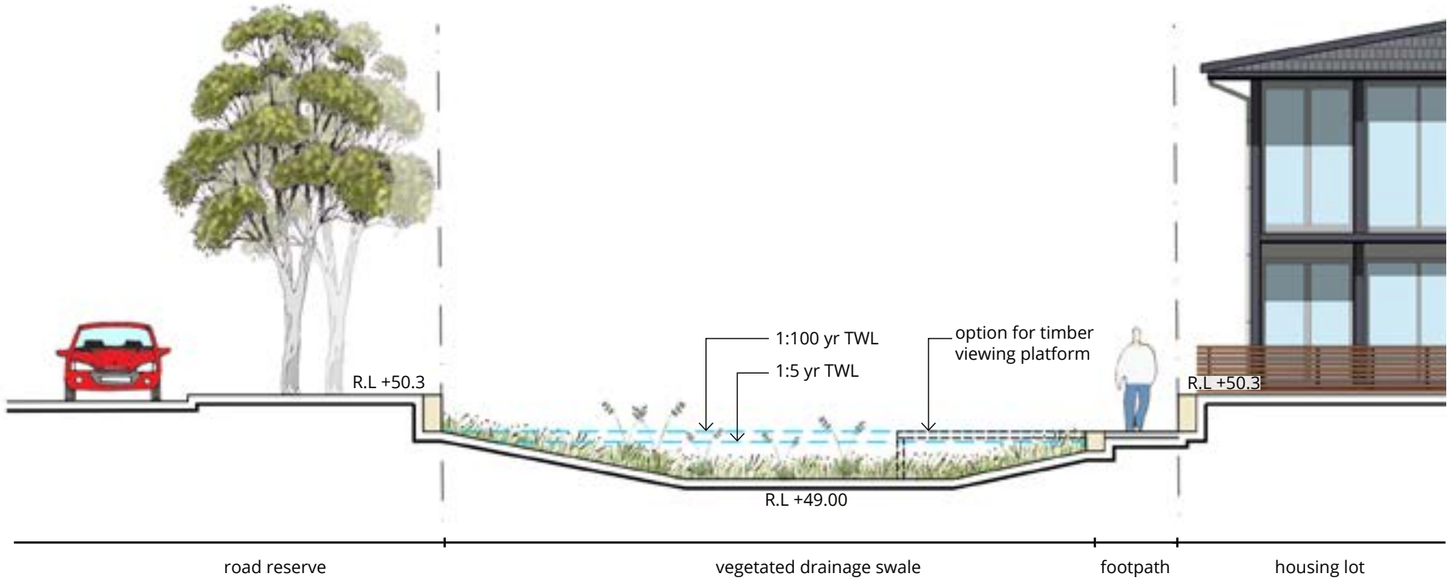

LOT 1 ABERNETHY RD
LANDSCAPE SECTIONS

DWG **AN-SK-02**
REV **D**
DATE **10.05.21**

emerge ASSOCIATES

SECTION CC
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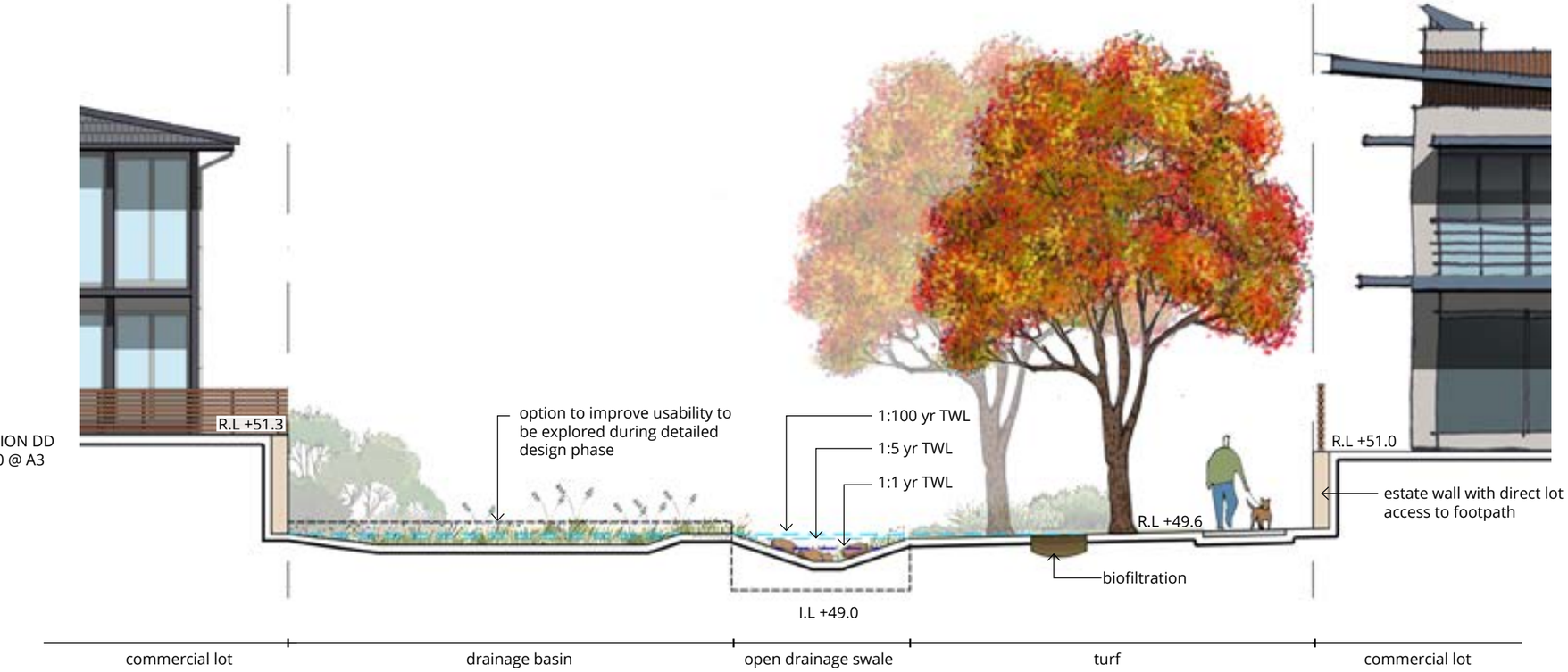

SECTION DD
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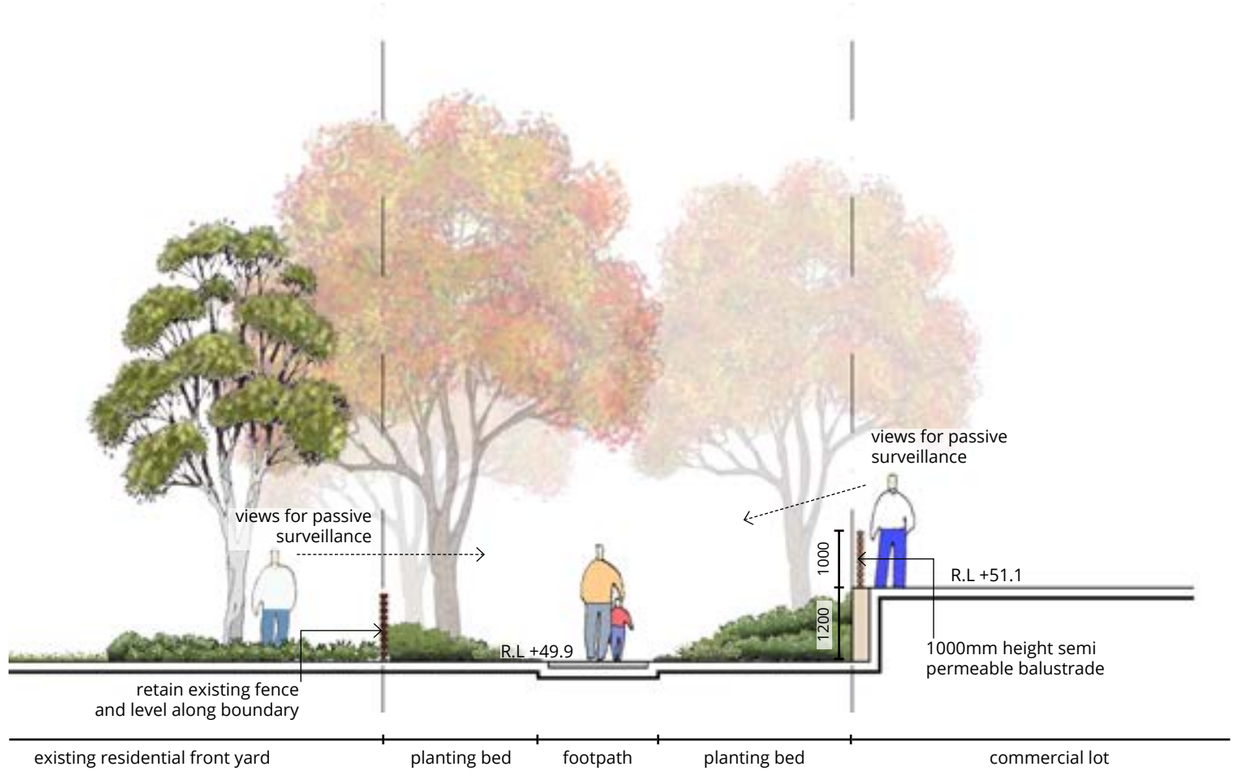
LOT 1 ABERNETHY RD

LANDSCAPE SECTIONS

DWG **AN-SK-02**
REV **D**
DATE **10.05.21**

emerge ASSOCIATES

SECTION EE



LOT 1 ABERNETHY RD

LANDSCAPE SECTIONS

DWG **AN-SK-02**
REV **A**
DATE **16.03.21**
SCALE **1 : 100 @ A3**

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emerge ASSOCIATES

Government of Western Australia
Department of Water and Environmental Regulation

Your ref: H18079Av6
Our ref RF10037-05
PA: 42045
Enquiries: Mark Hingston

Hyd2o
Unit 6 B, 103 Rokeby Road
Subiaco, WA, 6008

Attention: Suzanne Smart

Dear Suzanne

Lot 1 Abernethy Road, Byford – Local Water Management Strategy Addendum

Thank you for the *Lot 1 Abernethy Road, Byford – Local Water Management Strategy Addendum* (LWMS) dated 12 May 2021. The Department of Water and Environmental Regulation (the Department) has reviewed the LWMS addendum and advises it meets the requirements of the Department.

The Department's acceptance of the *Lot 1 Abernethy Road, Byford – Local Water Management Strategy Addendum* does not provide exemption from the need to gain any applicable statutory local government or other agency approvals, nor approvals that may be required under legislation administered by the Department.

In the event there are modifications to the proposal that may have implications on aspects of water management, the Department should be notified to enable the implications to be assessed.

If you wish to discuss the above further, please contact Mark Hingston at the Department's Mandurah Office on (08) 9550 4222.

Yours sincerely

Brett Dunn
Manager – Planning Advice
Kwinana Peel Region

28/5/2021

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Lots 1 & 2 Abernethy Road, Byford

Assessment of development potential

June 2019

macroplan

MacroPlan

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Melbourne VIC 3000
(03) 9600 0500

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580 George Street
Sydney NSW 2000
(02) 9221 5211

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Brisbane QLD 4000
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Broadbeach QLD 4218
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PERTH
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Prepared for: Aigle Royal

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Ellis Davies, Principal – Retail
Nora Farren, Senior Consultant – Retail

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Executive summary

Regional context

Byford is a rapidly growing suburb located 35 km south-east of the Perth CBD within the Shire of Serpentine Jarrahdale. The Shire experienced a 50% increase in population from 18,000 residents at 2011 to 27,600 residents at 2016. Recent population forecasts from the Western Australia Tomorrow Population Report No.11 show that Serpentine Jarrahdale is one of the fastest growing municipalities in Australia, expected to increase by 25,600 residents to 2026, reaching an estimated population of 53,200.

Trade area analysis

The trade area population is estimated at 29,350 as at June 2019. Over the most recent intercensal period (2011-2016) the trade area population increased very strongly at an average rate of 9.2% per annum. The trade area population is estimated to reach 49,290 by 2031, reflecting very strong average annual growth of 4.4%.

Socio-demographic profile

The trade area population is dominated by traditional families in their early life stages, who are attracted by the lifestyle on offer and housing opportunities in the region.

Byford retail facilities

There are four existing supermarkets located within the Byford Town Centre: IGA and Aldi located in the established eastern part the town centre, as well as Byford Village Shopping Centre (anchored by a Coles supermarket) and Byford Marketplace (anchored by a Woolworths supermarket) located in the newly developed western part.

Assessment of potential for retail and non-retail uses

Type	Case for	Case against	Finding
Medical precinct and pharmacy	• High growth area. • High proportion of traditional families. • Attract customers to site. • Well located to serve residents in western Byford.	• Byford well supplied with 5 medical centres located in local area. • May need to offer incentives to attract quality operator to the site given existing supply.	• Moderate demand potential for a medical centre, though could anchor a large medical precinct that serves all of Byford. • Recommended to have critical mass of medical facilities. • Ideally anchored by chain pharmacy, though pharmacy location rules may restrict another pharmacy in Byford.
Gymnasium	• Limited supply of gymnasiums in the catchment area. • Strong population growth. • Generates visits to site.	• Typically have capacity to pay only modest rent.	• There is considered solid potential for a gymnasium at the site, perhaps a chain outlet of 400 sq.m such as Jetts Fitness, Snap Fitness or Anytime Fitness
Supermarket	• Provide a strong anchor for the site and generate high levels of visitation.	• 4 supermarkets already situated within the Byford Town Centre, with an IGA supermarket also located at Lakeside Plaza.	• There is not considered potential for another supermarket in local area.
Large format retail	• Population of catchment approaching 30,000 and is growing very strongly. • Limited supply of large format retailers in local area. • High profile site which is easily accessible. • Significant amount of demand generated by trade area population for large format retail goods.	• Market not sufficiently large at this stage to support a large homemaker centre – i.e. can't create a critical mass of retailers. • Likely to attract only "second tier" large format retailers.	• Good opportunity for a small cluster of around 5 large format retailers of around 500 – 1,000 sq.m each in the short to medium term. Retailers expected to be supportable include an auto accessories outlet, a bicycle superstore, a flooring outlet, a furniture store and an electrical outlet. • In the longer term (10-15+ years) there may be the potential for additional large format retailers, while key anchors such as a major hardware store may consider Byford for an outlet as the population of the region approaches capacity.

Type	Case for	Case against	Finding
Service station	• High profile and easily accessible site. • Traffic volumes along Abernethy Road will continue to increase in line with population growth.	• May not complement other potential uses.	• Considered sound potential for a service station at the subject site.
Fast food restaurant	• High profile site with good amount of passing traffic that will continue to increase. • Easily accessibly site • High growth area.	• Location removed from South Western Highway. • McDonalds, KFC, Subway and Hungry Jacks already located in Byford.	• Good opportunity for one or two fast food outlets fronting Abernethy Road such as Red Rooster, Subway (relocation), or a Pizza outlet.
Childcare	• High proportion of children and young families in the area. • Easily accessible site located opposite a school. • Rapidly growing trade area population.	• 6 childcare centres located in Byford, which is considered ample supply at this stage • Childcare centre may not be compatible with other potential uses on site.	• There is not considered a good opportunity for a childcare centre at the subject site at this stage, though there will be demand for another childcare centre in the catchment by around 2024. • As the population of the area approaches capacity over the next 20+ years there is expected to be the demand for another 5 childcare centres in the region.
Automotive	• Located in major growth corridor • Tonkin Highway to be extended	• Typically requires a very high-profile site with frontage to a highway to be successful.	• Need cluster of operators to ensure customers are attracted to the site • May not be highest and best use for the site, though could be a short/medium term option before a development in the longer term

Introduction

This report presents an independent assessment of the market potential for future retail and non-retail facilities at Lots 1 & 2 Abernethy Road, Byford. The subject site is located within a designated district centre in the Shire of Serpentine Jarrahdale, approximately 35 km south-east of the Perth CBD.

This report has been prepared in accordance with instructions received from Aigle Royal and is presented in four sections as follows:

- **Section 1** reviews the regional and local context of the subject site, as well as detailing the proposed development.
- **Section 2** examines the trade area expected to be served by the potential retail and non-retail facilities, including current and projected population levels, the socio-demographic profile and the retail expenditure capacity of the trade area population.
- **Section 3** outlines the competitive retail environment of the region, including future competitive developments of relevance.
- **Section 4** provides a retail floorspace demand analysis for the trade area.
- **Section 5** assesses the range of retail and non-retail uses expected to be supportable at the subject site.

Section 1: Site location and centre composition

This section of the report reviews the regional and local context of the area, as well as the proposed development.

1.1 Regional context and site location

The subject site is located at Lots 1 & 2 Abernethy Road in Byford. The site forms the western part of the Byford Town Centre, which is located approximately 7 km south of Armadale, 18 km east of Kwinana and 35 km south-east of the Perth CBD (refer Map 1.1). The eastern part of the town centre has undergone recent development and currently incorporates two relatively new supermarket centres (anchored by Coles and Woolworths). Located within a few hundred metres there is also an Aldi supermarket and an IGA supermarket.

The site has good access to the arterial road network with north-south connections via Tonkin Highway and South Western Highway, linking to major employment areas such as Perth Airport, Welshpool, and Armadale in the north. South Western Highway provides links to major tourism centres in the Southwest Region such as Bunbury. The Perth CBD can be accessed via Thomas Road and Kwinana Freeway.

Tonkin Highway is a major north-south traffic route in western Perth, which currently ends at Thomas Road. A Stage 3 extension is planned to extend the highway past Byford and connect with the South Western Highway at Mundijong. The Federal and State Governments have committed to the full funding of the extension, and work is scheduled to commence in 2020. A grade separation is currently planned at Orton Road to the south of Byford.

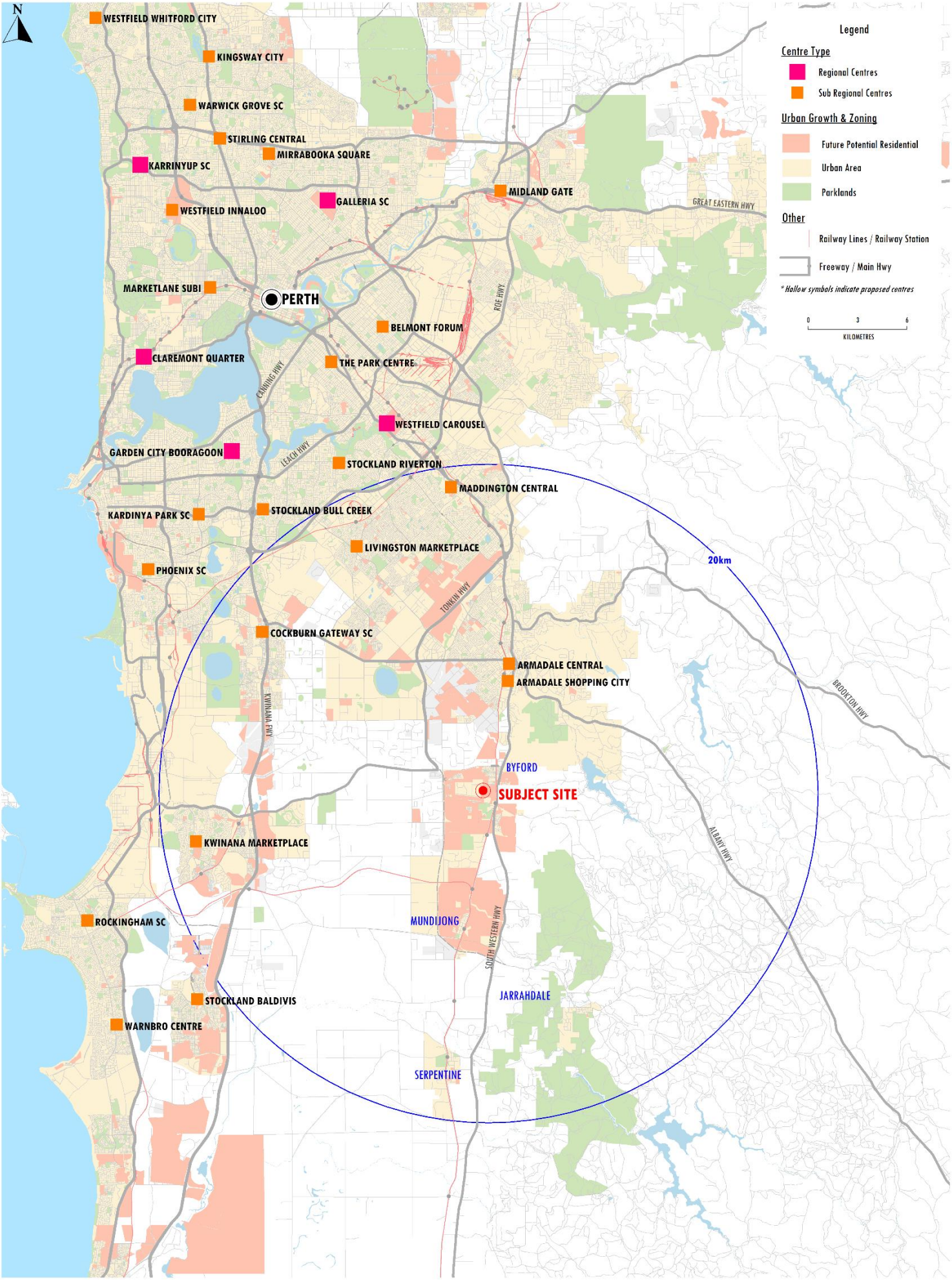
The subject site fronts Abernethy Road, a major east-west thoroughfare which is currently being upgraded (refer Map 1.2). The road network improvements on Abernethy Road will help to increase the level of east-west traffic as more vehicles use the route to access the Tonkin Highway and Kwinana Freeway to the west and the South Western Highway to the east. Following the upgrades currently in progress, road use is projected to increase in volume to carry 16,800 vehicles per day by 2030 (Shire of Serpentine-Jarrahdale).

The Shire of Serpentine Jarrahdale is a predominantly rural Local Government Area (LGA) with the largest towns being Byford and Mundijong, smaller towns Serpentine and Jarrahdale and rural residential areas in Oakford and Darling Downs. The eastern areas of the Shire are dominated by conservation, timber and water catchment uses, with major water storages for Perth such as the Wungong Reservoir (part) and the Serpentine Dam located in the Shire.

The economic base of the Shire of Serpentine Jarrahdale is still strongly oriented towards primary industries, although a large share (more than half) of residents work outside the Shire. Other important industries include construction (driven by housing growth in the region) and other services, such as retail trade, education and health. The central spine of the Shire of Serpentine Jarrahdale features many of the urban centres and the main transport corridor.

In 2018 the Department of Planning, Lands and Heritage released the Perth and Peel@3.5 million strategic planning framework and more specifically the South Metropolitan and Peel Sub-regional Framework. This strategy identified that Serpentine Jarrahdale can expect to accommodate an additional 90,000 people (113,000 in total) by 2050. Byford is a rapidly growing town within the Shire of Serpentine Jarrahdale, and the Byford Town Centre is identified in the sub regional framework as a district level activity centre highlighting the importance of its role as a place for people to live, work and play. It is earmarked to be the primary location for retail and entertainment in the Byford District Structure Plan area.

The highest-order activity centre in the surrounding region is the Armadale Strategic Metropolitan Centre. Due to its proximity, Byford currently leverages off Armadale for access to higher-order services such as health and employment, however, future planning should look to increase the provision of these services locally. Several major strategic initiatives such as the Tonkin Highway Extension and passenger rail extension (METRONET) are already planned or being considered. These projects will have a significant influence on the regional context of Byford.



Map 1.1: Byford

Regional context

macroplan

Map 1.2: Lots 1 and 2 Abernethy Road, Byford

Site location

macroplan

As part of the METRONET project, the Armadale Railway Line is set to be extended 7.8 km south from Armadale to Byford. The METRONET Office is working closely with the Shire of Serpentine Jarrahdale on developing a number of viable options, however at this point there is not a confirmed or preferred location for the station. It is estimated the project business case will be completed in late 2019, with construction anticipated to commence in 2021 with completion in 2023. The project includes the provision of 500-1,000 car parking bays. Figure 1.1 below shows an area that has been identified and is currently under investigation for suitability for the future Byford Station.

Figure 1.1

With the recent population growth occurring in Byford, the area is dramatically changing and transitioning into a major growth corridor. Over the past 10 years residential development has increased dramatically, with the majority conventional fringe residential development. The Shire of Serpentine Jarrahdale is now one of the fastest growing municipalities in the nation according to the ABS and this high level of growth is expected to continue into the future. Based on information from the ABS, 40-50 people per week are moving into the area, which is changing the dynamics of the local population. While the median age for the Greater Perth Region and Western Australia has been 36 since 2006, the median age in the Shire of Serpentine Jarrahdale has fallen from 37 in 2006 to 32 in 2016.

The median band forecasts for Serpentine Jarrahdale from the Western Australian Planning Commission (WAPC) *Western Australia Tomorrow Population Report No.11* (March 2019) estimate the population of the municipality will increase by 25,600 people from 27,600 in 2016 to 53,200 by 2026, equivalent to an additional 2,560 residents each year. This increase reflects a very strong growth rate of 6.8% per annum over the period. By 2031 the population is expected to reach 69,920.

The most recent population forecasts from .id were updated in November 2017 and show lower projections compared with the current WAPC forecasts. The .id forecasts project the population of the Shire to grow by 19,341 people from 27,654 in 2016 to over 57,000 residents by 2031.

The previous Map 1.2 also shows the range of uses in the local area. Located directly opposite the subject site is Byford Secondary Collage, while nearby is Salvado Catholic College. The majority of the retail facilities within the Byford Town Centre are situated immediately east of the subject site, on the northern side of Abernethy Road.

1.2 Proposed development

The concept development plan shows that the majority of areas within the subject site are designated for residential development, while there are 5 large parcels designated for commercial development. The planned total commercial area across the subject site equates to approximately 3.23 hectares and it is understood the areas in the concept plan as shown on Figure 1.2 below, are not likely to change materially, although the distribution will. These parcels are envisaged to be developed for predominantly traditional retail and/or showrooms/large format retail uses.

LOCAL STRUCTURE PLAN AMENDMENT

ABERNETHY ROAD

BYFORD TOWN CENTRE

Figure 1.2

NORTH

0 125 m

SCALE @ A3: 1:5000

8861-STR-02-D

ROWE GROUP DESIGN

8861_STR02D_20200311_BYFORD (Structure Plan Extended) - DRAWN: W. CLEMENTS - DATE CREATED: 2020.03.11 - PROJECTION: MGA50 GDA94 -
N:\TOWN_PLANNING\8000-8999\8861\GRAFTING\GDB\WORABLES DATA OUT - ADAM GLASKIN - 2020.03.11

1.3 Previous documents

The Shire of Serpentine Jarrahdale has previously commissioned a number of reports relating to retail floorspace requirements within the Shire, including the Activity Centres Strategy, the Byford Town Centre Retail Demand Analysis and Local Structure Plans.

Serpentine Jarrahdale – Activity Centres Strategy

The Serpentine Jarrahdale – Activity Centres Strategy was completed for the Shire of Serpentine Jarrahdale in December 2012 by MacroPlan. The report is consistent with the Western Australian Planning Commission's Activity Centres for Perth and Peel with district centres at Byford and Mundijong supported by a network of smaller neighbourhood nodes and local centres. The floorspace projections for the Byford district centre within the document are sourced from the Pracsys Byford Town Centre Retail Demand Analysis as detailed below.

Byford Town Centre Retail Demand Analysis

The Byford Town Centre Retail Demand Analysis was completed by Pracsys in September 2010 as a component of the Draft Byford Local Structure Plan. The primary catchment identified in the document generally includes the key growth areas also encompassed within the main trade area identified in this report. The document also identified additional floorspace requirements for the Byford town centre into the future and concluded that an additional 15,500 sq.m of retail floorspace could be accommodated within the Byford Town Centre by 2031.

This report seeks to identify the indicative retail floorspace demand and market potential for the retail component of the development at Lots 1 & 2 Abernethy Road Byford based on the latest population forecast as provided by the Western Australian Planning Commission through Western Australia Tomorrow and recent ABS New Dwelling Approval (NDA) and Estimated Residential Population (ERP) data, as well as data from the recent 2016 Census of Population and Housing.

Section 2: Trade area analysis

This section of the report reviews the trade area expected to be served by the retail component of the proposed development at Lots 1 & 2 Abernethy Road Byford. It details the current and projected population levels, the socio-demographic profile and retail expenditure capacity of the trade area population. It also reviews the current and future retail facilities within the trade area including demand for retail floorspace.

2.1 Trade area definition

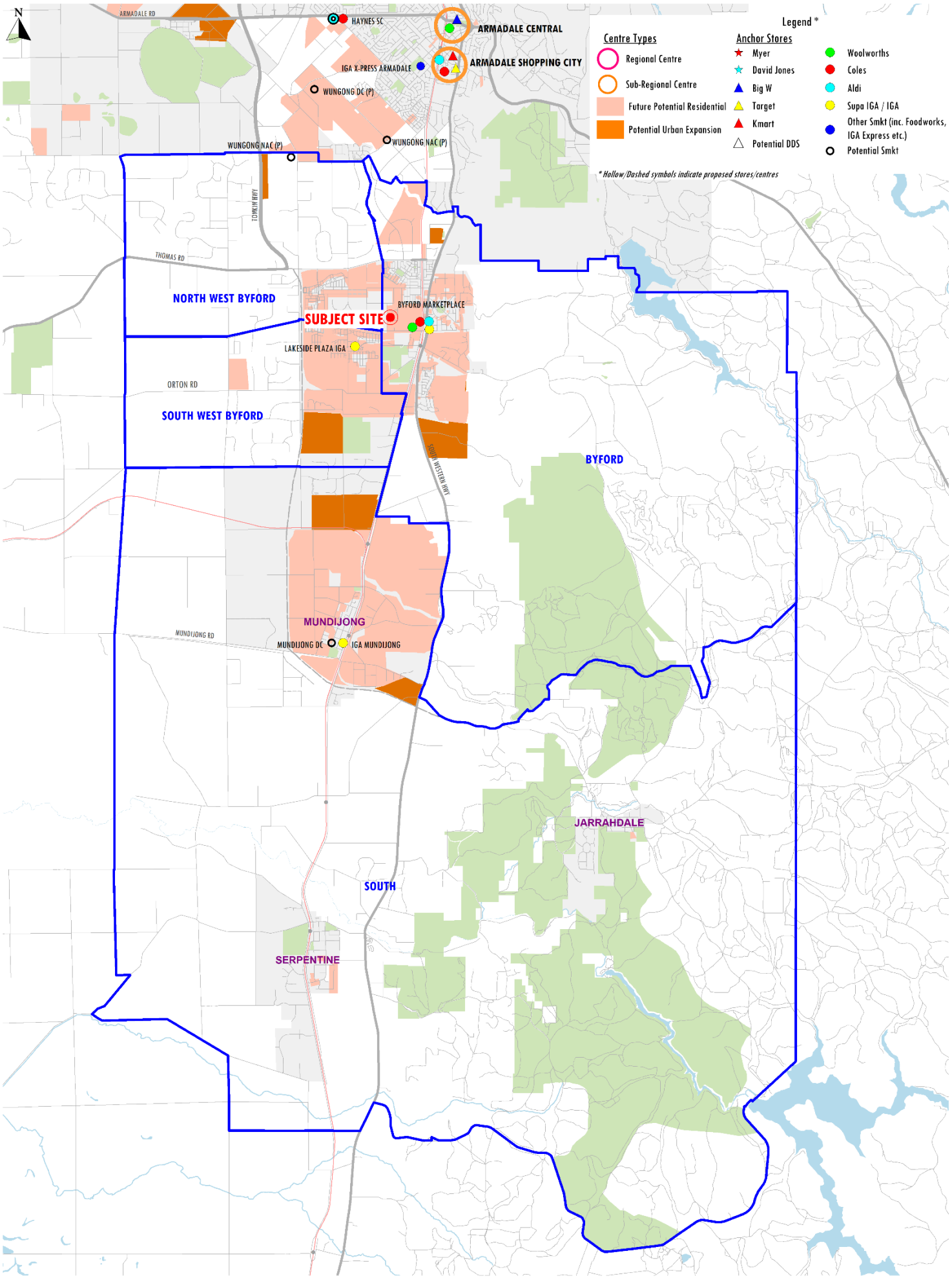
The extent of the trade area or catchment that is served by any shopping centre or retail facility is shaped by the interplay of a number of critical factors. These factors include:

- The relative attraction of the centre, in comparison with alternative competitive retail facilities. The factors that determine the strength and attraction of any particular centre are primarily its scale and composition (in particular the major trader or traders that anchor the centre); its layout and ambience; and car parking, including access and ease of use.
- The proximity and attractiveness of competitive retail centres. The locations, compositions, quality and scale of competitive retail facilities all serve to define the extent of the trade area which a shopping centre is effectively able to serve.
- The available road network and public transport infrastructure, which determine the ease (or difficulty) with which customers are able to access a shopping centre.
- Significant physical barriers which are difficult to negotiate, and can act as delineating boundaries to the trade area served by an individual shopping centre.

The catchment or trade area of relevance for the proposed retail at Lots 1 & 2 Abernethy Road Byford has been identified talking into consideration all of the above factors. For the purposes of the analysis presented in this report we have defined a main trade area which has been divided into four sectors described as follows (refer Map 2.1):

- The **Byford sector** encompasses the main urban area of Byford and extends north to Wungong, east to the municipal border, south to Langford Park and west to Warrington Road.
- The **North-West Byford sector** extends north to Rowley Road, south to Abernethy Road and west to Nicholson Road.
- The **South-West Byford sector** extends south from Abernethy Road to Gossage Road and west to Nicholson Road.
- The **South Byford sector** extends south from Gossage Road to Henderson Road and Kingsbury Drive, west to Kwinana Freeway and east to the municipal border.

The combination of the above sectors is referred to as the **main trade area** throughout the remainder of this report.



Map 2.1: Lots 1 & 2 Abernethy Road, Byford

Trade area and competition

macroplan

2.2 Trade area population

Table 2.1 details the current and projected population levels within the main trade area. The information has been collected from a range of sources, including the following:

- Australian Bureau of Statistics (ABS) Census of Population and Housing (2011 and 2016);
- ABS Dwellings Approvals and Estimated Residential Population Data (2016-2018);
- Western Australia Tomorrow (March 2019) prepared by the WA Planning Commission;
- Population projections prepared by forecast.id for the City of Serpentine Jarrahdale updated in November 2017; and
- Other investigations of future residential development, undertaken by this office.

Over the most recent intercensal period (2011-2016), the main trade area population increased from 16,220 to 25,210 residents at an average rate of 9.2% (or 1,798 people) per annum. Since 2016 growth has moderated and the main trade area population is estimated to contain approximately 29,350 residents as at June 2019.

Table 2.1
Abernethy Rd Byford trade area population, 2011-2031*

	Estimated population			Forecast population		
Trade area sector	2011	2016	2019	2021	2026	2031
• Byford	5,740	8,200	9,100	9,900	11,900	13,650
• South	5,570	5,960	6,200	6,440	7,690	11,440
• South-West Byford	1,090	5,100	6,900	8,100	11,100	13,100
• North-West Byford	3,820	5,950	7,150	7,950	9,950	11,100
Main trade area	**16,220**	**25,210**	**29,350**	**32,390**	**40,640**	**49,290**

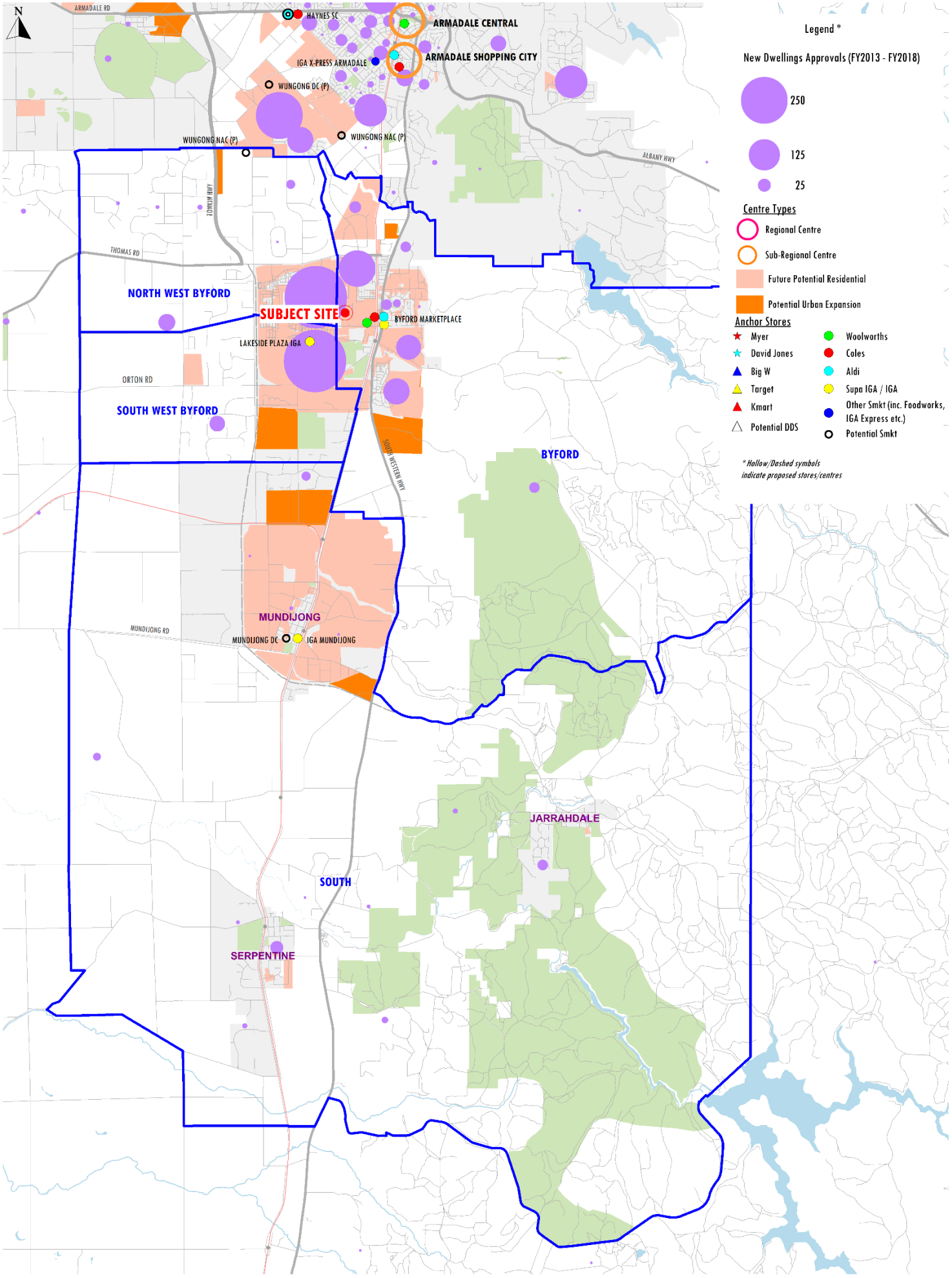
	Average annual growth (no.)				
Trade area sector	2011-16	2016-19	2019-21	2021-26	2026-31
• Byford	492	300	400	400	350
• South	78	80	120	250	750
• South-West Byford	802	600	600	600	400
• North-West Byford	426	400	400	400	230
Main trade area	**1,798**	**1,380**	**1,520**	**1,650**	**1,730**

	Average annual growth (%)				
Trade area sector	2011-16	2016-19	2019-21	2021-26	2026-31
• Byford	7.4%	3.5%	4.3%	3.7%	2.8%
• South	1.4%	1.3%	1.9%	3.6%	8.3%
• South-West Byford	36.2%	10.6%	8.3%	6.5%	3.4%
• North-West Byford	9.3%	6.3%	5.4%	4.6%	2.2%
Main trade area	**9.2%**	**5.2%**	**5.1%**	**4.6%**	**3.9%**

**As at June*
Source: ABS Census 2016; Western Australian Planning Commission, WA Tomorrow; Forecast.id; MacroPlan Dimasi

Map 2.2 following illustrates the new dwelling approvals around the Byford locality. As shown, a significant level of residential development has occurred over recent years within the main designated growth areas to the north-west and south-west of the Byford Town Centre. Future population growth within the main trade area will be mainly driven by greenfield developments, with the majority of growth to occur within the South-West Byford and South Byford sectors.

Taking all of the above into account, the main trade area population is expected to continue to grow over the coming years and is forecast to reach 49,290 residents at 2031, representing an average annual growth rate of 4.4%. The majority of this growth is to occur within the South-West Byford sector which is expected to reach 13,100 residents at 2031.



Map 2.2: Byford

New Dwellings approvals, FY2013-18

macroplan

2.3 Socio-demographic profile

Table 2.2 and Chart 2.1 detail the socio-demographic profile of the main trade area population based on the ABS 2016 Census of Population and Housing, compared against metropolitan Perth and Australian averages. The key highlights are as follows:

- Main trade area residents earn above average household incomes, however residents of the Byford sector earn slightly below average household incomes (-1.9%) where per capita incomes fell in comparison to the benchmark between 2011 and 2016. The most affluent sector in the main trade area is the North-West Byford sector with an average household income that is 11.1% above the metropolitan Perth benchmark.
- The average age of main trade area residents is 33 years, which is notably lower than the metropolitan Perth average of 37.4 years. This difference reflects the above average representation of children, and below average proportion of residents over 50 years old, with these metrics increasing between 2011 and 2016.
- 86.5% of households in the main trade area own their home, which is above the metropolitan Perth average of 71.7%. The main trade area has a high proportion of residents in the process of buying their homes, as opposed to outright owners (65.3% versus 21.2%).
- Australian born residents account for 73% of the main trade area population, which is above the metropolitan Perth average (61.4%). The proportion of Australian born residents in the trade area has declined from 75.1% in 2011.
- Traditional families are the most prevalent household type in the main trade area, accounting for over half (54.5%) of households. This is much higher than the metropolitan Perth benchmark, where traditional families account for 47% of households.

The age distribution, home ownership level and above average household size of the main trade area indicate that the region is dominated by young traditional families attracted by the affordability of housing in the area and the lifestyle on offer. Young traditional families typically associate strongly with their local shopping centres.

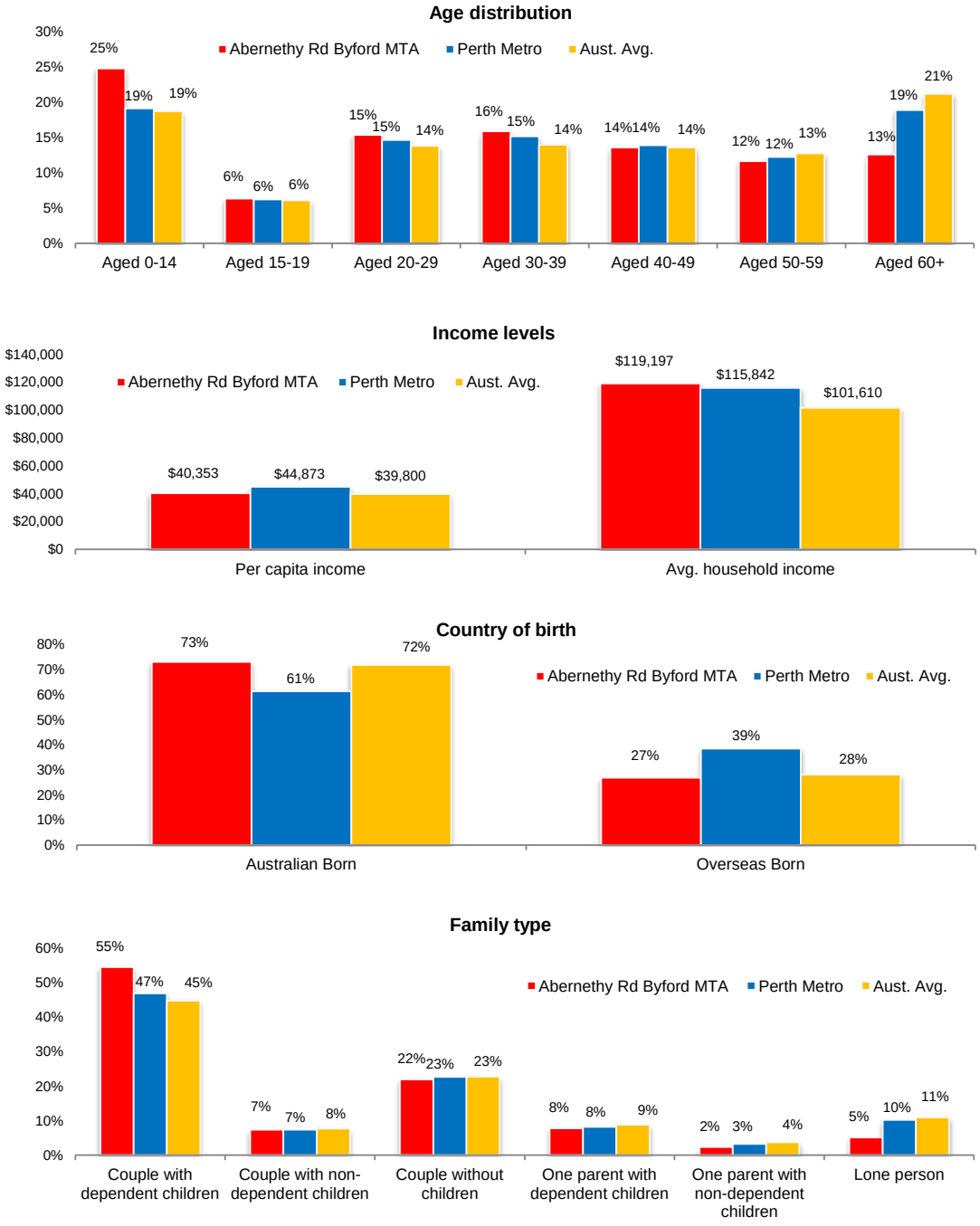
Table 2.2
Abernethy Rd Byford main trade area - socio-demographic profile, 2016

Census item	Byford	South	Sth-west	Nth-west	Main TA	Perth Metro avg.	Aust. avg.
Per capita income	$37,701	$42,472	$40,699	$41,587	$40,353	$44,873	$39,800
Var. from Perth Metro bmark	*-16.0%*	*-5.3%*	*-9.3%*	*-7.3%*	*-10.1%*		
Avg. household income	$113,623	$118,292	$118,622	$128,674	$119,197	$115,842	$101,610
Var. from Perth Metro bmark	*-1.9%*	*2.1%*	*2.4%*	*11.1%*	*2.9%*		
Avg. household size	3.0	2.8	2.9	3.1	3.0	2.6	2.6
Age distribution (% of population)							
Aged 0-14	26.5%	19.9%	26.8%	25.5%	24.8%	19.1%	18.7%
Aged 15-19	6.2%	7.6%	5.0%	6.4%	6.3%	6.2%	6.1%
Aged 20-29	16.2%	10.0%	21.1%	14.6%	15.3%	14.6%	13.8%
Aged 30-39	16.2%	10.2%	20.9%	16.7%	15.8%	15.2%	14.0%
Aged 40-49	12.3%	16.8%	11.7%	13.5%	13.5%	13.9%	13.5%
Aged 50-59	10.4%	15.8%	7.8%	12.4%	11.6%	12.2%	12.7%
Aged 60+	12.2%	19.7%	6.7%	10.8%	12.6%	18.8%	21.1%
Average age	32.1	38.6	28.8	32.3	33.0	37.4	38.6
Housing status (% of households)							
Owner (total)	82.3%	88.3%	87.6%	89.5%	86.5%	71.7%	67.4%
• Owner (outright)	19.4%	36.2%	7.8%	19.1%	21.2%	28.8%	31.9%
• Owner (with mortgage)	62.9%	52.1%	79.8%	70.4%	65.3%	42.9%	35.5%
Renter	17.7%	11.3%	12.4%	10.5%	13.4%	27.4%	31.8%
Birthplace (% of population)							
Australian born	72.5%	77.6%	67.7%	73.8%	73.0%	61.4%	71.9%
Overseas born	27.5%	22.4%	32.3%	26.2%	27.0%	38.6%	28.1%
• Asia	4.3%	1.1%	8.4%	6.1%	4.8%	12.5%	11.2%
• Europe	14.1%	16.6%	11.8%	12.1%	13.8%	16.2%	9.6%
• Other	9.1%	4.6%	12.1%	8.0%	8.4%	9.9%	7.4%
Family type (% of population)							
Couple with dep't child.	56.0%	48.0%	58.9%	55.9%	54.5%	47.0%	44.8%
Couple with non-dep't child.	6.9%	10.5%	3.8%	7.8%	7.4%	7.4%	7.7%
Couple without child.	19.7%	26.3%	21.9%	20.5%	22.0%	22.7%	22.8%
One parent with dep't child.	9.2%	5.5%	7.7%	8.7%	7.8%	8.2%	8.8%
One parent w non-dep't chil	2.8%	2.9%	1.9%	1.7%	2.4%	3.3%	3.7%
Lone person	4.9%	6.2%	5.0%	4.6%	5.2%	10.2%	11.0%
Car ownership							
% 0 Cars	1.4%	1.0%	0.8%	0.3%	0.9%	4.9%	7.7%
% 1 Car	21.5%	17.1%	23.8%	17.3%	19.9%	33.1%	36.1%
% 2 Cars	45.3%	35.1%	49.8%	43.7%	43.3%	40.5%	37.5%
% 3 Cars	18.9%	22.1%	17.6%	20.7%	19.9%	13.8%	12.2%
% 4 plus Cars	12.9%	24.7%	8.1%	17.9%	16.0%	7.5%	6.5%

Source: ABS Census of Population & Housing, 2016; MacroPlan Dimasi

Chart 2.1

Abernethy Rd Byford main trade area - socio-demographic profile, 2016



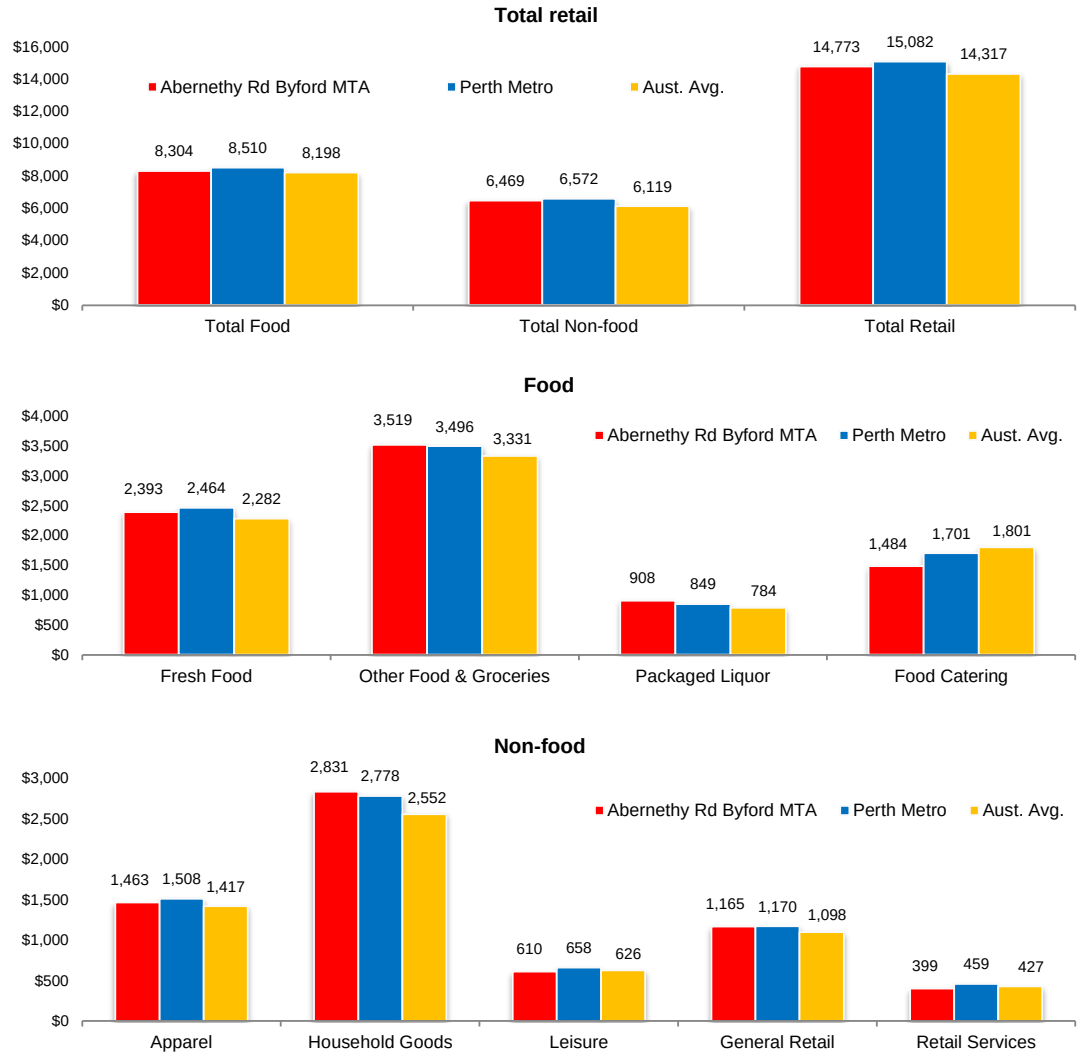
Source: ABS Census of Population & Housing, 2016; MacroPlan Dimasi

2.4 Retail expenditure

Chart 2.2 shows per household retail expenditure capacity for the main trade area population for 2018/19, and compares these estimates with the average for metropolitan Perth and Australia. Total retail expenditure per household is estimated to be **12.1% above** the average for the Perth metropolitan region and **19.4% above** the Australian average. All spending estimates in this report are inclusive of GST.

Chart 2.2

Abernethy Rd Byford main trade area - retail expenditure per person, 2018/19*



*Including GST
Source: MarketInfo; MacroPlan Dimasi

The following points are noted:

- Retail expenditure per household for the main trade area population is estimated to be substantially above the metropolitan Perth average and the Australian average. Expenditure on non-food is 12.6% higher than the Perth average and 22.3% above the Australian benchmark.

- Retail expenditure in the main trade area on packaged liquor is 22.3% above the metropolitan Perth benchmark. While food catering is the only food category performing below the benchmark (-0.2%).

- The retail expenditure capacity of main trade area residents on household goods is above both the metropolitan Perth and Australian averages (+16.6%). Expenditure on general retail is also substantially above (+14%) the Perth benchmark. The only non-food category below benchmark for the main trade area population is spending on retail services (-0.4%) compared with the Perth metropolitan area.

Table 2.3 presents projections of total retail spending generated by the main trade area population, by trade area sector, over the period from 2019 to 2031. The total retail expenditure generated by the main trade area population is estimated at $423 million at 2019. This expenditure is forecast to increase to $949 million by 2031, which reflects an annual average growth rate of 7%.

The average annual growth rate of 7% over the forecast period consists of the following elements:

- Residential population growth, which is expected to average **4.4%** per annum over the forecast period;

- Real growth in per capita retail expenditure, which is generally expected to average **0.8%** per annum over the medium to longer term; and

- Retail inflation, which is assumed to average **1.5%** per annum over the forecast period.

The strongest growth in retail expenditure capacity is forecast to be generated by the South-West Byford sector population, estimated at $93 million at 2019, and forecast to increase to $222 million by 2031, which reflects an average annual growth rate of 7.5%.

Table 2.4 presents estimates of the retail expenditure capacity of the main trade area population by broad retail category over the forecast period. Take-home food, packaged liquor and groceries (FLG), which is the most relevant category for supermarkets, accounts for 46% of all retail expenditure in the main trade area and is forecast to increase from $195 million at 2019 to $444 million by 2031. The household goods category which is the most relevant for large format retail expenditure accounts for 19% of all retail expenditure in the main trade area and is forecast to increase from $81 million at 2019 to $178 million by 2031 showing average annual growth of 6.8%.

Table 2.3
Abernethy Rd Byford main trade area - retail expenditure ($M), 2019-2031*

Year ending June	Byford	South	South-West Byford	North-West Byford	Main TA
2019	129	93	94	107	423
2020	137	97	105	115	455
2021	146	101	117	125	488
2022	156	106	129	134	525
2023	166	113	141	144	564
2024	176	120	154	154	605
2025	187	127	168	165	648
2026	199	135	182	176	692
2027	210	147	195	186	739
2028	221	165	207	195	788
2029	233	183	219	204	840
2030	245	202	232	214	893
2031	258	222	245	224	949
Average annual growth ($M)					
2019-2031	10.7	10.8	12.5	9.8	43.8
Average annual growth (%)					
2019-2031	5.9%	7.5%	8.3%	6.4%	7.0%

**Inflated dollars & including GST*
Source: MarketInfo; MacroPlan Dimasi

Table 2.4
Abernethy Rd Byford main trade area - retail expenditure by category ($M), 2019-2031*

Year ending June	FLG	Food catering	Apparel	Household goods	Leisure	General retail	Retail services	**Total retail**
2019	195	43	42	81	17	33	11	423
2020	210	46	45	87	19	36	12	455
2021	226	50	48	93	20	38	13	488
2022	243	54	52	100	21	41	14	525
2023	262	58	55	107	23	44	15	564
2024	281	63	59	115	25	47	16	605
2025	301	67	63	123	26	50	18	648
2026	322	72	67	131	28	53	19	692
2027	344	78	71	140	30	57	20	739
2028	367	83	76	149	31	60	21	788
2029	392	89	80	158	33	64	23	840
2030	417	96	85	168	35	68	24	893
2031	444	102	90	178	37	71	26	949
Average annual growth ($M)								
2019-2031	20.7	5.0	4.0	8.1	1.7	3.2	1.2	43.8
Average annual growth (%)								
2019-2031	7.1%	7.6%	6.6%	6.8%	6.5%	6.5%	7.1%	7.0%

**Inflated dollars & including GST*
Source: MarketInfo; MacroPlan Dimasi

Retail expenditure category definitions:

- FLG: take-home food and groceries, as well as packaged liquor.
- Food catering: expenditure at cafes, take-away food outlets and restaurants.
- Apparel: clothing, footwear, fashion accessories and jewellery.
- Household goods: giftware, electrical, computers, furniture, homewares and hardware goods.
- Leisure: sporting goods, music, DVDs, computer games, books, newspapers & magazines, stationery and photography equipment.
- General retail: pharmaceutical goods, cosmetics, toys, florists, mobile phones and pets.
- Retail services: hair & beauty, optical goods, dry cleaning, key cutting and shoe repairs.

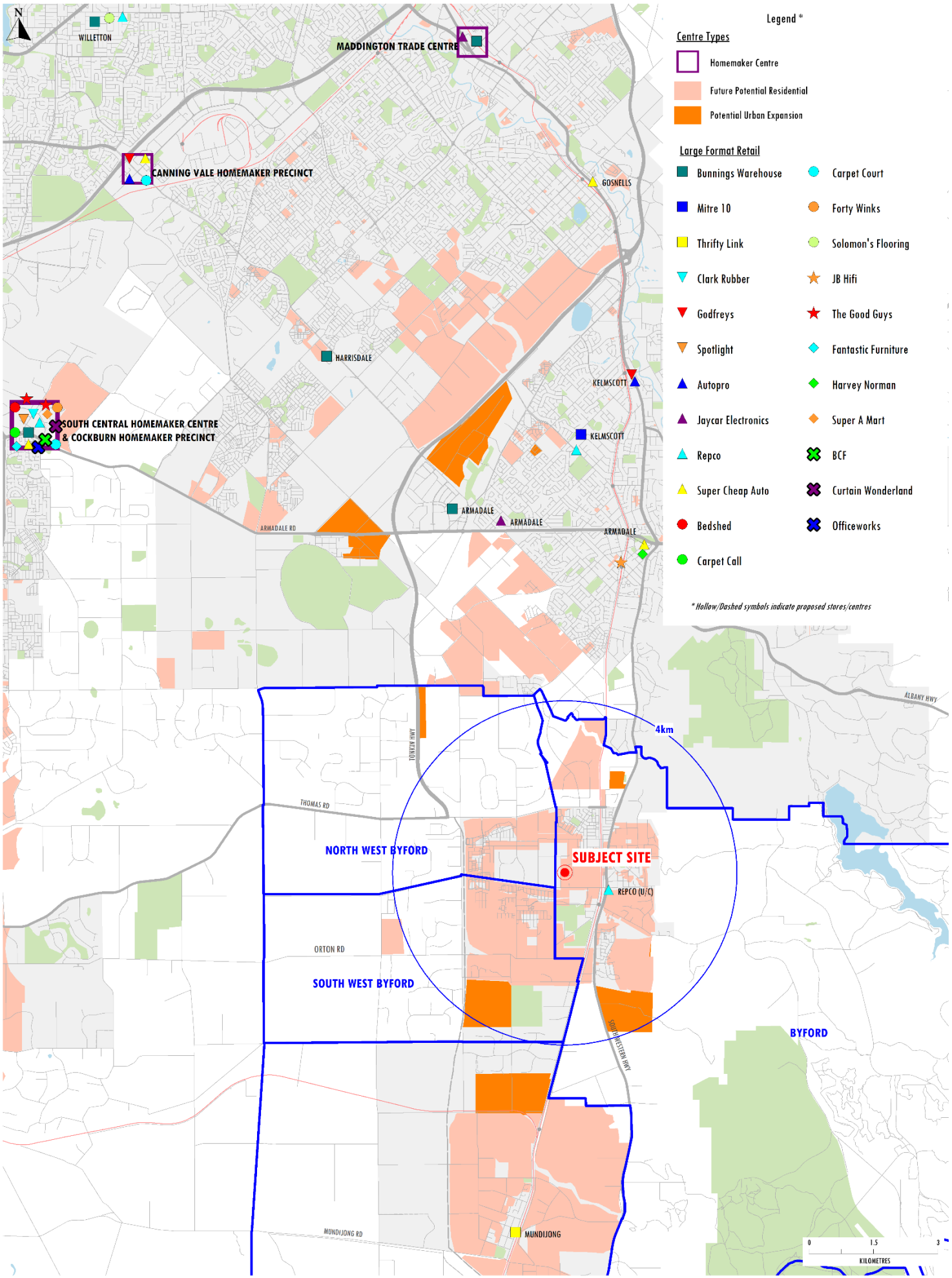
Section 3: Competitive environment

This section of the report outlines the competitive retail environment of the area. Table 3.1 details the major retail facilities of relevance to the subject site, while the previous Map 2.1 illustrates the locations of the traditional shopping centres. The following Map 3.1 illustrates the locations of large format retail outlets in the surrounding region.

Table 3.1
Abernethy Rd Byford - schedule of major retail facilities

Centre	Retail GLA (sq.m)	Major traders	Dist. by road from Abernethy Rd Byford (km)
Within trade area			
Byford Town Centre	13,900		
• Byford Marketplace	4,600	Woolworths, BWS	0.3
• Byford Village	5,000	Coles	0.5
• Byford IGA centre	1,200	IGA, Cellarbrations	0.6
• Aldi Byford	1,600	Aldi	0.8
• Balance	1,500		
Lakeside Plaza	2,500	IGA	2.0
Mundijong		IGA, Thrifty-Link Hardware	8.5
Beyond trade area			
Armadale Shopping City	31,560	Coles, Aldi, Kmart, Target, Best & Less	9.0
Armadale Central	21,780	Woolworths, Big W, Grand Cinema	9.0
Large format retail			
South Central homemaker precinct	46,000		21.0
Canning Vale homemaker precinct			26.0
Maddington trade centre			27.0

Source: Property Council of Australia; MacroPlan Dimasi



Map 3.1: Byford

Homemaker centres/large format retail

macroplan

The older part of the Byford Town Centre straddles the South Western Highway and is situated east of the Perth to Bunbury railway line. As detailed previously, the State Government has committed to electrifying the line to Armadale and providing a new passenger station. The Byford Town Centre has attracted significant investment in new retail and commercial facilities over the past four to five years.

The eastern part of the Byford Town Centre contains a mix of older facilities such as the IGA supermarket and surrounding shops as well as new development including an Aldi supermarket. There is also a range of other commercial facilities and personal services in the area, while to the south of Abernethy Road there is Hungry Jacks and a Tavern. The western part of the Byford Town Centre contains two new neighbourhood centres anchored by Coles and Woolworths supermarkets, as detailed below.

Overall there are six supermarkets located within the main trade area – four of which are located within the Byford Town Centre – which range in size from full scale chain supermarkets to small IGA foodstores.

- **Byford Marketplace** is located on Abernethy Road adjacent to the subject site. The centre is anchored by a 3,600 sq.m Woolworths supermarket and BWS with several specialty stores including a café, a newsagency, a hairdresser and a take-away food outlet. A small cluster of medical/health facilities are also located at the centre including a medical centre, a pharmacy, a dentist, a podiatrist and a beautician. The recently developed centre still have a number of vacant shops still to be leased. The centre has over 250 car parking space and can be easily accessed from Abernethy Road.

- **Byford Village** is located on Abernethy Road approximately 500 metres from the subject site and adjacent to the railway line. The centre opened in late 2016 is anchored by a 4,000 sq.m Coles supermarket. The centre comprises some 1,000 sq.m of specialty retail, as well as a medical centre. Some of the specialty shops include Liquorland, Priceline Pharmacy, The Coffee Club, a florist, a juice bar, a newsagency and several beauty salons/hairdressers.

- **Byford IGA** is located on the South Western Highway approximately 600 metres from the subject site. Located in the same centre are several convenience-oriented specialty stores including Cellarbrations, take-away food outlets and personal services.

- **Aldi Byford** is located on South Western Highway just north of Byford IGA, while further north is a small cluster of specialty shops.

- **Lakeside Plaza** is a neighbourhood centre situated approximately 2 km south-west of the subject site within The Glades residential estate. The centre encompasses an IGA supermarket, major medical precinct and some 15 specialty stores.

- **Mundijong IGA** is located on Patterson Street in a retail strip centre approximately 9 km south of the subject site, while a Thrifty-Link Hardware store is also located nearby.

Beyond the extent of the main trade area there is additional retail facilities of competitive relevance, which include two sub-regional shopping centres located in Armadale approximately 9 km from the subject site.

Within the main trade area there is very limited provision of large format retail, with only the Thrifty-Link Hardware store at Mundijong. The closest other large format retail outlets are situated beyond the main trade area at Armadale, approximately 8 km north of the subject site, including a Harvey Norman and Super Cheap Auto together on Prospect Road and a large Bunnings Warehouse on Armadale Road. More extensive provision of large format retail is provided at Cockburn/Jandakot approximately 20 km north-east of the subject site. The South Central homemaker precinct comprises approximately 46,000 sq.m and includes retailers such as The Good Guys, Amart Furniture, Beacon Lighting Spotlight, Bunnings, Tyrepower, Clark Rubber, Pet City, Fantastic Furniture and Autobarn.

Section 4: Retail floorspace demand

This sub-section provides a retail floorspace demand analysis for the trade area, in order to determine the appropriate broad scale of facilities that could be supported at the subject site. Modelling retail demand for a given area depends on a range of factors and the output should be viewed in broad terms.

Table 4.1 details the total estimated amount of retail floorspace demand by residents in the main trade area, based on a retail expenditure methodology. The floorspace figures are calculated by applying an average Retail Turnover Density (RTD) to the estimated available retail expenditure figures by category (as detailed in Section 2 of this report). The RTD is the level of sales per sq.m which retailers in each category typically achieve. Adopted RTD levels are the highest for retailers in FLG (including supermarkets), at $9,500 per sq.m, and average around $6,500 per sq.m.

The analysis outlines that the trade area population generates the demand for nearly 65,000 sq.m of retail floorspace. This demand would be served by facilities located within the trade area, such as the existing retailers within the Byford Town Centre, while an amount the retail floorspace demand would be directed to higher-order shopping centres in the broader region, such as at Armadale, Westfield Carousel as well as the Perth CBD. This analysis also shows that the estimated retail floorspace demand by trade area residents is to increase by some 45,000 sq.m over the forecast period to 2031.

Table 4.1
Abernethy Rd Byford main trade area - Estimated retail floorspace demand (sq.m), 2019-2031

Year ending June	FLG	Food catering	**Total food**	Apparel	H'hold goods	Leisure	General retail	Retail services	**Total non-food**	**Total retail**
2019	20,574	6,544	**27,120**	9,320	19,091	2,689	4,453	2,080	**37,630**	**64,750**
2020	21,608	6,900	**28,510**	9,762	20,002	2,813	4,658	2,184	**39,420**	**67,930**
2021	22,714	7,286	**30,000**	10,226	20,971	2,943	4,874	2,295	**41,310**	**71,310**
2022	23,895	7,702	**31,600**	10,712	21,998	3,081	5,101	2,414	**43,310**	**74,910**
2023	25,129	8,139	**33,270**	11,215	23,070	3,224	5,337	2,538	**45,380**	**78,650**
2024	26,367	8,582	**34,950**	11,715	24,140	3,366	5,572	2,663	**47,460**	**82,410**
2025	27,610	9,030	**36,640**	12,211	25,210	3,507	5,806	2,788	**49,520**	**86,160**
2026	28,858	9,485	**38,340**	12,705	26,278	3,647	6,038	2,914	**51,580**	**89,920**
2027	30,146	9,956	**40,100**	13,202	27,381	3,791	6,276	3,044	**53,690**	**93,790**
2028	31,475	10,444	**41,920**	13,702	28,519	3,938	6,520	3,179	**55,860**	**97,780**
2029	32,809	10,938	**43,750**	14,199	29,655	4,084	6,762	3,315	**58,010**	**101,760**
2030	34,148	11,439	**45,590**	14,692	30,790	4,230	7,003	3,451	**60,170**	**105,760**
2031	35,492	11,946	**47,440**	15,183	31,924	4,374	7,242	3,587	**62,310**	**109,750**
RTD*	9,500	6,500	**8,800**	4,500	4,250	6,500	7,500	5,500	**4,900**	**6,500**

**Retail Turnover Density - Turnover ($) per sq.m in 2019, growth assumed at 0.8% p.a*
Source: MarketInfo; MacroPlan Dimasi

In order to determine the broad level of retail floorspace demand generated by the main trade area population for various retail types, an average floorspace provision per capita method can be applied. This provides retail floorspace demand estimates for particular retail formats (e.g. supermarkets, discount department stores, other traditional retail including food and non-food retail stores as well as large format retail).

The retail demand per capita methodology assumes that the provision of retail floorspace per person throughout Australia at present is around 2.2 sq.m. There are no official figures measuring retail floorspace on a national basis, with the Australian Bureau of Statistics having ceased the 5-yearly Retail Census in 1991/92. Having regard to data previously available from retail censuses, and also allowing for the amounts of retail floorspace which have been built over the years, a figure in the order of 2.2 sq.m is considered to be a robust estimate, and is a figure generally used by a majority of retail consultants.

The total per capita retail floorspace supply figure is further broken down into the demand for store types/retail categories, utilising a range of sources. This includes the current provision of supermarket and department store floorspace as sourced from company annual reports; the total amount of shopping centre and large format retail floorspace as sourced from the Property Council of Australia; and estimates of the amount of retail facilities in strip centres and freestanding locations across Australia. Table 4.2 below details the estimated breakup of the current national provision of retail floorspace per capita by store type.

Table 4.2 also provides broad estimates of the expected demand of retail floorspace by retail type for the Byford trade area, currently and at 2026. This analysis assumes that the level of retail floorspace per person remains constant at 2.2 sq.m per person over the forecast period. This is considered a somewhat conservative estimate the as per capita provision rate has historically been increasing over time. Though it is also acknowledged that the ongoing growth in online shopping is putting a downward pressure on the growth in retail floorspace per capita.

Table 4.2
Abernethy Rd Byford - estiamted retail floorspace demand, 2019

Trader/type	Aust. avg. per capita (sq.m)	2019	2026
Food retailing			
Supermarkets	0.35	10,270	14,220
Take-home food & liquor spec.	0.25	7,340	10,160
Food catering	0.25	7,340	10,160
Total food	0.85	24,950	34,540
Non-food retailing			
Dep't stores/DDS	0.24	7,040	9,750
Non-food mini-majors/spec.	0.45	13,210	18,290
Large format retail	0.58	17,020	23,570
Total non-food	1.27	37,270	51,610
Retail services			
Retail services spec.	0.08	2,350	3,250
Total retail floorspace	**2.20**	**64,570**	**89,400**

Source: MacroPlan Dimasi

According to this analysis, the amount of total retail floorspace demand by trade area residents is estimated to increase from 64,600 sq.m to 89,400 sq.m from 2019 to 2026, which is generally consistent with the expenditure methodology method. Based on this analysis, a majority of the supermarket floorspace demand and a significant proportion of the take-home food and liquor specialty space is being served by the existing provision of supermarket and convenience retail facilities provide in the Byford Town Centre and at Lakeside Plaza. On the other hand, as expected, the majority of non-food retail expenditure is presently escaping the main trade area and is mostly being served by surrounding higher-order shopping centres.

Table 4.2 also shows the growth in demand for large format retail floorspace. For this retail category, floorspace demand is estimated at 17,600 sq.m at 2019, increasing to 23,400 sq.m at 2026. Given the lack of large format retail facilities in the trade area, most of this demand would be directed to facilities located beyond the catchment. This shows the potential for a provision of large format retail outlets at the subject site.

Section 5: Potential supportable commercial uses

This section considers the retail and non-retail uses expected to be supportable at the subject site. The following analysis and conclusions allow for planned extensive population growth in the area, as well as the future Byford train station, which will improve the convenience of the area. The Tonkin Highway extension will also greatly improve accessibility to Byford. At present a grade separation is planned at Orton Road in the south of Byford, rather than Abernethy Road. While a grade separation at Abernethy Road would be preferred, it is not considered critical for the recommended uses. This reflects that the site is situated adjacent to the Byford Town Centre which will remain the main activity hub serving Byford and the surrounding area.

5.1 Potential retail uses

Discount department stores

Discount department stores (dds) are large outlets typically located in shopping centres and range in size from around 5,500 - 8,000 sq.m. Target, Kmart and Big W are the major chain dds operators in Australia. The three major chains currently have some 590 stores (excluding the smaller Target Country stores), with each chain operating nearly 200 stores each. Across Australia, there is generally one dds for every 35,000 – 45,000 residents in major metropolitan locations, with the provision generally higher in the outer growth corridors.

Given that the population of the trade area will only reach 40,000 at around 2026, there is not considered short to medium term potential for a dds at the subject site.

Supermarket

A supermarket would be a strong anchor for the subject site, however given that Woolworths, Coles, Aldi and IGA supermarkets are already present in the local area, a supermarket is not expected to be sustainable at the subject site for the foreseeable future.

Large format retail

The analysis in Section 4 of this report shows that the trade area population currently generates considerable demand for large format retail outlets. Given the lack of such facilities in the catchment, most the homemaker expenditure of the trade area population is currently being directed to large format retail precincts located outside the trade area.

The population of the trade area is approaching 30,000, which is not considered sufficient to support a large homemaker centre. However, there is considered the potential to sustain a small cluster of large format retailers at the subject site. The types of tenants expected to be supportable include an auto accessories outlet, a bicycle superstore, a flooring outlet, a furniture store and an electrical outlet.

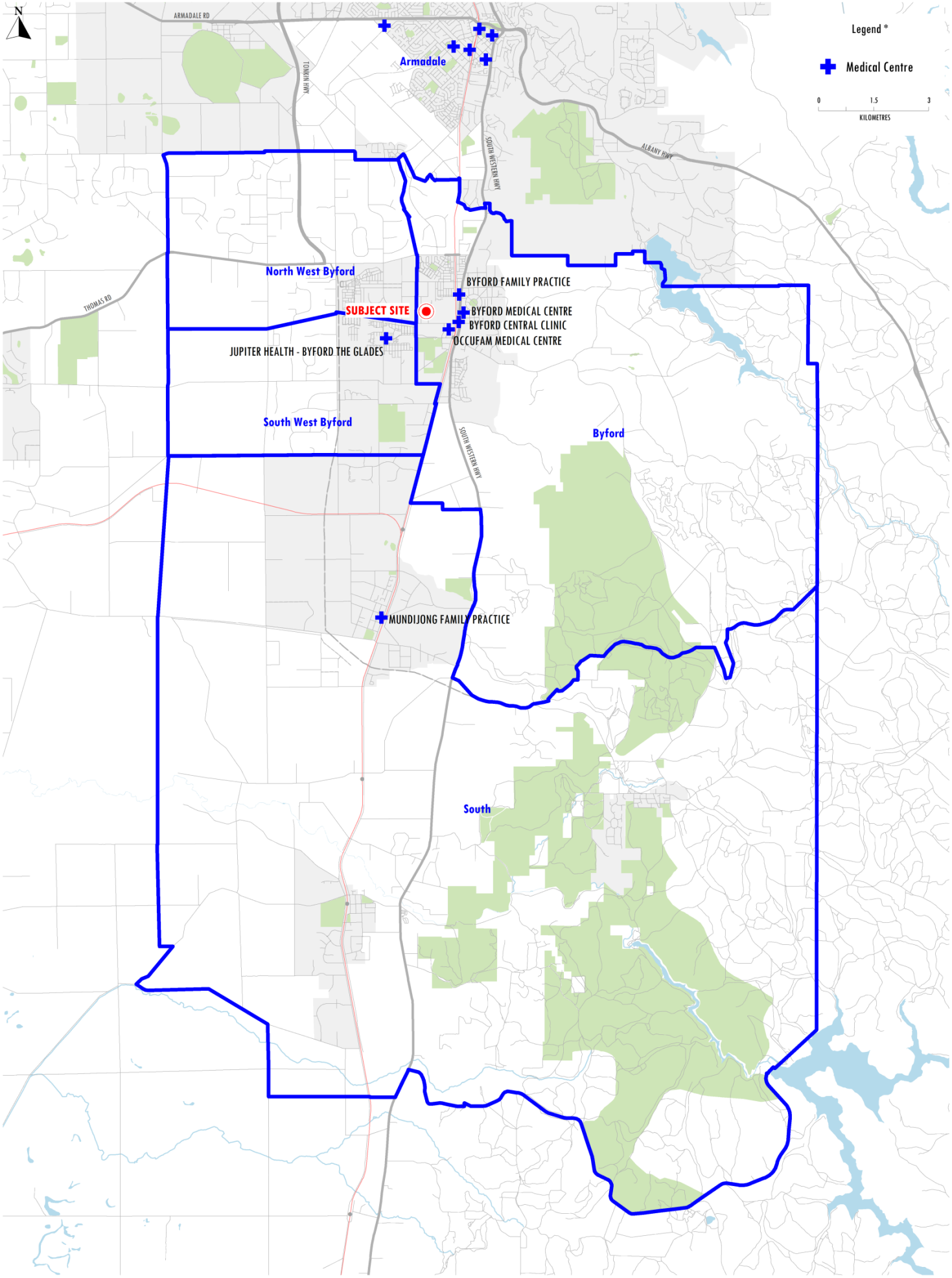
5.2 Potential non-retail uses

Medical precinct

With a growing proportion of expenditure going towards healthcare costs, medical centres can perform an important use in mixed-use developments. Medical centres can generate a steady flow of people to locations, with obvious benefits for retailers, particularly a pharmacy. Medical centres attract all population segments, though the most important customer groups are likely to be elderly residents and young children.

Map 5.1 illustrates the location of medical centres in the surrounding area. At present the local area is reasonably well served with five medical centres located in Byford. There are also a mix of allied health facilities located throughout Byford.

There is considered moderate demand for a medical centre at the subject site, given the existing supply in the local area. Though, a larger medical precinct is expected to work well if a medical centre is co-located with a number of other allied health facilities such as a dental clinic, a podiatrist, a chiropractor, an osteopath, a psychologist and/or a physiotherapist. A discount pharmacy such as Chemist Warehouse would be a suitable anchor for such a medical precinct, though pharmacy location rules may prevent a pharmacy locating at the subject site given the provision of existing pharmacies in the local area.



Byford

Medical centres

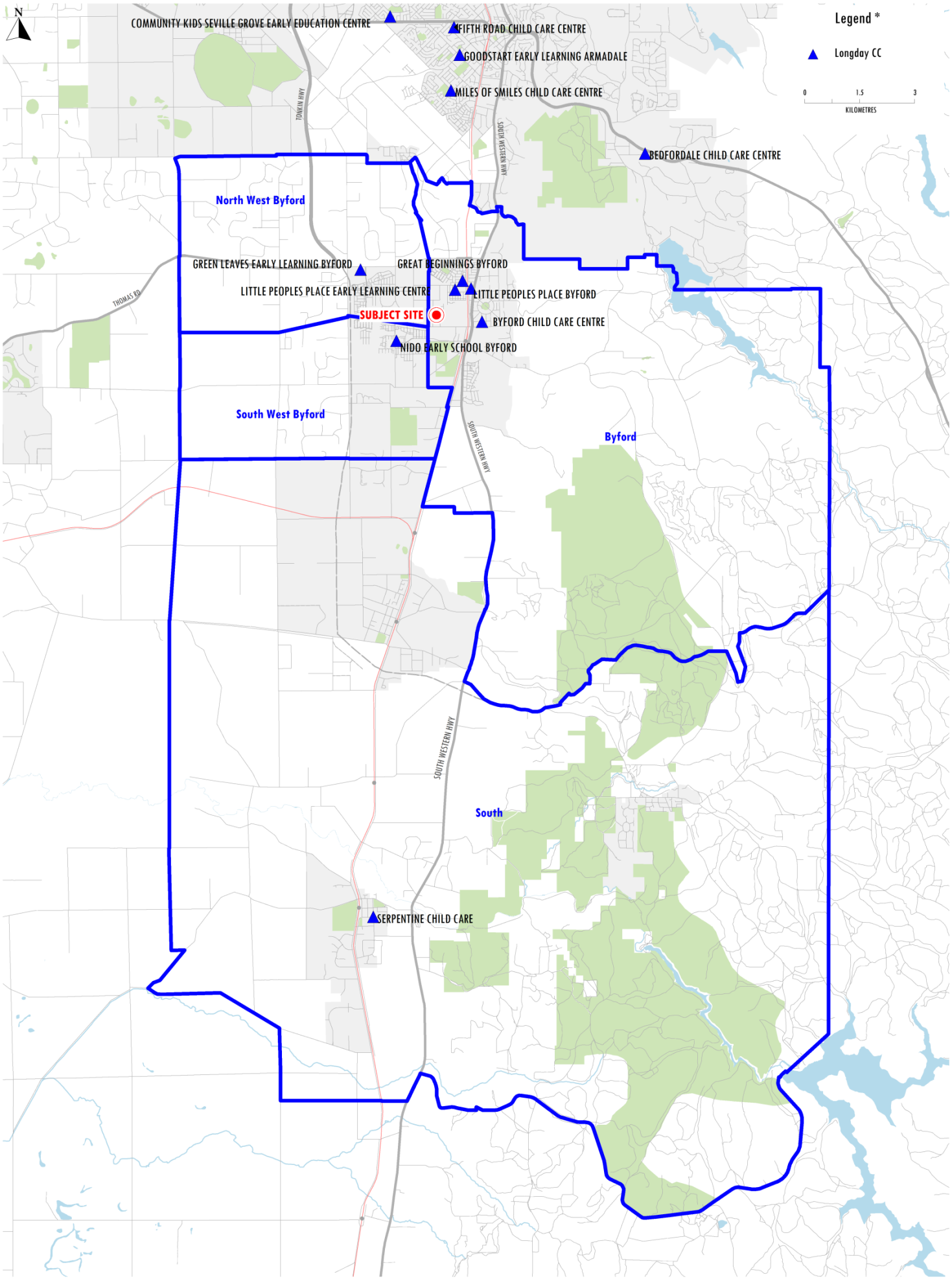
macroplan

Childcare centre

Childcare facilities are typically well suited to growing areas in outer metropolitan locations, which generally attract young families. Locating childcare centres close to activity centres capitalises on the generally 'time poor' nature of parents of young children, many of whom are likely to value the convenience of a range of other facilities near their childcare centre.

Childcare centres attract the bulk of activity on weekdays in the mornings (between 7am and 9am) and in the afternoons/evenings (between 4pm and 6pm). These centres are typically closed on weekends. Childcare centres provide services to working parents, and there are obvious opportunities for synergies with retailers and other commercial uses at the site.

In broad terms, a childcare centre requires a catchment population of around 5,000 people, therefore around six childcare centres are potentially supportable in the Byford trade area. As shown on Map 5.2 there are seven childcare centres located in the catchment, with six centre situated in Byford. Therefore, there is not considered a good opportunity for a childcare centre to be included at the subject site at the present time.



Byford

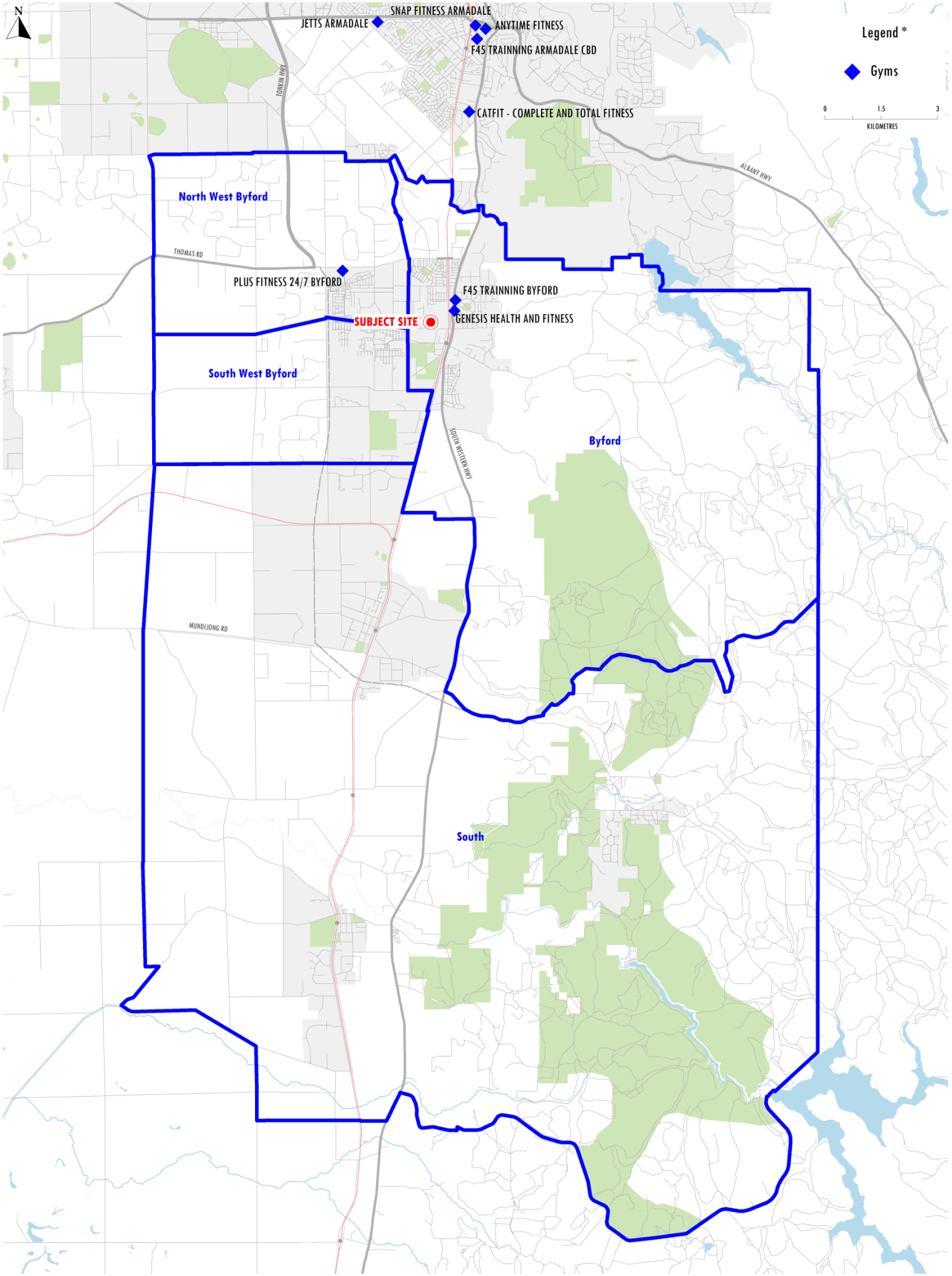
Childcare centres

macroplan

Gymnasium/fitness facilities

The growing health and wellbeing sector presents an opportunity to provide a gymnasium or a fitness centre within mixed-use developments. Such a facility greatly adds to the convenience of mixed-use developments, and can cater to the needs of local residents. Fitness centres have the potential to drive activity outside of typical retail hours, and can greatly contribute to the overall amenity of commercial developments.

There are currently three fitness centres/gymnasiums located in the trade area, as shown on Map 5.3. Given the existing catchment population, combined with the strong population growth, there is considered the sufficient demand to support a gymnasium or fitness centre at the subject site. The size of the gymnasium could potentially vary from a boutique offer of around 300 - 400 sq.m, while a larger offer would require up to 1,000 sq.m of floorspace. The gymnasium would suit catering to the generally budget-conscious population, who are also relatively time poor and may need to use the facility afterhours. A 24 hour chain outlet, such as Jetts Fitness, Snap Fitness or Anytime Fitness of around 400 sq.m, would potentially work well at the subject site. The closest Jetts Fitness/Snap Fitness/Anytime Fitness outlets to Byford are located at Armadale.



Byford

Gymnasiums/fitness centres

macroplan

Service station and fast food outlets

Service stations and fast food outlets typically locate on easily accessible sites with substantial amount of passing traffic. The subject site has extensive frontage to Abernethy Road, which is a major east-west traffic route in the area. Traffic volumes along Abernethy Road are expected increase as strong population in the area continues, with the road currently being upgraded.

Given the high-profile location of site and its central location in Byford, there is considered the opportunity for a service station as well as one or two fast food outlets to be supportable at the subject site.

Summary and conclusions

The subject site is easily accessible and well-located on Abernethy Road, immediately to the west of the existing retail facilities within the Byford Town Centre. Future uses at the site are well placed to serve the substantial and rapidly growing population of Byford and the surrounding area. Based on the analysis presented in this report the subject site is expected to be able the support the following retail and non-retail uses:

- A medical hub anchored by a medical centre and pharmacy (depending on location rules), together with around 4-5 allied health facilities;
- A gymnasium of around 400 sq.m;
- Around five large format retail outlets of around 500 – 1,000 sq.m each; and
- A service station and a fast food restaurant on pad sites.

TABEC
Civil Engineering Consultants

AIGLE ROYAL DEVELOPMENTS
LOT 1 ABERNETHY ROAD, BYFORD
Engineering Servicing Summary

AUGUST 2019

CLIENT: AIGLE ROYAL DEVELOPMENTS

PROJECT: 2399 – LOT 1 ABERNETHY ROAD BYFORD

TITLE: LOT 1 BYFORD ENGINEERING SERVICING REPORT

DOCUMENT REVIEW				
Revision	Date Issued	Written By	Reviewed By	Approved By
A	14 August 2019	BF	MA	BF
B	18 May 2020	BF	MA	BF

TABLE OF CONTENTS

TABLE OF FIGURES

1 INTRODUCTION

Aigle Royal Developments (ARD) is proposing to develop Lot 1 Abernethy Road, Byford (the Site). The following report provides a broad overview of the existing conditions and summarises our assumptions regarding the possible infrastructure servicing for the Site. The report has been prepared for ARD to assist with their local structure plan (LSP) amendment for the proposed residential and commercial development.

The investigation and preparation of the report is mainly based on preliminary advice from the various service authorities. The information is current as of August 2019 and is subject to change as development proceeds around the Site.

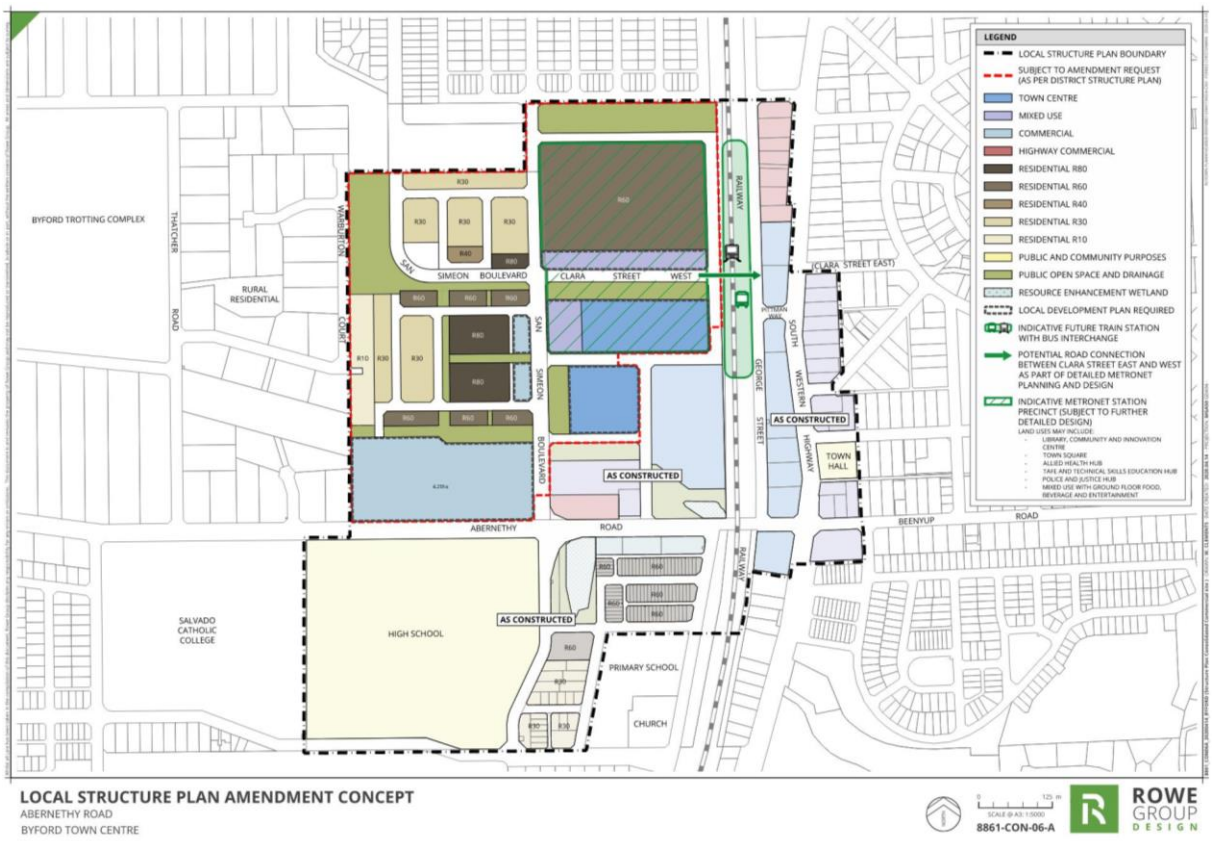


Figure 1 – Rowe Group LSP Amendment Concept (April 2020)

2 THE SITE

2.1 Site Description

The 19.7-hectare Site is located approximately 40 kilometres southeast of the Perth CBD, adjacent to the Byford Town Centre and in close proximity to the proposed Byford Train Station within the Shire of Serpentine Jarrahdale.

The Site is zoned 'Urban' under the Metropolitan Region Scheme and 'Urban Development' under the Shire of Serpentine Jarrahdale Town Planning Scheme No. 2. The Site forms part of the approved Byford Town Centre Local Structure Plan prepared by Urbis in 2014. A previous development concept plan for the Site also had conditional WAPC subdivision approval.

The Site is located on the northern side of Abernethy Road opposite Byford Secondary College and bound by Byford Village Shopping Centre to the east, Warburton Court and existing development to the west and the Marri Park development to the north.

Figure 2 – Lot 1 Abernethy Road, Byford (Aerial Image)

2.2 Landform / Topography

The Site had previously been used for grazing purposes and is cleared and predominantly grassed, except for a few scattered trees in the southeast portion of the Site. There are no existing major structures, however two drains, Beenyup Brook and Oaklands South Drain, traverse the Site which is also seasonally inundated due to perching of rainfall runoff.

The Site level adjacent to the Abernethy Road and Sansimeon Boulevard intersection is approximately RL53m AHD, gently falling in a north-western direction at approximately 1% grade to RL45m AHD in the northwest corner.

Beenyup Brook is located in the southern portion of the Site and flows in an east to west direction. The Oaklands South Drain traverses the northern portion of the Site in a northwest direction. There are no Conservation Category Wetlands or Bush Forever Sites within the landholding. The nearest sensitive wetlands are located either upstream or significantly downstream of the Site and therefore will not be impacted by the proposed development.

Figure 3 - Lot 1 Abernethy Road Contours (MNG Maps, 2019)

2.3 Ground Conditions

The surface geology type is described as Guildford Clay: alluvium (clay, loam, sand and gravel). A geotechnical site investigation undertaken in 2009 found that the soil conditions across the Site generally comprised sand, silt, clayey gravel and clayey sand.

The investigation determined the topsoil consists of fine to medium grained and silty sand with rootlets to approximately 0.1m depth. The topsoil is underlain by a thin layer, 0.2m-0.3m depth, of fine to medium grained sand with silt and gravel in the south and south-western corner of the Site. The remainder of the Site is underlain by clayey gravel or clayey sand.

Groundwater levels are subject to variation due to the influence of rainfall, temperature, tides, local drainage and the seasons. The Department of Water and Environment Regulation (DWER) Perth Groundwater Atlas does not provide any groundwater level records for the Site.

Low-lying areas of the Site become waterlogged during winter months due to the perching of rainfall runoff on the shallow clays of the Guildford formation. The development of the Site will not interact with the deep regional groundwater aquifer and will require the installation of subsoil drainage on the Guildford formation to alleviate the perching of rainfall on the shallow clayey sand and gravel material.

Localised groundwater monitoring was undertaken as part of the previous Lot 1 Abernethy Road LWMS. This monitoring recorded peak perched groundwater levels across Lot 1 that ranged between 0.4m to 0.9m below the surface. The peak perched groundwater level of 0.4m below the surface was recorded at a monitoring bore located in the centre of the Site (MB21).

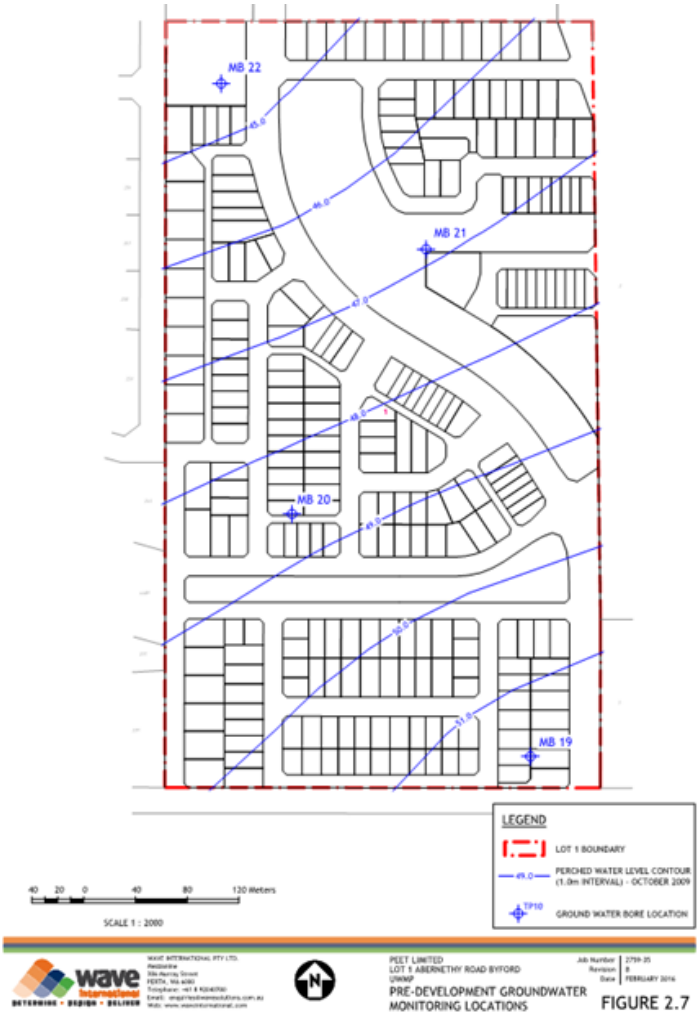


Figure 4 – Lot 1 Predevelopment Perched Groundwater Levels October 2009 (Wave, 2016)

A review of the DWER Acid Sulfate Soils (ASS) risk mapping indicates that the Site is located in an area having moderate to low risk of ASS occurring within 3m of the natural ground surface.

The ASS risk mapping is provided below:

Figure 5 – Acid Sulfate Soil Risk Mapping (DWER)

If ASS is to be disturbed, a suitably qualified environmental consultant will be engaged to conduct an investigation of the area and if necessary, prepare an ASS Management Plan. The ASS Management Plan will detail the actions to minimise and mitigate potential adverse environmental effects during the works.

3 SITEWORKS AND EARTHWORKS

Siteworks for urban development generally comprises the clearing of existing vegetation, stripping of topsoil and the earthworking of existing ground surfaces to facilitate a required form of development.

There is an appreciation of the importance to retain significant existing vegetation and topography to provide a sense of place within development areas and to meet sustainability objectives. Whilst the Site contains limited vegetation that may be suitable for retention in a residential development, the proposed areas of commercial development and importation of fill to raise existing ground levels may affect the ability to retain this vegetation.

The earthworks are likely to involve the sand filling of the Site, regrading of the subsurface clay layer and installation of subsoil drainage to support development, provide the required clearance to the Guildford formation and post-development perched groundwater levels and achieve the desired site classification. Earthworking of the Site is also required to ensure the positive drainage of the allotments to the road and drainage reserves for disposal.

It is anticipated that the final levels across the Site will be dictated by either the fill required for improvement of the AS2870 site classification or the minimum level required to ensure adequate separation from the Guildford formation and groundwater levels. Additionally, final levels will need to accommodate interface levels with the adjacent developments and existing infrastructure. Furthermore, finished floor levels for the buildings will need to be at least 500mm above the estimated 1% average exceedance probability (AEP) flood levels within the multiple use corridors.

The Site naturally falls 1% from the southeast to northwest. As the wastewater services are planned to generally follow the natural grade of the land, it is not envisaged that the sewer will influence the determination of minimum lot levels.

Based on achieving a targeted site classification in accordance with AS2870, previous geotechnical investigations for the Site and site classification for the adjacent development, a site classification of ‘S’, is anticipated post development following suitable site preparation as determined by a detailed geotechnical investigation and market acceptability.

The imported material used for filling should be a free drainage clean sand material having a fines content less than 5% and permeability greater than 5m/day to avoid the imported material having a negative impact on site drainage.

In accordance with current market expectations flat residential allotments will generally be created. Due to the existing flat nature of the Site, stepping between allotments is likely to be achieved with the minimal use of retaining.

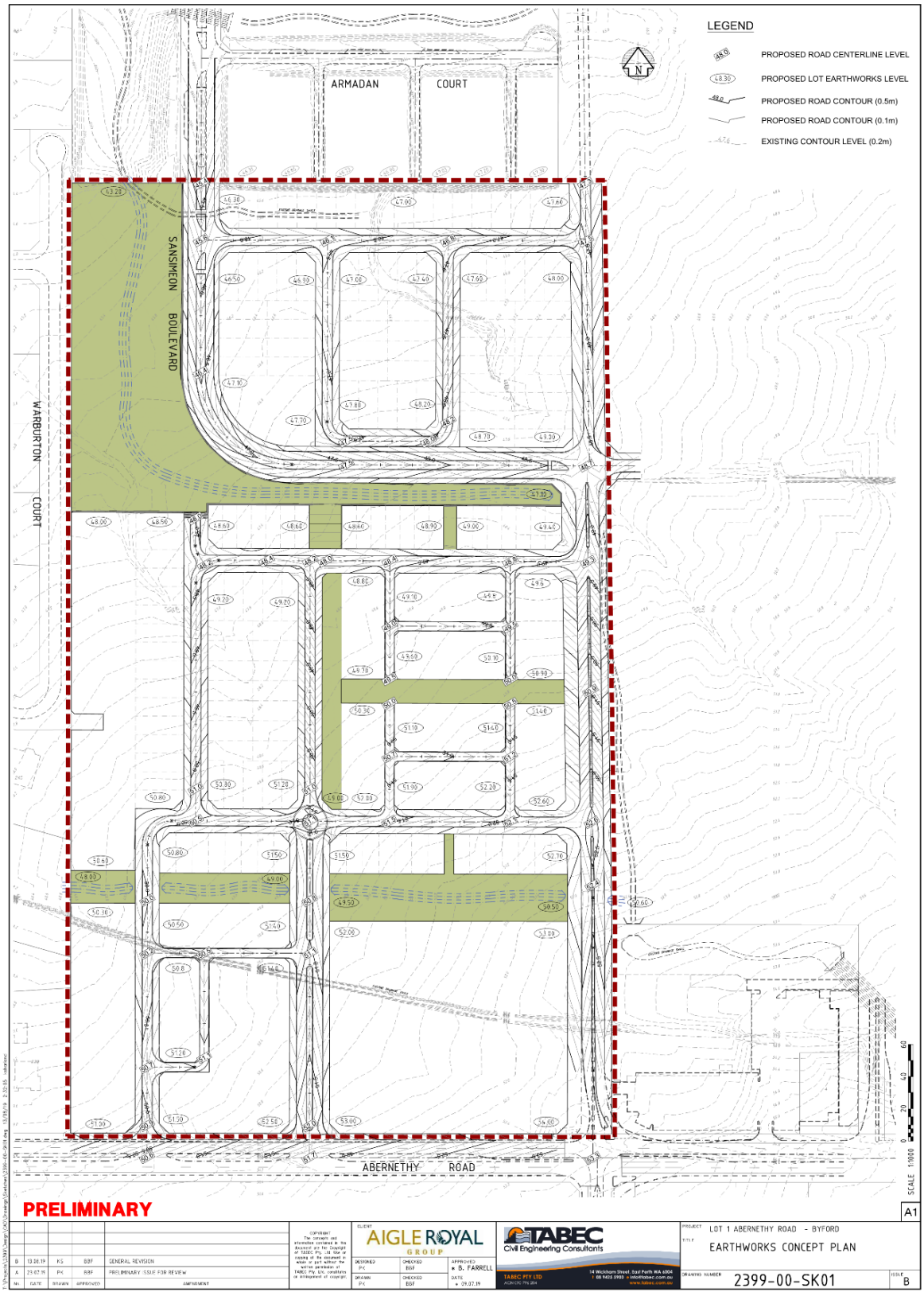


Figure 6 – Preliminary Bulk Earthworks Design (TABEC, 2019)

4 ROADS AND TRAFFIC

The Site is well connected to the regional road network with the adjacent Abernethy Road providing the main connection for vehicular access to the Site. Abernethy Road provides a connection to the Byford Town Centre and South Western Highway to the east and Thomas Road, via Nicholson Road, to the west. The section of Abernethy Road adjacent to the is currently being upgraded by the Shire of Serpentine Jarrahdale to a dual carriageway road with a roundabout at the future Sansimeon Boulevard intersection.

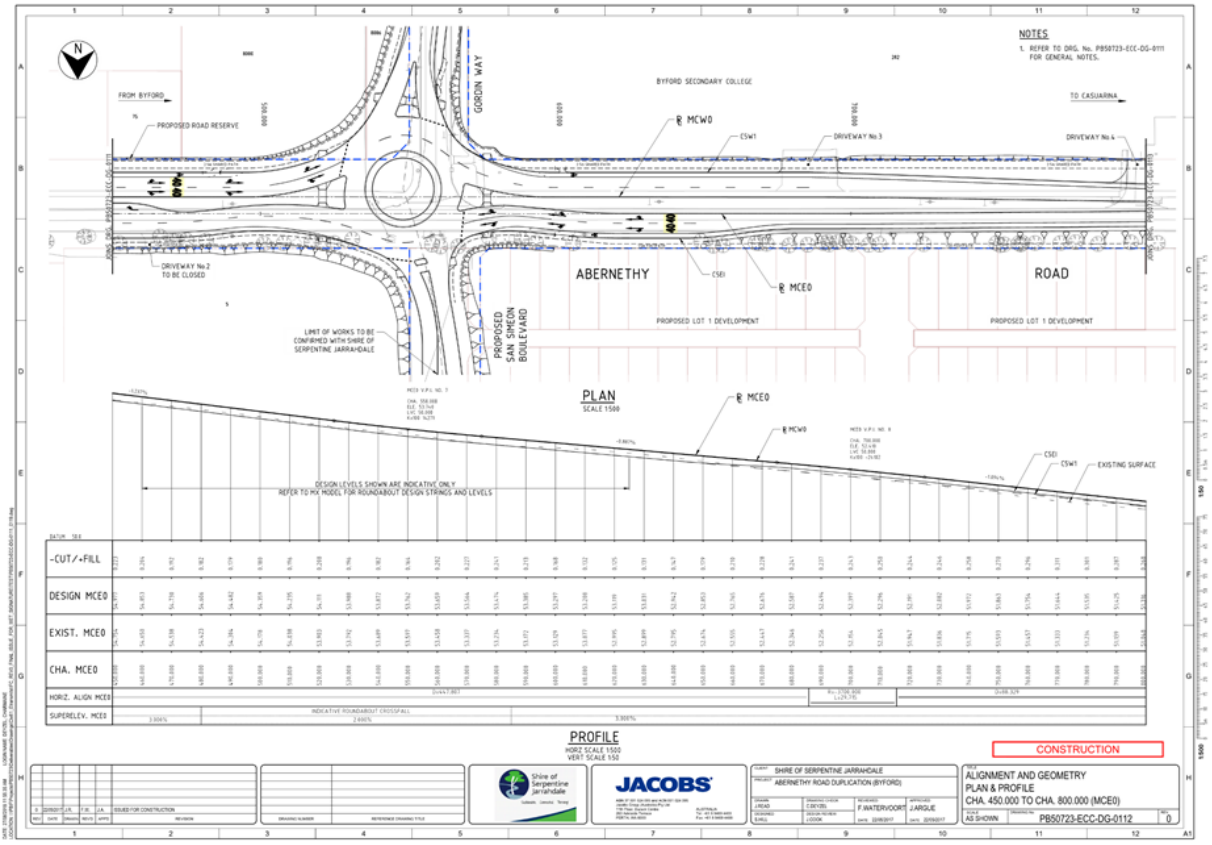


Figure 7 – Abernethy Road Upgrade Design (SoSJ/Jacobs, May 2017)

Figure 8 – Abernethy Road, Byford – Before Upgrade (Google Street View, May 2018)

Access to the development is proposed via the extension of Sansimeon Boulevard from the Abernethy Road roundabout to the existing Marri Park development on the northern boundary of Lot 1. The extension of Sansimeon Boulevard through the development will provide the main local distribution of traffic within the development. Two additional intersections with Abernethy Road are also proposed to provide access to the development and service the commercial area.

The internal road network will be required to be in accordance with the current Liveable Neighbourhoods, Shire of Serpentine Jarrahdale standards and IPWEA Subdivision Guidelines. Roadworks will generally consist of kerbed and asphalted pavement. A network of dual use and pedestrian footpaths will also be required to facilitate pedestrian movement throughout the development.

5 STORMWATER MANAGEMENT

The Site falls within the area covered by the Byford District Water Management Strategy (DWMS), which was prepared by Urbaqua (2018). The DWMS addresses broadscale stormwater management measures over a 4,500-hectare area which includes the Site. A Local Water Management Strategy (LWMS) and Urban Water Management Plan (UWMP) were prepared for the previous development proposal for the Site Wave International.

Hyd2o, on behalf of ARD, has prepared a LWMS addendum to support the revised local structure plan that has been prepared for Lot 1 Abernethy Road, Byford. The addendum seeks to update the LWMS to align the stormwater management strategy with both the updated LSP and the Byford DWMS.

Key elements of the proposed system refine the strategy presented in the Byford DWMS which are reflected in the LSP including:

- Maintenance of existing surface water flow paths for Beenyup Brook and Oaklands Drain.
- Creation of a link to divert flows from Beenyup Brook towards Oakland Drain to assist with alleviating flooding downstream as outlined in the DWMS.
- There are no offline stormwater detention areas proposed for the Site. Subdivisional drainage will utilise the online storage of the district drainage network as the critical durations differ for the subdivision and for the regional flows.

Stormwater management will be undertaken consistent with DWER water sensitive design practices. The system will consist of lot soakwells, subsoil drainage, piped road drainage system, biofiltration areas, and both Beenyup Brook and Oaklands Drain realigned and reconfigured to provide water quantity and quality treatment for stormwater generated from the proposed development and the external catchment.

Runoff from minor events will be retained and infiltrated on Site. Individual lots will be managed using soakwell systems or rainwater tanks to retain and infiltrate roof runoff. A conventional piped network will be designed to manage road runoff discharging to the MUCs. Major events will be conveyed away from properties to the MUCs via overland flow within road reserves.

Volumes for ecological protection will be based on the first 15mm event. These volumes will be determined at UWMP stage on the basis of more detailed modelling in parallel with engineering design. Final design and ultimate configurations will be determined in consultation with the Shire.

Regional flows will dictate the design of the multiple use corridors (MUCs) as these flows are substantially larger than the flow generated by the subdivision. The flood attenuation area configuration, location, and elevations will be documented in future UWMPs and will be dependent on final earthworks, drainage, and road design levels for the development.

The stormwater drainage system will be designed and constructed in accordance with Council requirements.

Development of the Site will also require the installation of subsoil drainage on the Guildford formation to alleviate the perching of rainfall. Subsoil drainage outfall levels will be governed by the invert levels of the Beenyup Brook, Oaklands South drain and the Guildford formation layer. Subsoil drains will require a free outfall above the invert level of the MUCs to ensure a free-flowing outlet above the winter baseflow levels.

The subsoil drains will outfall to the bioretention swales so that discharge is treated before being exported from the Site. The subsoil drainage network will be integrated with the piped stormwater drainage network.

The conceptual Hyd2o stormwater management plan is shown below:

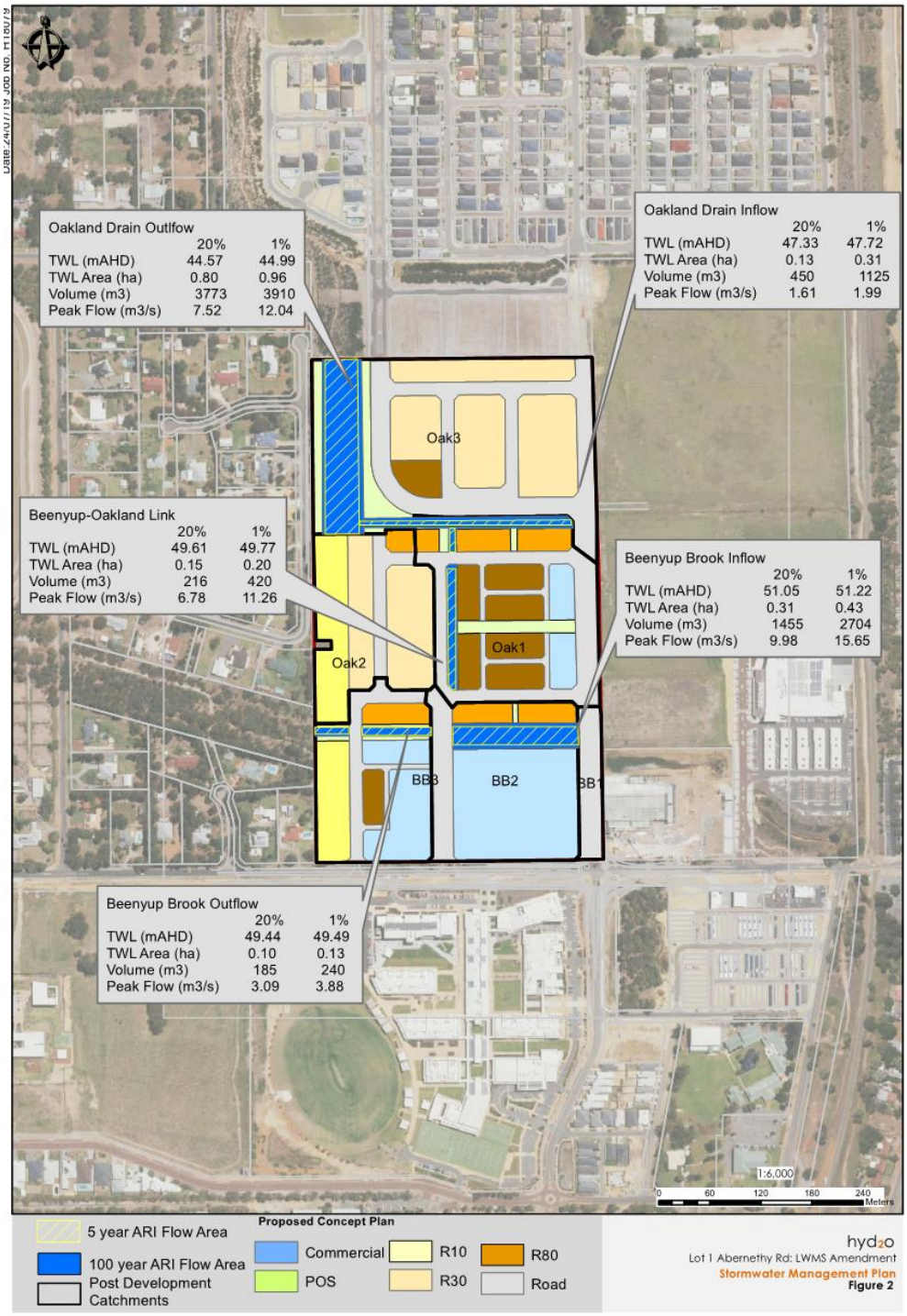


Figure 9– Stormwater Management Plan (Hyd2o, 2019)

6 WASTEWATER

In accordance with current Water Corporation catchment planning, the proposed development will be sewered via an extension of the sewer located in Sansimeon Road adjacent to the Marri Park development on the northern boundary of Lot 1 Abernethy Road.

Figure 10 – Existing Wastewater Infrastructure (Water Corporation, 2019)

The DN300 sewer will be extended along Sansimeon Road before reducing to a DN150 sewer main south of the future DN300 sewer connection from Lot 5. DN300 gravity sewers constructed by Developers are refunded by the Water Corporation at a fixed linear metre rate.

Water Corporation planning will be reviewed when the staging and timing of development progresses further. Wastewater infrastructure will be designed and constructed in accordance with Water Corporation standards and requirements. Standard Water Corporation wastewater headworks are applicable in this area.

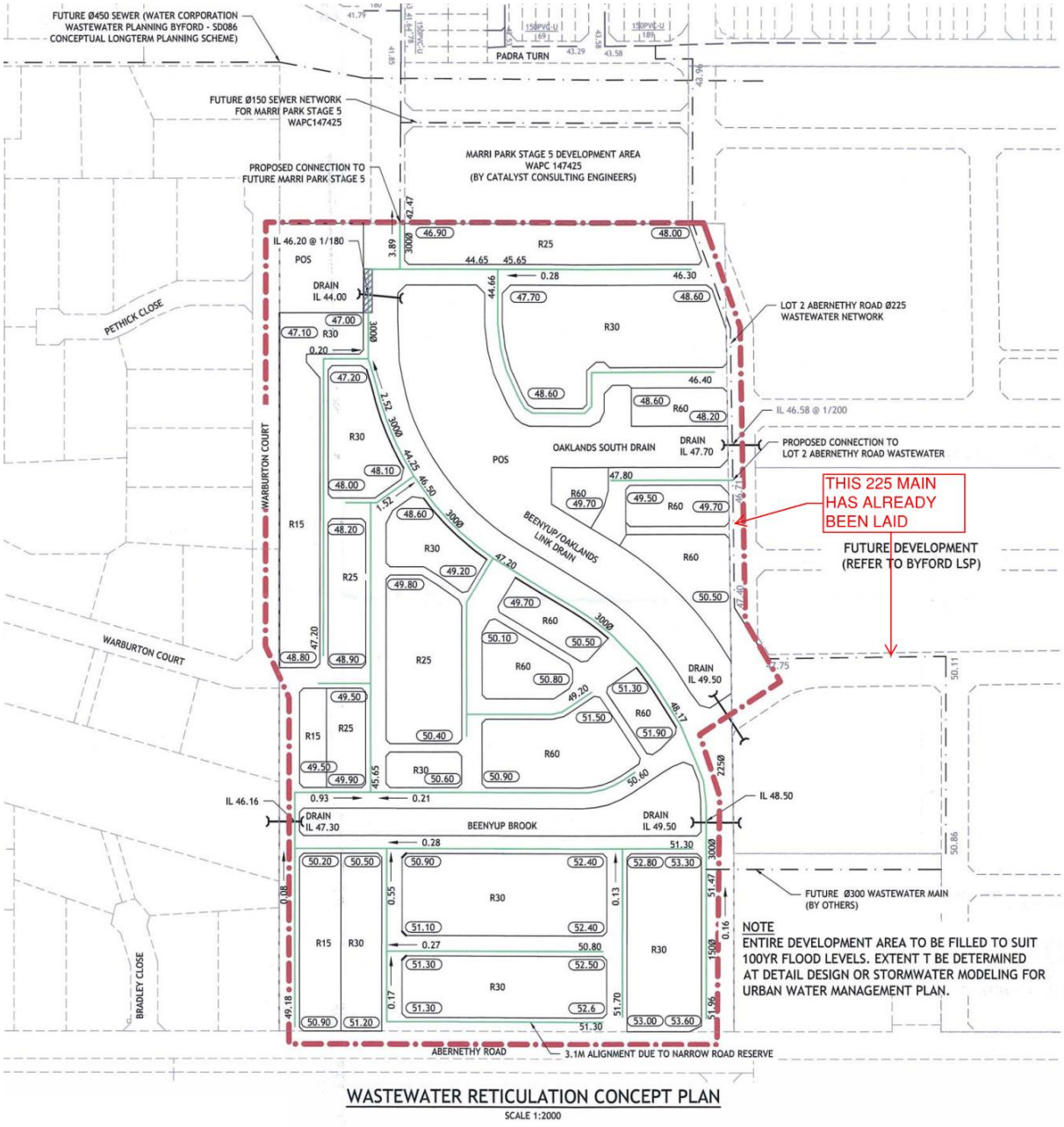


Figure 11 – Water Corporation Wastewater Planning – Based on Previous Subdivision Concept (July 2019)

7 WATER SUPPLY

The Site is within the Water Corporation license area and can be served via a connection to and extension of the existing water mains in Abernethy Road (DN150) on the southern boundary and Sansimeon Boulevard (DN100) in the north-west corner of the Site.

Figure 12 – Existing Water Infrastructure (Water Corporation, July 2019)

An internal water reticulation network will be constructed within the Site to provide a service to all lots in accordance with the Water Corporation requirements. The extension of a DN150 water main along Sansimeon Boulevard will provide the backbone of the internal reticulation network. Standard Water Corporation water headworks are applicable in this area.

Water Corporation planning, based on the previously proposed development layout, has been provided and is shown below.

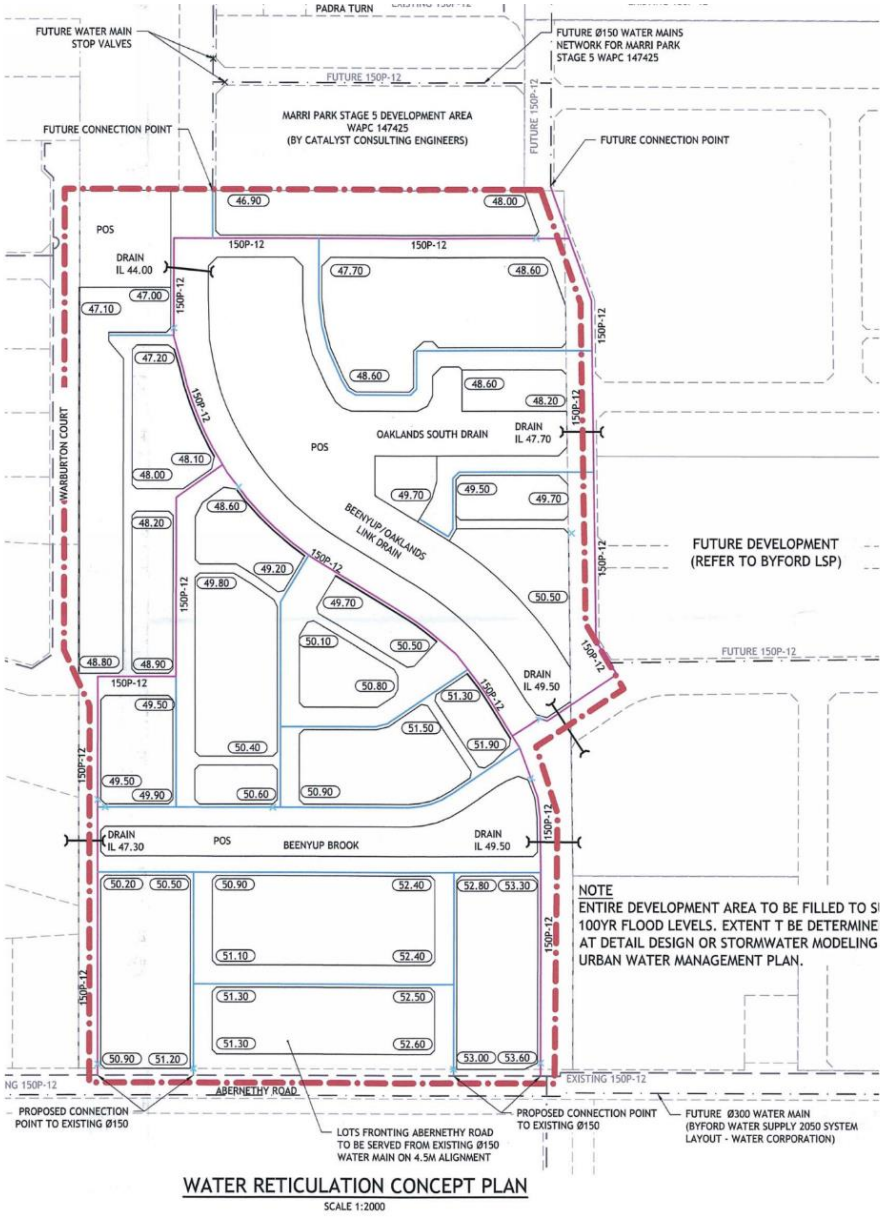


Figure 13 – Water Corporation Water Planning – Based on Previous Subdivision Concept (July 2019)

8 POWER SUPPLY

A connection to the existing 115 Abernethy Road Substation opposite the Site will be required to provide an electrical supply for the proposed development. The connection to the existing substation will likely require the undergrounding of a section of the existing overhead powerlines in Abernethy Road as part of the subdivision approval.

Power systems are dynamic in nature, due to the connection of new users and changes in consumer behaviour. As such, Western Power's distribution electricity networks will change over time and this may have a bearing on the amount of reinforcement required to accommodate new developments.

Based on the Western Power UDS Manual requirements, the Rowe Group Draft Concept Plan (dated May 2019) and a projected yield of approximately 300 residential lots and 3.23 hectares of commercial area the estimated load for the proposed development of the Site is approximately 2.06MVA. A review of the Western Power Network Mapping Tool indicates the current available capacity is less than 5MVA.

Western Power network capacity is available on a first-come first-served basis. As capacity cannot be reserved, it is possible that requirements will also be altered resulting in a variation in power infrastructure requirements. There may be other competing applications for new loads or upgrades, which may use the available spare capacity.

Figure 14 – Existing Power Network Capacity (Western Power, 2019)

Within the development High Voltage (HV) cables will connect to the switchgear and transformers which will function to reduce the voltage suitable for consumer usage. In order to provide the required load, it is estimated that approximately 3 switchgear and 5 transformers will be required to service the development. Generally, this infrastructure would be located in POS and green areas throughout the development, with transformers and switchgear also likely to be located on the proposed commercial sites. However, this is dependent on the future development for the commercial sites and staged layout for the development and will ultimately be determined during detail design.

Power will then be reticulated underground throughout the development. Low voltage (LV) feeders will extend from each transformer feeding the pillar units servicing each new lot. The provision of LV and HV interconnection to the adjoining development areas will also have to be catered for.

Western Power standard system charges and HV pool credits would be applicable to the residential component of the proposed development.

9 TELECOMMUNICATIONS

The NBN network is located adjacent to the Site and provides a connection point for an NBN compliant pit and pipe network to be extended within the proposed development.

The Site would enter into a Master Agreement with NBN. NBN had a previous agreement with the former landowner however this has expired. NBN is required to recover part of the cost of deploying the NBN network infrastructure by applying a developer contribution charge per premises. Current NBN developer contribution charges are applied at $600 per single dwelling unit and $400 per multi dwelling unit.

Backhaul contributions may apply if the NBN access network infrastructure required to connect the new development is not available. Provided the initial stage of development is within 1km of the existing NBN network there should be no backhaul charges for the development. However, if development commences in an area exceeding 1km, then a backhaul charge will be applied.

NBN advised that the previous application indicated no backhaul charges based on a Stage 1 connection adjacent to Abernethy Road as per the previous pit and pipe design below:

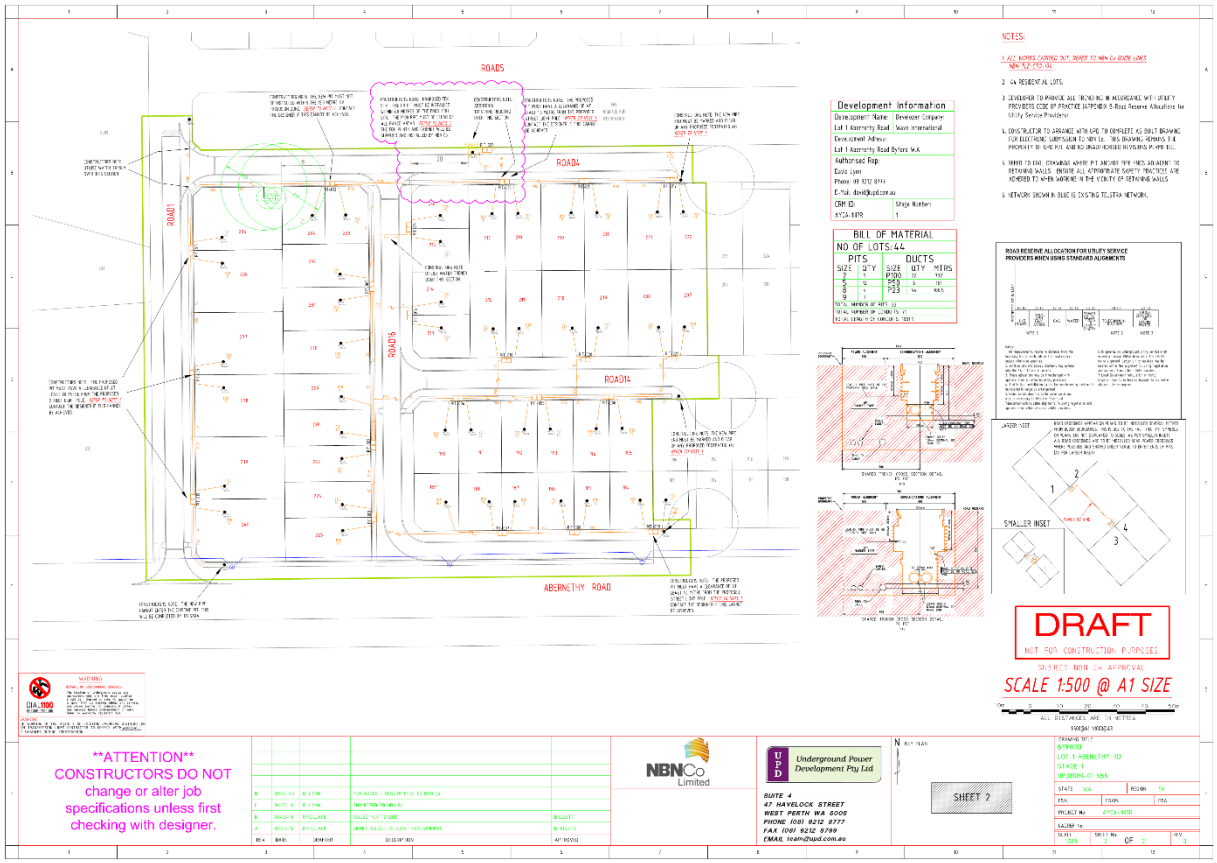


Figure 15 – Existing NBN Infrastructure and Previous Stage 1 NBN Design (NBN/UPD, April 2017)

10 GAS SUPPLY

ATCO Gas infrastructure is present in the vicinity of the Site. A DN160 PE gas main is located in the southern verge of Abernethy Road adjacent to the Site. A connection to this existing main will allow for a gas reticulation network to be provided to the proposed development if desired.

The general arrangement is that the Developer supplies the trench and ATCO Gas install the main at their cost. However, depending on the location of the connection a capital contribution for the extension to Site may be sought from the developer. Given the proximity of the existing gas infrastructure a contribution is unlikely.

The Stage 1 gas design for the previous WAPC approved subdivision layout is shown below:

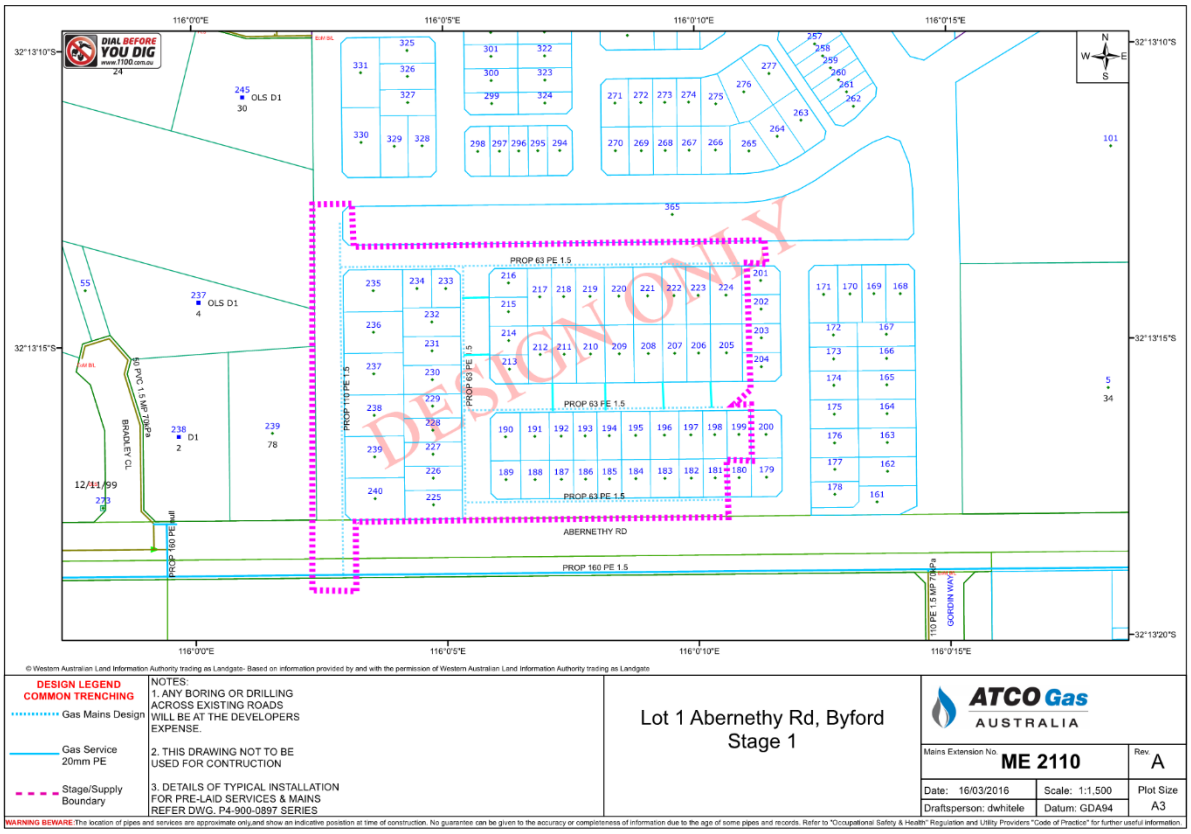


Figure 16 – Existing Gas Infrastructure and Previous Stage 1 Design (ATCO Gas, 2018)

11 SUMMARY

All required utilities are available to service the proposed development.

Based on the preliminary engineering servicing review, there would appear to be no engineering or servicing constraints to the development of the Site. Significant planning has already been undertaken by the Relevant Authorities to support the existing and proposed development within the vicinity of the Site.