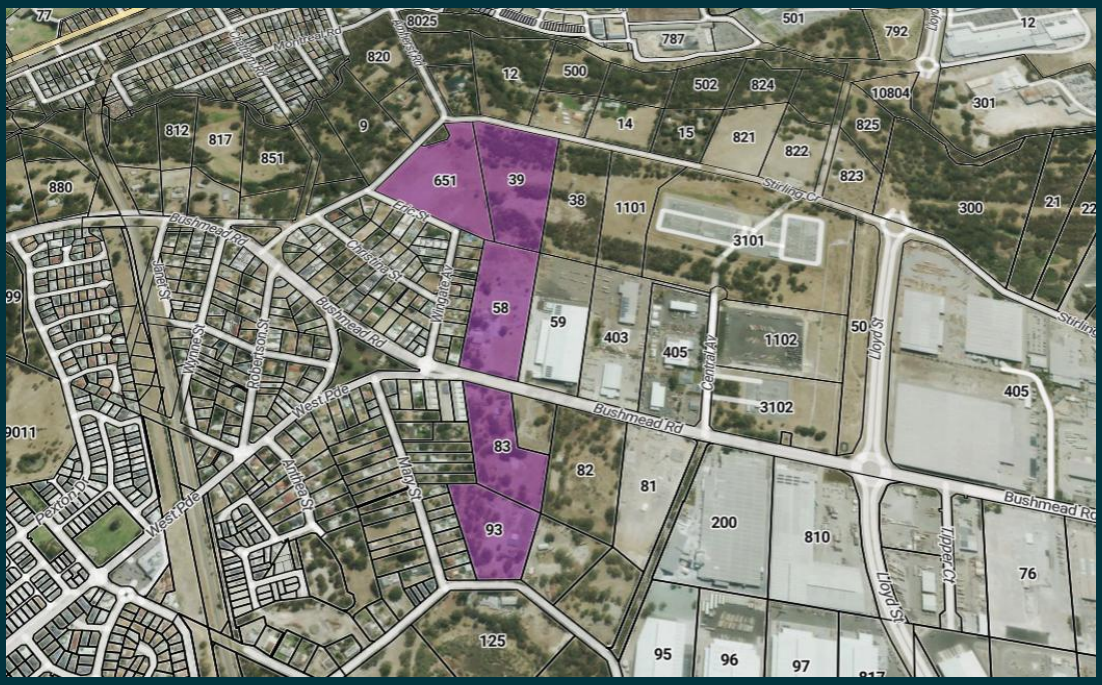
24PER-0004
28 JULY 2026

Hazelmere Special Use Area 16 Structure Plan

Lots 651 and 39 Stirling Crescent,

Lots 58 and 83 Bushmead Road and

Lot 93 Hazelmere Circus, Hazelmere



HAZELMERE SPECIAL USE ZONE 16
LANDOWNER GROUP

URPS

Endorsement Page

This structure plan is prepared under the provisions of the City of Swan
Local Planning Scheme No. 17

IT IS CERTIFIED THAT THIS STRUCTURE PLAN WAS APPROVED BY RESOLUTION OF THE WESTERN AUSTRALIAN PLANNING COMMISSION ON:

23 SEPTEMBER 2026

Signed for and on behalf of the Western Australian Planning Commission



An officer of the Commission duly authorised by the Commission pursuant to section 24 of the *Planning and Development Act 2005* for that purpose, in the presence of:

Anne Woodin
_____ Witness

30 SEPTEMBER 2026 Date

30 SEPTEMBER 2036 Date of Expiry

Table of Amendments

No.	Summary	Date Approved by WAPC

Hazelmere Special Use Area 16 Structure Plan

28 July 2026

Primary Contact

URPS
Level 17, 1 Spring Street
Perth WA 6000

(08) 6285 3177
urps.com.au

In association with

Donald Veal Consultants - Traffic
Bayley Environmental Services – Hydrology
Bushfire Smart – Bushfire Management
Pracsys – Retail Needs Assessment

Prepared for

Hazelmere Special Use Zone 16 Landowner Group

URPS Project Manager

Justin Hansen, Director
jhansen@urps.com.au

URPS Ref

24PER-0004

Document history and status

Revision	Date	Author	Reviewed	Details
V1	10/06/2025	J. Hansen	J. Hansen	Report for Lodgement
V2	28/07/2025	R. Walker	J. Hansen	Schedule of Modifications

We acknowledge the Whadjuk Nyoongar people as the Traditional Custodians of the land on which we work and pay respect to their Elders past, present and emerging.

© URPS. All rights reserved; these materials are copyright. No part may be reproduced or copied in any way, form or by any means without prior permission.
This report has been prepared for URPS' client. URPS and its associated consultants are not liable to any person or entity for any damage or loss that has occurred, or may occur, in relation to that person or entity taking or not taking action in respect of any representation, statement, opinion or advice referred to herein.

Contents

Endorsement v

Table of Amendments vi

Executive Summary 1

Summary Table 3

Abbreviations 4

PART ONE – IMPLEMENTATION 5

1. Structure Plan Area 5

1.1 Structure Plan Content 5

2. Operation 5

3. Interpretation and Use 5

3.1 Variations to LPS17 Land Use Permissibility 6

4. Subdivision & Development Requirements 6

4.1 Structure Plan Map 6

4.2 General Provisions – All Subdivision and Development 7

4.3 Sub-Precincts 7

4.4 Public Open Space 13

4.5 Transport and Traffic Considerations 14

4.6 Protection or management of environmental or landscape features 14

5. Infrastructure Coordination, Servicing and Staging 15

5.1 Staging 15

5.2 Infrastructure Contributions and Responsibilities 16

6. Additional Details 16

6.1 Notifications on Title 17

Plan 1 – Local Structure Plan Map 18

Plan 2 – Concept Subdivision Plan 19

Figure 1 – District Distributor B (Eric Lumsden Drive) Cross Section Design Options 20

PART TWO – EXPLANATORY SECTION 21

7. Planning Background 21

7.1 Introduction & Purpose 21

7.2 Land Description 21

Figure 2 – Location Plan 23

Figure 3 – Aerial Photo 24

7.3 Pre-Lodgement Consultation 25

7.4 Planning Framework 25

Figure 4 – MRS Zoning 28

Figure 5 – Local Planning Scheme No. 17 Zoning 29

Figure 6 – Opportunity & Constraints and Staging Plan 30

Figure 7 – Hazelmere Enterprise Area Structure Plan 31

Figure 8 – Hazelmere Enterprise Area – Precinct 3 32

8. Site Characteristics & Context 36

8.1 Context 36

8.2 Flora and Vegetation 36

8.3 Landforms and Soils 37

8.4 Acid Sulphate Soils 37

8.5 Contamination 37

8.6 Groundwater and Surface Water 38

8.7 Bushfire Hazard 38

8.8 Heritage 38

8.9 Infrastructure 39

9. Structure Plan Design 41

9.1 Structure Plan Overview 41

9.2 Residential Densities 41

9.3 Local Development Plans 42

9.4 Movement Network 42

9.5 Public Open Space 46

9.6 Activity Centres 48

9.7 Education & Community Facilities 48
9.8 Water Management 49
10. Infrastructure Servicing & Staging 49
10.2 Infrastructure Contributions and Responsibilities 51
Technical Appendices 53
Appendix 1 – Local Water Management Strategy 54
Appendix 2 – Traffic Impact Assessment 55
Appendix 3 – Bushfire Management Plan 56
Appendix 4 – Western Power Capacity Plan 57
Appendix 5 – Water Corporation Sewer Concept Plan 58
Appendix 6 – Retail Needs Assessment 59

List of Tables

- **Table 1** – Zoning and Land Uses
- **Table 2** – Highway Service Zone Sub-Precinct – Specified Provisions
- **Table 3** –Light Industry Zone Sub-Precinct – Specified Provisions
- **Table 4** – Residential Zone Sub-Precinct – Specified Provisions
- **Table 5** – Public Open Space Schedule
- **Table 6** – Additional Information Requirements
- **Table 7** – Studies to be Required as Conditions of Subdivision or Development Approval
- **Table 8** – Title Details
- **Table 9** – State Planning Policies
- **Table 10** – Public Open Space – Landowner Composition (Residential Zoned Land)
- **Table 11** – Road Infrastructure – Landowner Responsibility

List of Plans

- **Plan 1** – Local Structure Plan Map
- **Plan 2** – Planning Framework Summary

List of Figures

- **Figure 1** – District Distributor B (Eric Lumsden Drive) Cross Section Design Options
- **Figure 2** – Location Plan
- **Figure 3** – Aerial Photo
- **Figure 4** – MRS Zoning
- **Figure 5** – Local Planning Scheme No. 17 Zoning
- **Figure 6** – Opportunity & Constraints and Staging Plan
- **Figure 7** – Hazelmere Enterprise Area Structure Plan
- **Figure 8** – Hazelmere Enterprise Area – Precinct 3

Executive Summary

Purpose

The purpose of the Hazelmere Special Use Zone 16 Structure Plan (the 'Structure Plan') is to provide a coordinated and robust planning framework to guide the future subdivision, land use, and development of Lots 651 and 39 Stirling Crescent, Lots 58 & 83 Bushmead Road and Lot 93 Hazelmere Circus, Hazelmere. The subject area is located approximately 1.5km south west of the Midland Town Centre and approximately 16km north east of the Perth central business district.

The subject sites are owned by both private individuals and companies. Prepared on behalf of the contributing landowners south of Bushmead Road, the Structure Plan forms part of the broader Hazelmere Enterprise Area Structure Plan, 2011 ('HEASP') and supporting environmental and servicing studies.

The Structure Plan aligns with the statutory and strategic planning context set out by the Metropolitan Region Scheme, the City of Swan Local Planning Scheme No. 17 (LPS17), and the Planning and Development (Local Planning Schemes) Regulations 2015. It builds on the framework established by the Kewdale-Hazelmere Integrated Masterplan, 2006 ('KHIM'), HEASP, and more recent Guildford Hazelmere Local Area Plan, 2020 ('GHLAP') and which were all endorsed by the Western Australian Planning Commission ('WAPC').

The Structure Plan provides framework for the area to be developed for residential, highway commercial and light industrial land use; this offering transitional land uses between the General Industrial land to the east and the Residential land to the west. The proposed strategic north-south aligned spine road through the Structure Plan provides an opportunity for industrial traffic to not need to enter the residential area of Hazelmere, Woodbridge and Guildford.

Vision

The Structure Plan is an expansion of the HEASP and GHLAP and facilitates orderly planning as outlined in this document.

Design Approach

The Structure Plan has been prepared consistent with the provision of the

- City of Swan LPS 17, Schedule 2, Part 4, clause 15(1) and
- Part 5, clause 30(1) of the Planning and Development (Local Planning Schemes) Regulations 2015 and the other relevant policies.

The design responds to both the site's natural and constructed features, and is underpinned by a suite of technical investigations including:

- Environmental Assessment at the district level
- Civil Engineering and Servicing Reporting at the district level
- Traffic Impact Assessment
- Local Water Management Strategy
- Bushfire Management Plan

This evidence-based approach has informed the layout of various land uses, integration of open space and drainage, and coordination of movement networks with adjoining landholdings.

The structure plan is designed to be flexible yet coordinated, ensuring orderly development and alignment with surrounding precincts.

Summary Table

Item	Data (HA Rounded)	Structure Plan Reference (Section No)
Total Structure Plan Area	21.15 ha	Section 3.1 – Site Description
Area of each land use proposed: • Highway Service • Industrial - Light • Key Road Reservations • Residential	• 5.47 • 8.86 • 3.68 • 2.24	Section 6.1 – Land Use and Zoning
Estimated Lot Yield (Residential R20)	46	Section 6.3 – Subdivision Layout
Estimated Dwelling Yield	48	Section 6.3 – Subdivision Layout
Estimated Population (2.8 person/dw)	131	Derived from Section 6.2 – Residential Zone
Number of High Schools	Nil	Section 6.2 – Community Facilities
Number of Primary Schools	Nil	Section 6.2 – Community Facilities
Estimated Commercial Floor Space (Highway Service)	3.24 ha (GLA)	Appendix 6 – Retail Needs Assessment; Section 6.2.
Estimated Number and % of Public Open Space: • Regional Open Space • District Open Space	Nil	Section 6.4 – Public Open Space
Estimated area and number: • Neighbourhood Parks • Local Parks	• Nil • 0.38 ha	Section 6.4 – Public Open Space
Estimated number and area of natural area and biodiversity assets	Nil	

Abbreviations

AHD	Australian Height Datum
ASS	Acid Sulfate Soils
AS	Australian Standard
BMP	Bushfire Management Plan
BRA	Bio-Retention Areas
CAP	Controlled Access Place
CBD	Central Business District
CCW	Conservation Category Wetland
DPLH	Department of Planning, Lands and Heritage
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
HEASP	Hazelmere Enterprise Area Structure Plan
KHIM	Kewdale-Hazelmere Integrated Masterplan
LDP	Local Development Plan
LPS17	Local Planning Scheme No. 17
LWMS	Local Water Management Strategy
MGL	Maximum Groundwater Level
POS	Public Open Space
RAV	Restricted Access Vehicle
SAR	Special Area Rate
SPP	State Planning Policy
SUZ16	Special Use Zone No. 16 (Structure Plan area)
TIA	Traffic Impact Assessment
UWMP	Urban Water Management Plan
WAPC	Western Australian Planning Commission

PART ONE – IMPLEMENTATION

*The Hazelmere Special Use Zone 16 Structure Plan (the '**Structure Plan**') has been prepared in accordance with Schedule 2, Part 4, Clause 16 of the Planning and Development (Local Planning Schemes) Regulations 2015, and shall be used to guide subdivision and development within the Structure Plan area.*

1. Structure Plan Area

This Structure Plan applies to Lots 651 and 39 Stirling Crescent, Lots 58 and 83 Bushmead Road, and Lot 93 Hazelmere Circus, Hazelmere, within the City of Swan and forming part of Special Use Zone No. 16 (**SUZ16**) under Local Planning Scheme No. 17 (**LPS17**).

1.1 Structure Plan Content

This Structure Plan comprises:

- Part One – Statutory Section (this section);
- Part Two – Explanatory Report (non-statutory); and
- Technical appendices.

NB. In accordance with the structure and intent of the WAPC's *Structure Plan Framework*, Part Two of the Structure Plan is intended to provide explanatory information that supports and justifies the provisions outlined in Part One.

With information clearly set out in Part One, such as zoning, land use controls, development standards, and spatial planning elements, its repetition in Part Two is unnecessary and offers no additional planning benefit. This approach avoids duplication, ensures clarity, and maintains alignment with the purpose of each section as defined under the Framework.

2. Operation

This Structure Plan comes into operation on the date it is approved by the Western Australian Planning Commission (**WAPC**) pursuant to Schedule 2, Part 4, Clause 22 of the *Planning and Development (Local Planning Schemes) Regulations 2015*.

3. Interpretation and Use

Land use permissibility within the Structure Plan area shall be in accordance with the corresponding zones as per the Zoning Table at Clause 4.3 under LPS17, unless otherwise provided for under Part One – Section 3.1 of this Structure Plan.

Terms used in this Structure Plan shall have the meaning given to them in the *Planning and Development (Local Planning Schemes) Regulations 2015* or LSP17 Schedule 1B, as applicable.

This Structure Plan guides and informs subdivision and development. It does not rezone land.

The Structure Plan proposes the following land use Zones or Reservations:

Table 1: Zoning and Land Uses

Land Use	HA Area (Approx)
Highway Service	5.474
Light Industry	8.855
District / Higher Order Road Reservations	3.676
Residential (R20) / Local Streets	2.812
Public Open Space / Drainage	0.380
Total:	21.197

3.1 Variations to LPS17 Land Use Permissibility

Land use permissibility shall be in accordance with LPS17. A Transport Depot is not a contemplated use within the Highway Service zone where it may impact residential amenity. Any uses within the area identified as Highway Service shall be considered having regard to potential impacts on residential amenity.

4. Subdivision & Development Requirements

4.1 Structure Plan Map

The Structure Plan Map (Plan 1) forms part of Part One of this Structure Plan and spatially represents the key land use, zoning, and infrastructure elements necessary to guide the implementation of subdivision and development within the structure plan area. It identifies the structure plan boundary, existing cadastral layout, land use zones, reserves, the hierarchy of the proposed road network, R-Code densities, interface areas, and key infrastructure upgrades.

The map also highlights buffers to sensitive land uses, and any other spatial controls relevant to the implementation of the plan. All subdivision and development proposals are to be assessed in accordance with the provisions of this Structure Plan and with reference to the spatial arrangements depicted in Plan 1.

4.2 General Provisions – All Subdivision and Development

4.2.1 Bushfire Management

Development Applications or Subdivisions will require individual Bushfire Management Plans (BMP) be prepared to support the applications. Where the land is mapped as bushfire prone subdivision and development applications will need to comply with the requirements of State Planning Policy 3.7 and Guidelines.

4.2.2 Traffic Impact Considerations

Consistent with the Western Australian Planning Commission Transport Impact Assessment Guidelines (August 2016), development applications and subdivisions are to be supported by a relevant Transport Impact Assessment or Statement as determined by the Guidelines and based on the complexities of the proposed development.

4.3 Sub-Precincts

The endorsed HEASP and Structure Plan provisions contemplate the use of transitional land uses to facilitate a functional interface between adjacent land uses. The land use framework provided in this Structure Plan supports the achievement of these transitional outcomes, enabling service provision to both the core industrial precinct located to the east and the residential areas to the west, while ensuring compatibility and orderly planning across the precinct interface.

4.3.1 Specific Provisions for Sub-Precincts

Land use planning within the Structure Plan is arranged into three sub-precincts, with each sub-precinct allowing for specific land use outcomes. Where no specific development standards or conditions are outlined within this Structure Plan for a land use, the default provisions of LPS17 shall apply. The three sub-precincts are defined under Tables 2-4 below.

Highway Service Zone Sub-Precinct

Table 2: Highway Services Zone Sub-Precinct Specified Provisions

Criterion	Commentary
Location	Encompasses Parent Lot 651, and portion of Parent Lot 39, being the landholdings generally west of the proposed *District Distributor B Road* (Eric Lumsden Drive) and north of Eric Street.
Objectives	• To facilitate a range of commercial land uses that cater primarily to the needs of passing trade, including motorists and freight operators.

Criterion	Commentary
	• To support land uses such as service stations, lunch bars, motor vehicle sales and servicing, bulky goods showrooms, and other related uses, while avoiding land uses that would be more appropriately located in retail or industrial zones. • Land uses are to facilitate a transitional interface between the HEASP and adjoining residential areas, while also providing convenience services to both the core industrial precinct to the east and residential communities to the west.
Land Uses Permissibility	Pursuant to land use permissibility under LPS17.
Subdivision	• Minimum lot size: 1,000sqm • Minimum road frontage: 28m.
Building and Development Standards	Pursuant to Local Planning Policy *POL-TP-125 Building and Development Standards – Commercial Zones* except as varied below. • All development shall be set back minimum distance of 27m from Eric Street, inclusive of any development with a common boundary to a residential lot to: – facilitate the re-alignment of the power lines and services; and – provide separation between the existing residential land and the proposed land-uses of this sub-precinct. • Unless otherwise approved by the City of Swan, permitted uses within the 27m setback area shall be limited to: – Services infrastructure, – landscaping, – vehicle circulation, and – pedestrian access.
Site Access	• No vehicle access and egress is to be provided to and from Eric Street. • Vehicle access and egress points on the Distributor B Road (Eric Lumsden Drive) shall be limited to consolidated locations through the use of right of way easements or other legally secure instruments, with the intent that there is no more than two (2) vehicle crossovers in total.

Criterion	Commentary
	• A road access strategy is to be submitted with the development and subdivision application to demonstrate compliance and the suitability of the location proposed. • Where a subdivision or development proposal does not cover the entirety of the Parent Lot - a Local Development Plan can be required by the Local Government and the Western Australian Planning Commission to consolidate access.
Local Development Plans	• A Local Development Plan may be required for lots: – Where site-specific design controls are needed to address constraints or facilitate interface treatments; and/or – To coordinate and consolidate vehicular access to the RAV network per 'Site Access' provisions under this Table; – Abutting Eric Street. • Without limiting the matters that may be addressed, the LDP is to address, where relevant: – Landscape buffering and screening; – Fencing and boundary treatments; – Building siting and orientation; – Lighting design and spill management; – Signage treatment; – Acoustic attenuation; – Pedestrian and vehicle circulation, including restricting access from Eric Street to reduce any impacts on residential amenity; and – Any other measures necessary to achieve an orderly and compatible interface with adjoining residential land.
Traffic and Industrial Noise Mitigation	Development within the industrial precinct and adjoining residential or other noise-sensitive land uses shall incorporate appropriate noise attenuation measures to mitigate the impact of industrial operations and associated traffic movements consistent with *SPP 5.4 – Road and Rail Noise and SPP 4.1 – Industrial Interface*.

Light Industry Zone Sub-Precinct

Table 3: Light Industry Zone Sub-Precinct Specified Provisions

Criterion	Commentary
Location	Encompasses the eastern portion of the Structure Plan area, generally east of the proposed *District Distributor B Road* (Eric Lumsden Drive).
Objectives	• To facilitate land uses and development, as set out in the 'Light Industrial' zone, that provide an appropriate transition (interface) between the industrial core area and the residential areas and can be expected to be compatible with both areas. • To facilitate uses and development that do not cause any injury or adversely affect the amenity of the locality.
Land Uses	Pursuant to land use permissibility under LPS17.
Subdivision	• Minimum lot size: 1,000sqm • Minimum road frontage: 28m.
Traffic Considerations	Access and egress points into the RAV network are to be limited to consolidated locations providing service to multiple lot or land uses.
Traffic and Industrial Noise Mitigation	Development within the industrial precinct and adjoining residential or other noise-sensitive land uses shall incorporate appropriate noise attenuation measures to mitigate the impact of industrial operations and associated traffic movements consistent with *SPP 5.4 – Road and Rail Noise and SPP 4.1 – Industrial Interface*.
Building and Development Standards	Pursuant to City of Swan Local Planning Policy *POL-TP-124 Building and Development Standards – Industrial Zones*.
Site Access	• Vehicle access and egress points on the Distributor B Road shall be limited to consolidated locations through the use of right of way easements or other legally secure instruments, with the intent that there is no more than two (2) vehicle crossovers for each of the parent lots – Lot 39 Stirling Crescent, Lot 58 Bushmead Road, Lot 83 Bushmead Road and Lot 93 Hazelmere Circus, Hazelmere. • A road access strategy is to be submitted with the development and subdivision application to demonstrate compliance and the suitability of the location proposed.

Criterion	Commentary
	• Where a subdivision or development proposal does not cover the entirety of the Parent Lot - a Local Development Plan can be required by the Local Government and the Western Australian Planning Commission to consolidate access.
Local Development Plans	A Local Development Plan may be required for lots: • Where site-specific design controls are needed to address constraints or facilitate interface treatments; and/or • to coordinate and consolidate vehicular access to the RAV network per 'Site Access' provisions under this Table.
Landscaping	3m landscaping strip across any street frontage pursuant to City of Swan Vehicle Parking Standards and applicable policy requirements.
Sewer Connection	• Land use and development shall connect to reticulated sewer where available; • Land use and development is restricted to 'Dry Activities' unless the site and development is connected to reticulated sewer. 'Dry Activities 'means any use permitted by the applicable zone and where: – It can be demonstrated that the quality and volume of effluent to be disposed of on-site can be successfully disposed of, without adverse environmental or health effects, utilising effluent disposal systems approved by the relevant Government agency; and – The development is of a type which is predicted to generate waste water intended for disposal on site at a daily volume not exceeding 540 litres per 2000m^2 of site area; • Unless connected to any application for development approval shall include a Wastewater Management Plan to address effluent disposal, to demonstrate that Condition 2 can be achieved and to demonstrate that Condition 1 is unavailable, to the satisfaction of the Local Government.

Residential Zone Sub-Precinct

Table 4: Residential Zone Sub-Precinct Specified Provisions

Criterion	Commentary
Location	Encompasses the western portion of the Structure Plan area, generally west of the proposed *District Distributor B Road* (Eric Lumsden Drive) within Parent Lots 58 and 83 Bushmead Road, and Parent Lot 93 Hazelmere Circus.
Objectives	The Residential zone is intended to serve as a transitional buffer between the Hazelmere Enterprise Area's industrial core, adjoining Highway Service zoned land, and existing residential areas. The zone supports: • A low-density residential development that enhances housing diversity while mitigating amenity impacts from adjacent light industrial and commercial land uses to existing residential areas. • The contribution to the delivery of the HEASP's strategic objectives by facilitating a graduated land use interface that supports both economic and community outcomes.
Land Uses	Land use permissibility shall be as per the Residential zone provisions of LPS17, with low-density coding (e.g. maximum R20) applied to support a range of dwelling types.
Subdivision and Density Plans	Plan 1 – Structure Plan Map designates the R-Codes applicable to subdivision and development in the structure plan area.
Local Development Plans	A Local Development Plan may be required for lots: • With direct interface to non-residential uses; • Where site-specific design controls are needed to address constraints (i.e. Airport Noise Mitigation) or facilitate interface treatments; • Where lots are irregular in shape or subject to access restrictions.
Traffic Considerations	Subdivision and development shall: • Avoid direct vehicle crossovers/access onto higher order and higher-traffic roads. • Crossovers/access should be restricted to dedicated residential roads (i.e. CAPs roads) consistent with the Structure Plan Map.

Criterion	Commentary
Airport Noise Mitigation	The Structure Plan area is located within the area affected by aircraft noise exposure as identified under *State Planning Policy 5.1 – Land Use Planning in the Vicinity of Perth Airport* (SPP 5.1). • All subdivision and development within this area must be consistent with the requirements and guidance of SPP 5.1 and to achieve compliance with Australian Standard AS2021:15 Acoustic Noise Intrusion – Building Siting and Construction. • At the time of subdivision, a condition shall be imposed requiring the registration of a notification under Section 165 of the Planning and Development Act 2005 on the Certificate of Title of all residential lots, advising of potential noise impact from aircraft operations at Perth Airport.

4.4 Public Open Space

Subdivision for Residential zoned land within the Structure Plan area is subject to a 10% Public Open Space (POS) contribution requirement, in accordance with Clauses 143(1)(c), 153(1), and 154 of the Planning and Development Act 2005.

Table 5 provides a POS Schedule supporting the Structure Plan design to guide detailed subdivision and development.

Table 5: Public Open Space Schedule (Rounded)

(A) Gross Area		**21.15**
(B) Deductions		**17.92**
(Bi) Drainage >1:1yr ARI (Non Creditable)	*0*	
(Bii) Drainage >1:5yr ARI (Over 2% Restricted POS)	*0*	
District Distributor B (Eric Lumsden Drive) / Bushmead Rd / Local Distributors (Lost 651/39 and Lots 39/59)	*3.59*	
Industry - Light Zoned Land	*8.86*	
Highway Service Zoned Land	*5.47*	
(C) Gross Subdivisible Area for Residential (A - B)		**3.23**
(D) Required Public Open Space @ 10% (C*10%)		**0.323**
	(D1) 8% Unrestricted POS Permitted (D*80%):	0.26
	(D2) 2% Maximum Restricted POS Permitted (D*20%):	0.06
(E) POS Provision (Total of all Creditable POS areas)		**0.38**
POS North (1) @ 0.2000 (No Drainage Provision Proposed)	*0.20*	
POS South Lot 83 Portion (No 1:1 - 1:5yr ARI Drainage Required)	*0.079*	
POS South Lot 93 Portion (No 1:1 - 1:5yr ARI Drainage Required)	*0.101*	
POS Provision as a Percentage (E/C)		**11.78%**
POS Shorfall (-) / Surplus (+) Equivalent (E-D)		**0.06**

4.5 Transport and Traffic Considerations

4.5.1 Road Network and Reservations

The road network has been designed to support access to proposed residential, light industrial, and highway service land uses, while integrating with the broader Hazelmere Industrial Area road hierarchy.

Eric Lumsden Drive

Identified as a north-south District Distributor (Distributor B) road forming the main spine through the Structure Plan area. It provides key connections between Stirling Crescent to the north and Bushmead Road and Hazelmere Circus to the south. Eric Lumsden Drive is designed to accommodate Restricted Access Vehicles (RAV 7) in accordance with MRWA standards. A detailed cross-section, inclusive of proposed residential CAPs roads is illustrated under Figure 1.

Bushmead Road

An existing Distributor B road bisecting the Structure Plan area east-west. Intersections with Eric Lumsden Drive are proposed to be upgraded to include a roundabout to facilitate safe freight and local traffic movements.

Hazelmere Circus

To be realigned and downgraded to a Local Access Road, terminating at a T-junction with Eric Lumsden Drive, thereby discouraging industrial traffic from entering adjacent residential precincts.

Local Road Network – Residential

A small network of Local Access Roads is proposed to service residential land uses, inclusive of CAPs road reservations provided parallel to Eric Lumsden Drive. These roads will be constructed to Liveable Neighbourhoods and City of Swan standards and provide for safe and legible vehicle, pedestrian, and service access with managed intersections with Eric Lumsden Drive .

Road reserve widths will be in accordance with and City of Swan standards, with Distributor roads generally requiring 20–25 metres and Local Access Roads between 11.5 – 15 metres, subject to detailed subdivision design.

4.6 Protection or management of environmental or landscape features

No detailed environmental assessment is provided as part of this Structure Plan, as the subject land is largely cleared, historically disturbed, and not identified as containing any environmental constraints that would preclude future development.

The Structure Plan area is mapped as comprising Multiple Use category wetlands under the Department of Biodiversity, Conservation and Attractions' (DBCA) geomorphic wetland dataset. These wetlands are considered highly degraded and are identified as being suitable for development where hydrological functions can be appropriately maintained or replicated. The site does not contain any areas mapped as Conservation or Resource Enhancement category wetlands.

No Threatened Ecological Communities, Bush Forever sites, Environmentally Sensitive Areas, or significant flora or fauna species have been identified within the Structure Plan area. Site inspections, historical aerial imagery, and desktop assessments confirm the land has been extensively cleared and modified for rural-residential and agricultural use.

Accordingly, detailed environmental reporting is not considered necessary at the Structure Plan stage. Instead, individual landowners will be required to undertake site-specific environmental investigations at the time of subdivision or development, where necessary. These may include acid sulfate soils assessments, targeted flora/fauna surveys, or Urban Water Management Plans (UWMPs) to respond to drainage and hydrology considerations.

This staged approach is consistent with State Planning Policy 2.9 – *Planning for Water*, the Better Urban Water Management framework, and standard WAPC practices, and ensures that environmental investigations are proportionate to the level of planning and reflective of finalised development layouts given the likely scale of the individual landowner projects.

5. Infrastructure Coordination, Servicing and Staging

5.1 Staging

Development within the Structure Plan area is anticipated to occur in three broad stages:

- **Stage 1 – South:** Lots 83 and 93 (between Bushmead Road and Hazelmere Circus)
- **Stage 2 – Central:** Lot 58 (north of Bushmead Road)
- **Stage 3 – North:** Lots 651 and 39 (north of Lot 58 to Stirling Crescent)

Staging may proceed concurrently, subject to landowner intentions and market conditions. Progress across the Structure Plan area is dependent on coordinated delivery of key enabling infrastructure, including:

- Construction of Eric Lumsden Drive (District Distributor B road)
  - critical to ensuring safe and efficient access, supporting internal connectivity, and separating industrial and residential traffic. Its timely delivery will be coordinated with the City of Swan and is subject to Special Area Rate contributions, detailed design, and subdivision conditions.
- Drainage infrastructure in accordance with the approved LWMS
- Provision of essential services (reticulated water, sewer, power, and NBN)
- Perimeter roads or measures for bushfire protection

5.2 Infrastructure Contributions and Responsibilities

Development within the Structure Plan area is dependent on the coordinated delivery of key road and drainage infrastructure. The land falls within the Hazelmere Industrial Area Special Area Rate (SAR) zone, with funding applied at a 25% SAR to 75% municipal contribution ratio. This supports upgrades to Distributor B and Local Distributor roads and associated drainage works, consistent with the Structure Plan and LWMS.

Landowners are required to work with the City of Swan to deliver key intersection upgrades, with responsibilities outlined in Table 11 – Part Two. All distributor and industrial access roads must meet RAV 7 standards. While SAR funding supports these works, current reserves may be insufficient for full delivery. As such, forward-funding arrangements may be required via legal agreements, with reimbursement subject to available SAR funds.

Internal residential roads are the sole responsibility of landowners undertaking subdivision within the Structure Plan area.

6. Additional Details

The following tables identify additional technical information and investigations required to support future subdivision or development within the Structure Plan area. These requirements are to be addressed either at the time of subdivision or development application, or as a condition of approval, as specified.

This ensures that matters not fully resolved at the structure planning stage – such as detailed drainage, bushfire, environmental, servicing, and interface treatments – are appropriately managed at subsequent planning stages in consultation with the relevant authorities.

Table 6: Additional Information Requirements

Additional Information / Purpose	Approval Stage	Responsible Agency
Bushfire Management Plan updates – where site layout or land use varies from endorsed BMP.	Subdivision or development	DFES, City of Swan
Environmental Management Plan – if required for identified wetland or vegetation values on individual sites	Subdivision or development	DBCA, City of Swan
Noise Assessment – for residential areas impacted by freight or aircraft corridors.	Subdivision or development	City of Swan, DPLH

Table 7: Studies to be Required as a Condition of Subdivision or Development Approval

Additional Information	Responsible Agency
Local Development Plan(s) – to address interface, access, service design, noise mitigation and built form.	City of Swan
Detailed Urban Water Management Plan for each stage of subdivision.	DWER, City of Swan
Engineering Servicing Report (roads, drainage, power, sewer, water).	City of Swan, relevant utility providers
Landscaping Plan – for public open space and drainage areas or site specific Development Applications.	City of Swan
Detailed Bushfire Management Plan and APZ implementation.	DFES, City of Swan
Geotechnical and Acid Sulfate Soil investigation (where applicable).	DWER, City of Swan
Contamination Site Assessment (if required under DWER guidance).	DWER
Fauna/Flora Survey (if flagged by DBCA at detailed assessment).	DBCA
Environmental and Construction Management Plan (for industrial land).	City of Swan, DWER (as applicable)
Noise Mitigation Plan (if residential near ANEF contour areas, or industrial interface to sensitive areas).	City of Swan, DPLH

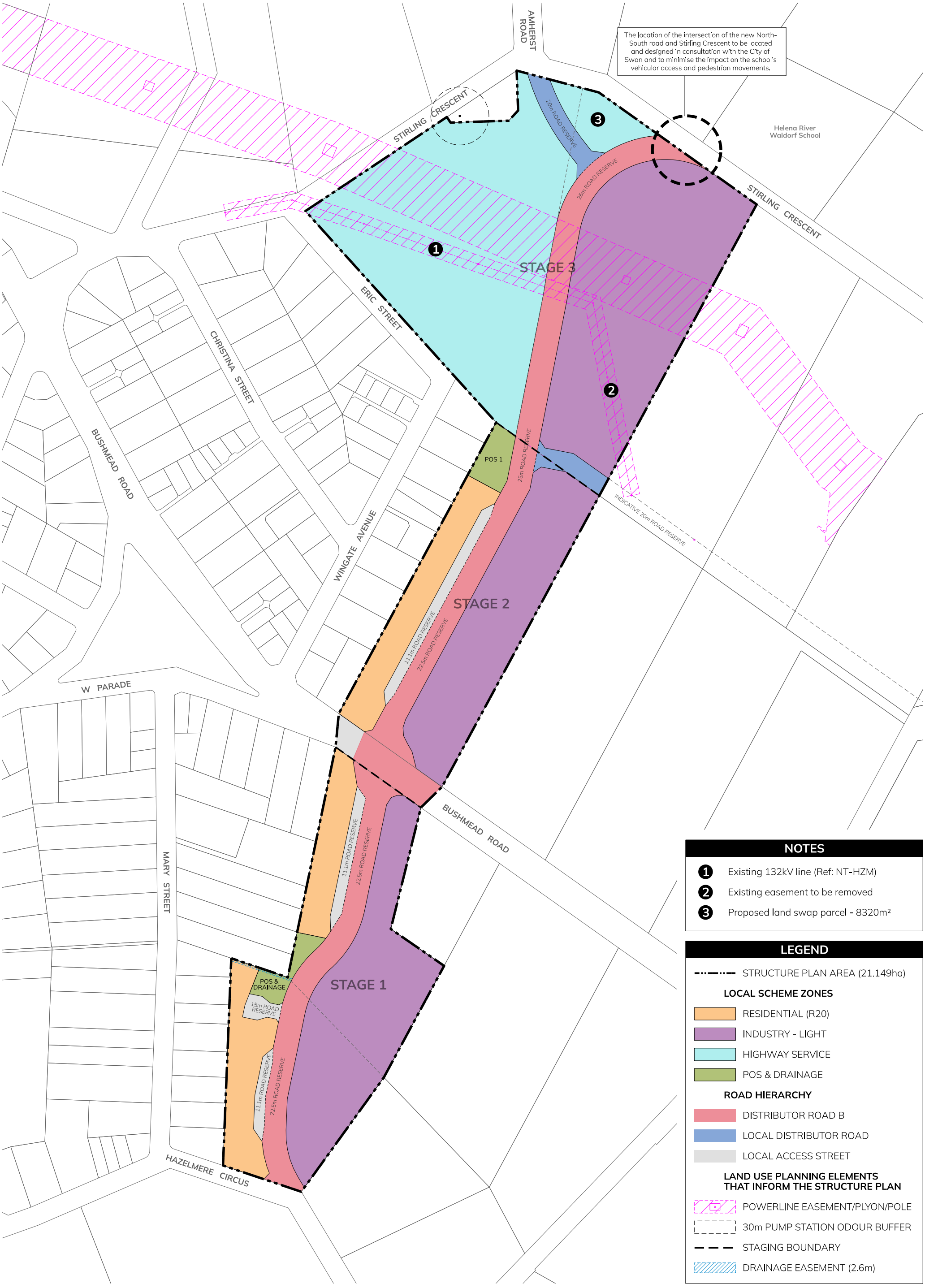
6.1 Notifications on Title

The following notifications may be imposed as conditions of subdivision or development approval by decision-makers in accordance with applicable State Planning Policies:

- Bushfire Risk (SPP 3.7): A notification may be required on the certificate of title advising that a Bushfire Management Plan (BMP) applies and that lots with a BAL rating of 12.5 or higher are subject to the provisions of SPP 3.7.
- Aircraft Noise (SPP 5.1): A notification may be required to advise of potential noise impacts due to proximity to Perth Airport.
- Freight Noise (SPP 5.4): A notification may be required to advise of potential freight-related noise impacts associated with the nearby RAV network.

In addition:

- Light Industry Zone and Highway Service Zone Sub-Precincts: A cross-access easement is required to coordinate and consolidate vehicular access to the RAV network in accordance with an approved Local Development Plan.



NOTES

1. Existing 132kV line (Ref: NT-HZM)
2. Existing easement to be removed
3. Proposed land swap parcel - 8320m²

LEGEND

- STRUCTURE PLAN AREA (21.149ha)

LOCAL SCHEME ZONES

- RESIDENTIAL (R20)
- INDUSTRY - LIGHT
- HIGHWAY SERVICE
- POS & DRAINAGE

ROAD HIERARCHY

- DISTRIBUTOR ROAD B
- LOCAL DISTRIBUTOR ROAD
- LOCAL ACCESS STREET

LAND USE PLANNING ELEMENTS THAT INFORM THE STRUCTURE PLAN

- POWERLINE EASEMENT/PLYON/POLE
- 30m PUMP STATION ODOUR BUFFER
- STAGING BOUNDARY
- DRAINAGE EASEMENT (2.6m)

URPS

CALLO

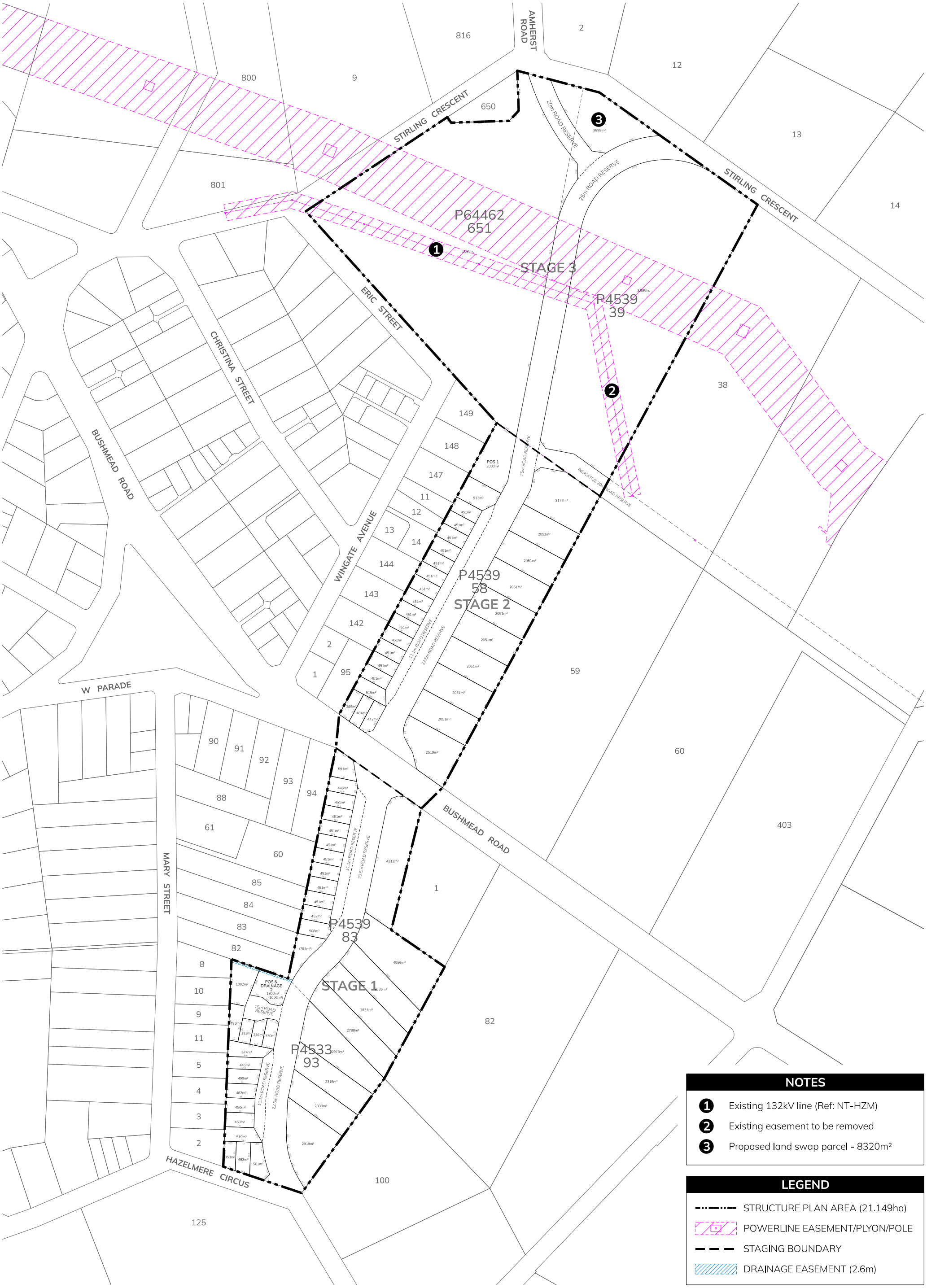
BUSHMEAD ROAD, HAZELMERE CIRCUS &

STIRLING CRESCENT, HAZELMERE

NORTH

0 35 70 105m

LOCAL STRUCTURE PLAN		DWG. REF.	- 2-001
30/06/2026		REVISION	- D
1:3500 @ A3		URPS REF.	- 24PER-0004



NOTES

1. Existing 132kV line (Ref: NT-HZM)
2. Existing easement to be removed
3. Proposed land swap parcel - 8320m²

LEGEND

- STRUCTURE PLAN AREA (21.149ha)
- POWERLINE EASEMENT/PLYON/POLE
- STAGING BOUNDARY
- DRAINAGE EASEMENT (2.6m)

URPS

CALLO

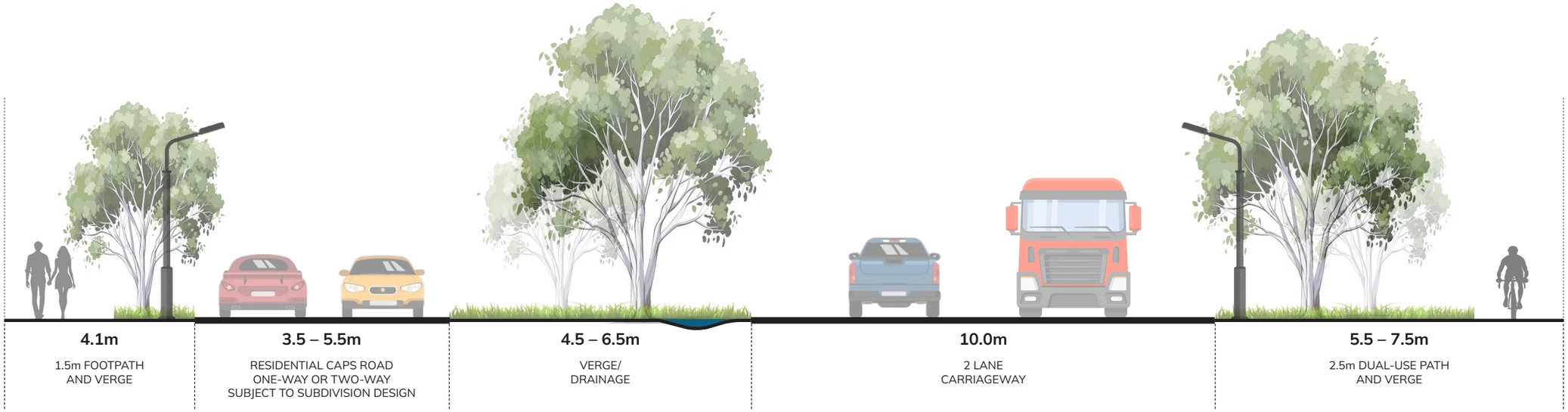
BUSHMEAD ROAD, HAZELMERE CIRCUS &

STIRLING CRESCENT, HAZELMERE

NORTH

0 35 70 105m

SUBDIVISION LAYOUT PLAN	DWG. REF.	-	5-010
01/07/2026	REVISION	-	C
1:3500 @ A3	URPS REF.	-	24PER-0004



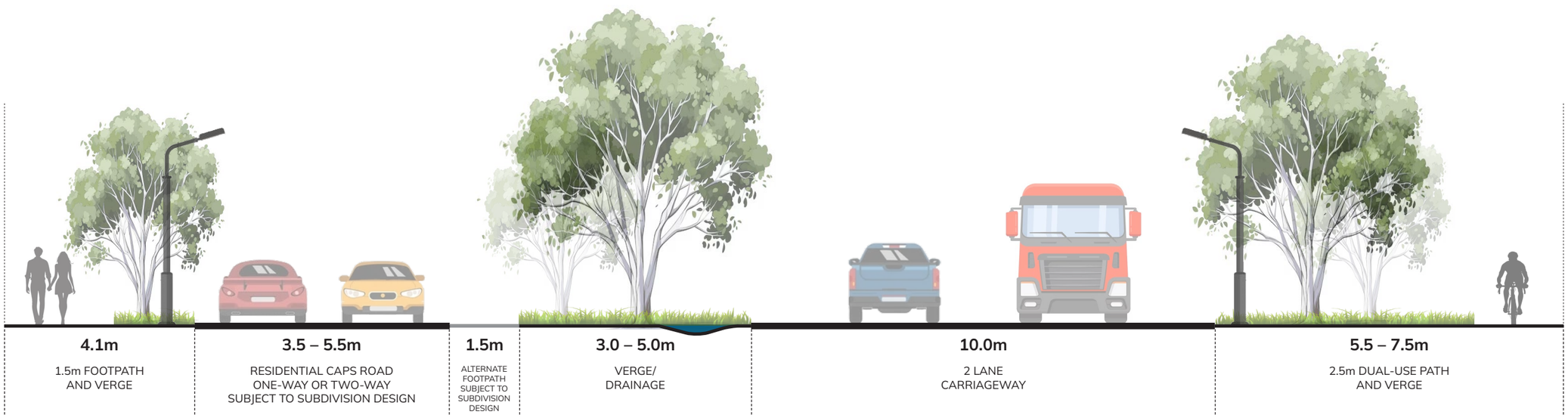


Figure 1

URPS

CALLO

DISTRICT DISTRIBUTOR B (ERIC LUMSDEN DRIVE) - CROSS SECTION DESIGN OPTIONS

BUSHMEAD ROAD, HAZELMERE CIRCUS & STIRLING CRESCENT, HAZELMERE

SECTIONS	DWG. REF.	—	SK01
20/01/2025	REVISION	—	C
1:100 @ A3	URPS REF.	—	24PER-0004

PART TWO – EXPLANATORY SECTION

7. Planning Background

7.1 Introduction & Purpose

The Hazelmere Special Use Zone 16 Structure Plan provides a coordinated planning framework to guide the future subdivision, land use and development of five land parcels in Hazelmere, approximately 1.5km from Midland and 16km from the Perth CBD. Prepared on behalf of contributing private and corporate landowners south of Bushmead Road, the Structure Plan forms part of the broader Hazelmere Enterprise Area Structure Plan (2011) and is supported by relevant environmental and servicing studies.

The Structure Plan aligns with the Metropolitan Region Scheme, City of Swan Local Planning Scheme No. 17, and the Planning and Development (Local Planning Schemes) Regulations 2015. It builds upon the strategic direction set by the Kewdale-Hazelmere Integrated Masterplan (2006), the HEASP (2011), and the Guildford Hazelmere Local Area Plan (2020), all endorsed by the WAPC.

The plan facilitates a mix of residential, highway commercial and light industrial land uses, providing a land use transition between General Industrial areas to the east and residential areas to the west. A key feature is the proposed north–south spine road (District Distributor B – Eric Lumsden Drive), which is intended to redirect industrial traffic away from residential precincts such as Hazelmere, Woodbridge, and Guildford.

7.2 Land Description

7.2.1 Location

The subject area is located in Hazelmere (refer Figure 2). The sites have direct access onto the existing constructed roads Stirling Crescent for lots 651 & 39, Bushmead Road for lots 58 & 83 and Hazelmere Circus for lot 93.

The area is generally bounded by Stirling Crescent to the north, lots within the Special Use Zone 25 to the east, Hazelmere Circus to the south and Mary Street and Windgate Avenue further to the west. The access and egress and the proposed future north/south road at the area is detailed further in the Transport Impact Assessment.

7.2.2 Area, Land Use & Ownership

The subject area is 21.149 ha in area and comprises 5 privately owned lots per current land ownership details in the table below. The subject area calculation includes portion of the existing Bushmead Road reservation (~0.35647ha) in additional to the effective five development lot areas (~20.79253ha).

The land is predominantly cleared from historical grazing (Figure 3 refers). Lots 651 and 39 are vacant with stands of planted vegetation and the others contain residential dwellings, sheds, horse stables and horse paddocks.

The subject lots are described below – per landowner and Certificate of Title details correct at the time of lodgement (June 2025):

Table 8: Title Details

Lot	Address	Volume	Folio	Ownership	Area (ha)
Lot 39	Stirling Crescent	2212	732	G-Trading Pty Ltd	5.5100
Lot 651	Stirling Crescent	2729	545	Stirling Brass Founders {WA) Pty Ltd	5.2763
Lot 58	167 Bushmead Road	1651	422	Sammy & Co (WA) Pty Ltd	4.43841
Lot 83	170 Bushmead Road	1789	662	Maiolo Development Pty Ltd	3.02921
Lot 93	40 Hazelmere Circus	1582	155	Callo (D, G and N)	2.53861
				Total:	20.79253

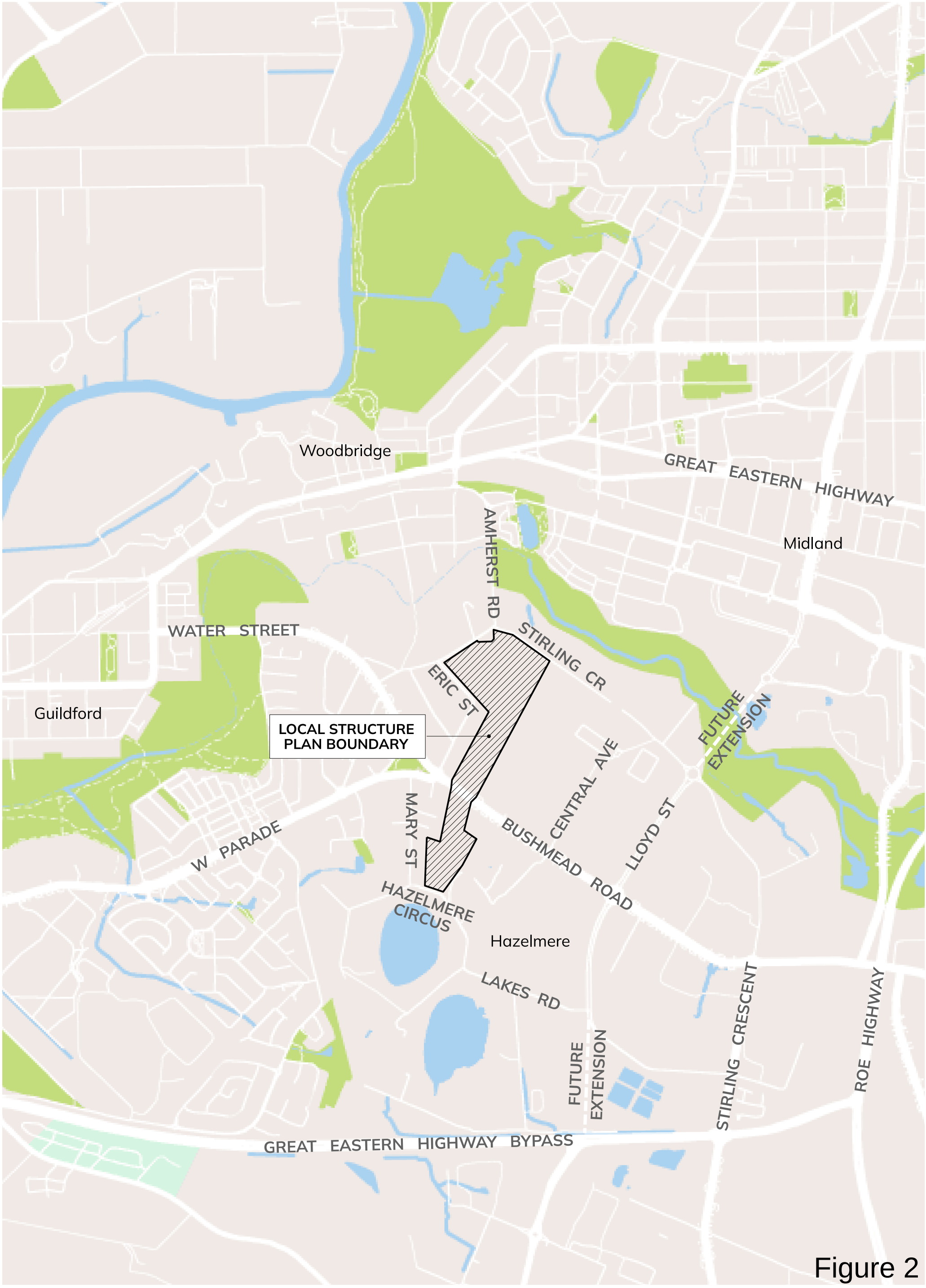


Figure 2

URPS

CALLO
BUSHMEAD ROAD, HAZELMERE CIRCUS &
STIRLING CRESCENT, HAZELMERE

NORTH
0 150 300 450m

LOCATION PLAN	DWG. REF.	- 5-001
21/03/2025	REVISION	-
1:15 000 @ A3	URPS REF.	- 24PER-0004



URPS

CALLO
BUSHMEAD ROAD, HAZELMERE CIRCUS &
STIRLING CRESCENT, HAZELMERE

NORTH
0 35 70 105m

AERIAL PHOTO
21/03/2025
1:3500 @ A3

DWG. REF. - 5-002
REVISION -
URPS REF. - 24PER-0004

7.3 Pre-Lodgement Consultation

7.3.1 Original Structure Plan Background

An earlier Structure Plan for the site was lodged by Statewest Planning on behalf of five landowners, proposing a similar land use mix and introducing a central north–south Distributor B road (Eric Lumsden Drive). The plan included four sub-precincts, with one residential sub-precinct (Sub-Precinct 2) accommodating approximately 48 dwellings, partially within the 25–30 ANEF aircraft noise contour.

Public advertising in late 2021 resulted in 24 submissions, including objections from Perth Airport (aircraft noise), DFES (bushfire risk), and local residents (traffic and land use impacts). Council deferred consideration in June 2022 due to insufficient community engagement, outdated traffic and bushfire assessments, and the passing of the proponent's representative.

In June 2023, the City of Swan recommended the WAPC refuse the Structure Plan, citing the absence of updated technical reports and conflict with SPP 3.7 and SPP 5.1. The WAPC has since held the proposal in abeyance pending further action.

7.3.2 Revised Structure Plan Pre-Lodgement Consultation

In July 2024, the owners of Lot 93 Hazelmere Circus engaged URPS to review and advance the previously deferred Structure Plan. Preliminary consultation with the City of Swan included a review of prior technical reports and design refinements in line with Council's June 2023 resolution. URPS developed a revised road layout to improve land efficiency while maintaining appropriate land use transitions. Design scenarios were workshopped with the City to inform the revised Structure Plan.

Following this, DPLH was engaged to reinitiate WAPC's assessment. Given the extent of proposed modifications, a new Structure Plan was recommended over resolving legacy issues from the earlier version. Elements of the original plan, including servicing alignments, were retained where relevant.

The updated Structure Plan was formally submitted in June 2025, informed by feedback from the City and DPLH. No additional agency referrals were deemed necessary, nor community engagement; this given the detailed submissions previously received for what was deemed a more impactful proposal to existing residential properties. While Lot 83 landowners have supported and participated in the redesign process, no other landowners in the precinct elected to engage, despite multiple invitations to do so.

7.4 Planning Framework

7.4.1 Zoning & Reservations

Region Scheme

- Zoned 'Urban' under the Metropolitan Region Scheme (MRS).

Local Planning Scheme

- Zoned 'Special Use Zone No. 16' under the City of Swan Local Planning Scheme No. 17 (LPS 17).
  - The 'Special Use 16' zoning was introduced via Amendment No. 86 to LPS 17, which was approved by the Minister for Planning on 23 May 2017 and subsequently gazetted on 28 July 2017.
- In accordance with the conditions set out under Schedule 4 of LPS 17 for Special Use Zone No. 16:
  - Subdivision and development shall be in accordance with a Structure Plan prepared and approved in accordance with the provisions of Part 4 of the deemed provisions.
  - A Structure Plan shall include all lots within this Special Use Zone and be prepared and approved prior to any additional land use, development proposal or subdivision of a lot, with the exception that the Local Government may consider granting an approval for the following land use, development or subdivision, without the prior requirement for a Structure Plan.
    a. Single House and associated residential structures and activities such as a Home Business; Home Occupation; Home Office; Home Store on a lot, or
    b. minor lot boundary changes.
  - The Structure Plan is required to observe the Land Use Intent and Development Requirements as detailed within Precinct 3A 'HEA Buffer Area' within the Local Government and WAPC approved Hazelmere Enterprise Area Structure Plan."
- The area is also included in the City's LPS 17 Part 6 - Special Control Area 'Aircraft Noise Exposure Areas'.
  - The Hazelmere Enterprise Area Structure Plan ANEF (2009) mapping identifies the subject site is in the contour of 20-25.
  - The Perth Airport Ultimate Capacity Australian Noise Exposure Forecast (2019) maps the site in the 25-30 contour. The clauses of LPS17 relevant to development are 6.2.1 and 6.2.2 and these are outlined below.
    - *6.2.1 Aircraft Noise Exposure Areas are defined on the Scheme Map in accordance with the WA Planning Commission's Statement of Planning Policy "Land Use Planning in the Vicinity of Perth Airport", and the Australian Noise Exposure Forecast referred to in the Commission's policy and the most recent Australian Noise Exposure Forecast prepared for RAAF Pearce.*

      Note: The designation of particular parts of the district as Aircraft Noise Exposure Areas should not be interpreted to imply that areas outside the respective noise exposure contours are unaffected by aircraft noise.
    - *6.2.2 In addition to development which otherwise requires approval under the Scheme, planning approval is required for any development involving building types identified as either 'conditionally acceptable' or 'unacceptable' for the relevant noise exposure zone in Australian Standard AS 2021.*

7.4.2 Regional & Sub Regional Structure Plans & Strategies

Perth and Peel @ 3.5 million

This document was released in March 2018 and provides the guidelines for the development of Perth and Peel towards an anticipated population of 3.5 million by 2050. The area is split into four sub-regions and the subject site is located in the North-East Sub-Region, which identifies it as 'Urban and Industrial'. The framework also identified employment opportunities in the area for the neighbouring residential location. The proposed Lloyd Street extension and the upgrade of the 132Kva Hazelmere lines are part of the proposed future Infrastructure works listed in the area. The Structure plan supports these outcomes.

North-East Sub-Regional Planning Framework

The framework identifies Hazelmere as an Industrial centre and a key employment area with the region having good proximity to established linkages and infrastructure. The proposed Structure Plan supports these desired outcomes and the objectives of clause 3.3 'Economic and Employment'. The proposed land uses will support the economic development of the area and enhance employment options.

7.4.3 District Planning Strategies

Kewdale-Hazelmere Integrated Masterplan (KHIM)

The 2002 Freight Network Review identified Kewdale-Hazelmere as Western Australia's primary intermodal freight precinct, driven by its strategic proximity to Perth Airport. In response, the (then) Department of Planning and Infrastructure prepared the Kewdale-Hazelmere Integrated Masterplan (KHIM) in 2003 to guide land use and infrastructure planning across the region.

Key objectives of the KHIM included:

- Supporting the area's role as a major road and rail freight logistics hub;
- Coordinating structure planning, transport corridors, and land use interfaces;
- Leveraging synergies between adjacent industrial areas;
- Defining the freight functions of Hazelmere, Kewdale, and Forrestfield; and
- Investigating the realignment of the freight rail line to bypass Midland.

The subject site falls within the Hazelmere Precinct of the KHIM, which recommended the Lloyd Street extension and improved freight infrastructure. The proposed land uses under the SUZ16 align with LPS17 permissibility ('D' and 'A' uses) and are consistent with the strategic intent of the KHIM.

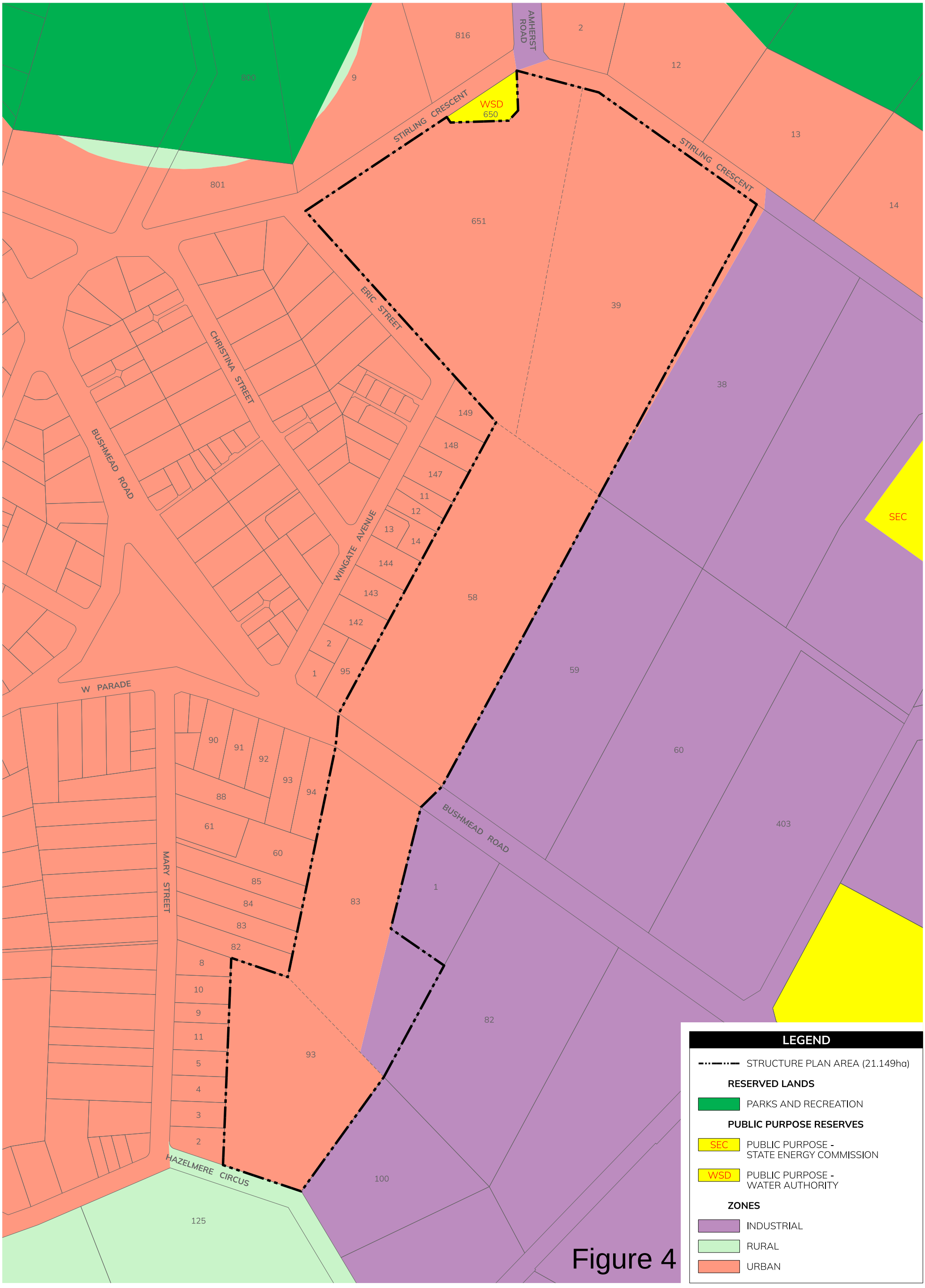


Figure 4

URPS

CALLO
BUSHMEAD ROAD, HAZELMERE CIRCUS &
STIRLING CRESCENT, HAZELMERE

NORTH
0 35 70 105m

METROPOLITAN REGION SCHEME ZONING
21/03/2025
1:3500 @ A3

DWG. REF. - 5-003
REVISION -
URPS REF. - 24PER-0004

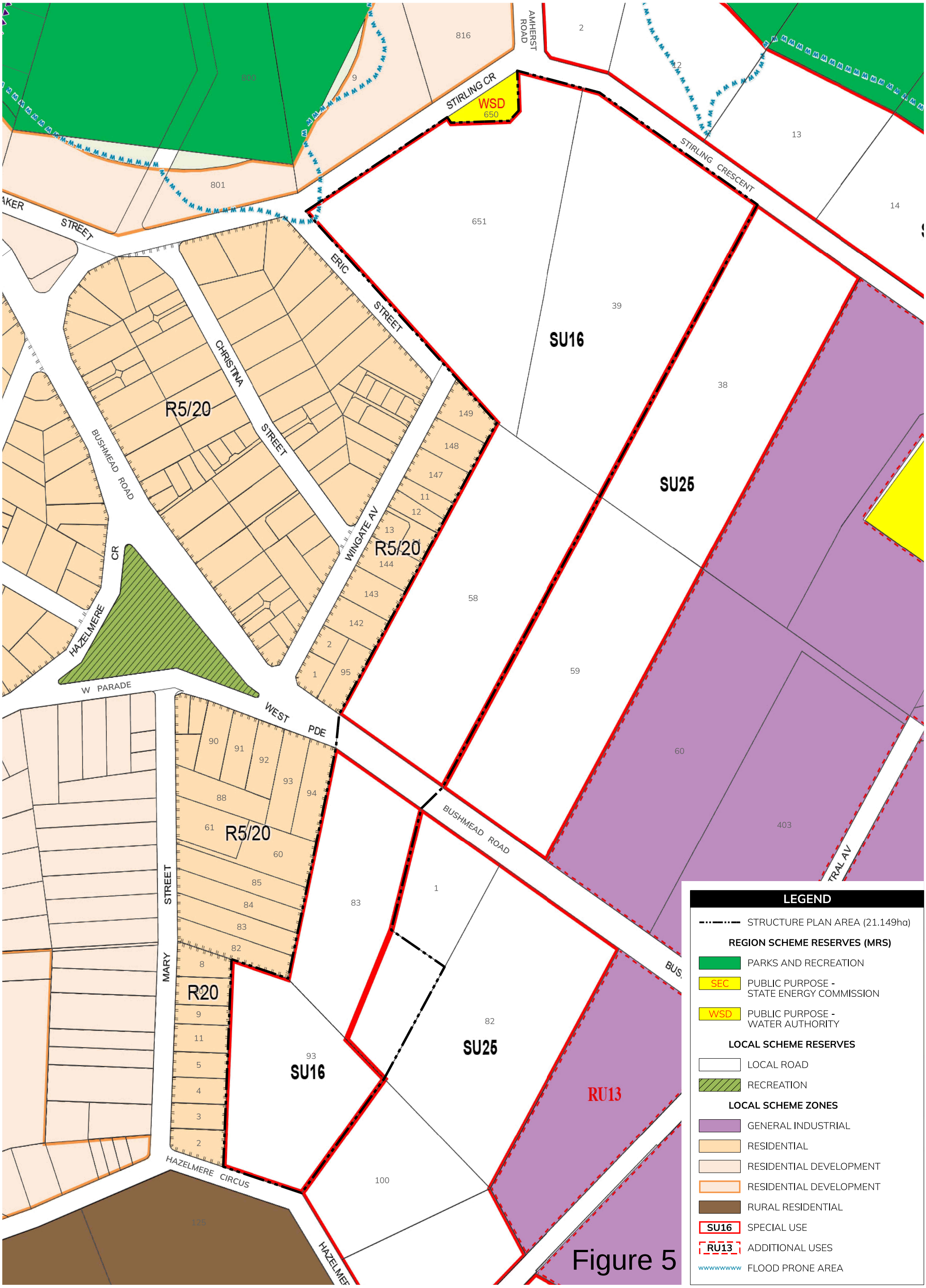


Figure 5

URPS

CALLO

BUSHMEAD ROAD, HAZELMERE CIRCUS & STIRLING CRESCENT, HAZELMERE

NORTH

0 35 70 105m

CITY OF SWAN
LOCAL PLANNING SCHEME No.17

21/03/2025

1:3500 @ A3

DWG. REF. - 5-004

REVISION -

URPS REF. - 24PER-0004

New road to tie in with Stirling Crescent road and service infrastructure.

Manage Highway Service interface to low density residential

27m wide restricted development area fronting Eric Street

Provide residential road & landscaping treatments for separation to industrial land uses.

Provide residential lots as transitional land use adjacent existing low density residential

POS (Drainage) and landscaping to alleviate vehicle noise and proximity to residential lots

Provide residential road & landscaping treatments for separation to industrial land uses.

New road & T-Intersection to tie in with Hazelmere Circus. Road upgrade by others.

NOTES

1. Existing 132kV line (Ref: NT-HZM)
2. Existing easement to be removed
3. Proposed land swap parcel - 8320m²

LEGEND

- STRUCTURE PLAN AREA (21.149ha)
- POWERLINE EASEMENT/PLYON/POLE
- LAND SWAP AREA 1
- LAND SWAP AREA 2
- DRAINAGE EASEMENT
- PROPOSED ANEF CONTOUR
- NO VEHICLE ACCESS/EGRESS
- CONSOLIDATED LOCATION FOR ACCESS/EGRESS
- ROAD ACCESS STRATEGY REQUIRED - CONSOLIDATED CROSSOVER LOCATIONS AND EASEMENTS FOR RECIPROCAL ACCESS/EGRESS
- POWER
- WATER
- SEWER

URPS

CALLO

BUSHMEAD ROAD, HAZELMERE CIRCUS &

STIRLING CRESCENT, HAZELMERE

NORTH

0 35 70 105m

OPPORTUNITIES & CONSTRAINTS	DWG. REF.	- 5-008
01/07/2026	REVISION	- B
1:3500 @ A3	URPS REF.	- 24PER-0004

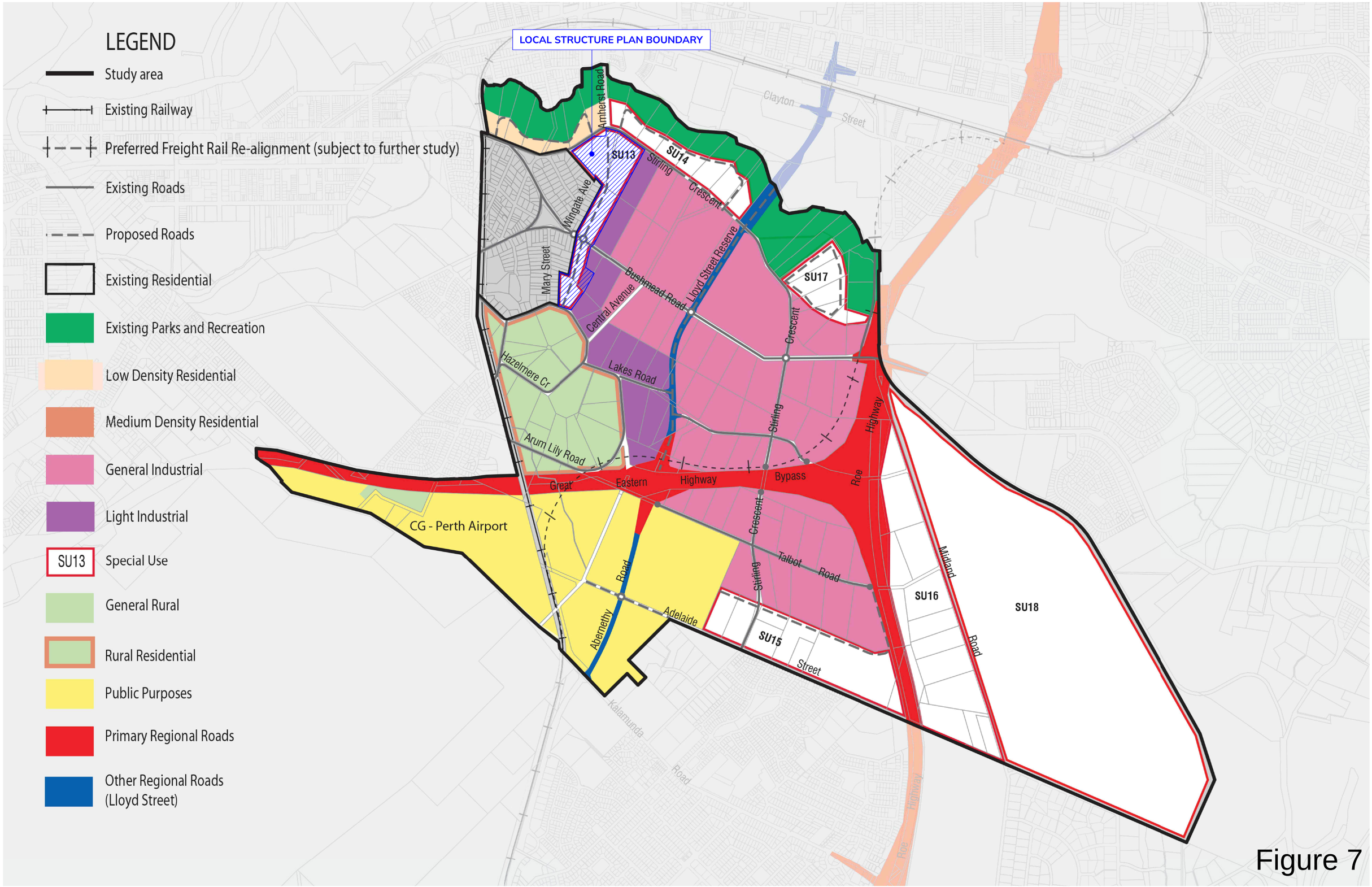


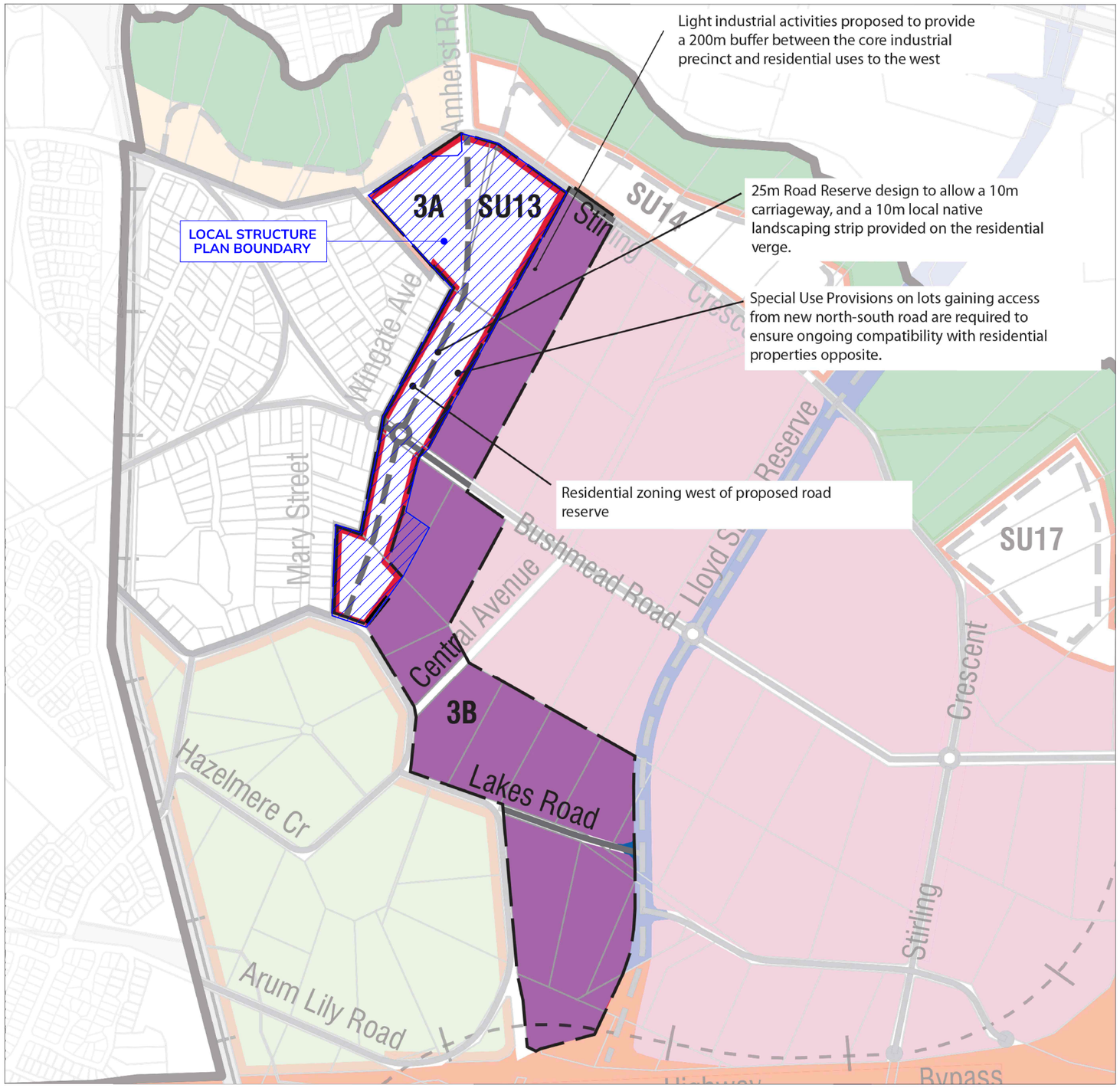
Figure 7

URPS

CALLO
BUSHMEAD ROAD, HAZELMERE CIRCUS &
STIRLING CRESCENT, HAZELMERE

HAZELMERE ENTERPRISE AREA STRUCTURE PLAN
21/03/2025
Not to Scale @ A3

DWG. REF. - 5-006
REVISION -
URPS REF. - 24PER-0004



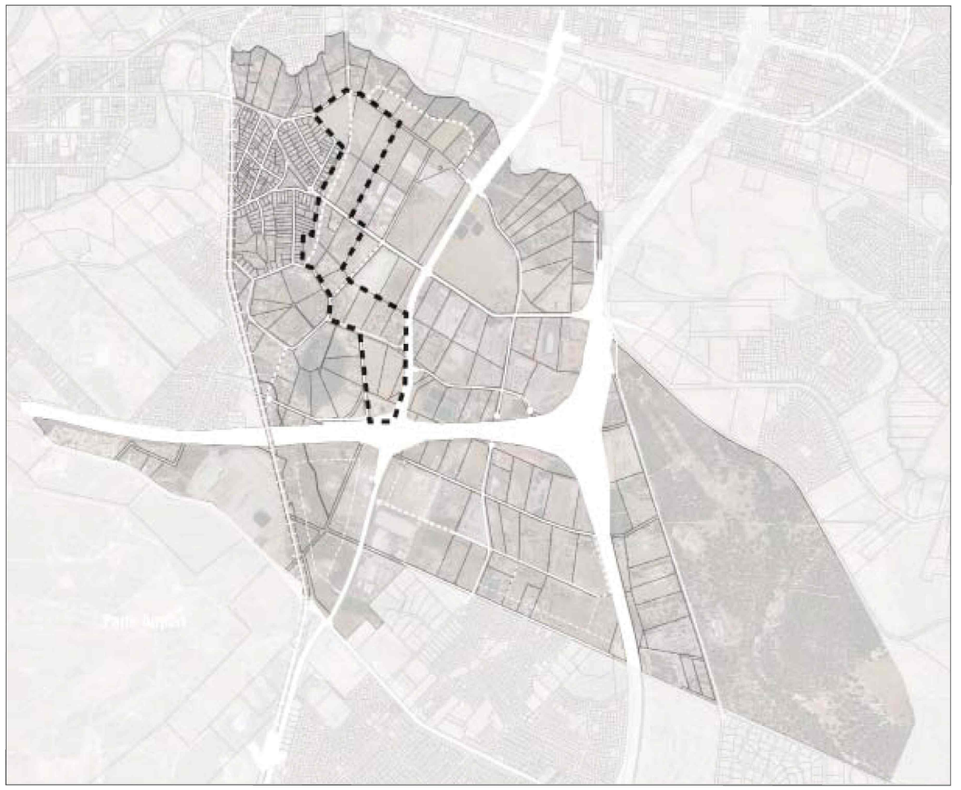


Figure 8

URPS

CALLO
BUSHMEAD ROAD, HAZELMERE CIRCUS &
STIRLING CRESCENT, HAZELMERE

HAZELMERE ENTERPRISE AREA STRUCTURE PLAN - PRECINCT 3
21/03/2025
Not to Scale @ A3

DWG. REF. - 5-007
REVISION -
URPS REF. - 24PER-0004

Hazelmere Enterprise Area Structure Plan (HEASP)

In 2011, the City of Swan and the (then) Department of Planning prepared the Hazelmere Enterprise Area Structure Plan (HEASP) in response to the KHIM's recommendation for more detailed land use planning. The HEASP was endorsed by both the City of Swan and the WAPC following extensive community consultation. Its guiding principles are to:

- Facilitate business growth in Hazelmere;
- Provide a land use interface that protects residential amenity;
- Support a vibrant, business-focused precinct; and
- Minimise environmental impacts and strengthen ecological connections.

The subject site falls within Precinct 3A – Buffer Area, where land uses are intended to provide a transition between the industrial core to the east and existing residential areas to the west.

The Structure Plan aligns with this intent by proposing compatible land uses under the SU16 zone that achieve an appropriate interface in accordance with HEASP objectives.

Lot 651, while within Precinct 3A, is physically separated from existing residential land and is suitably buffered to support its proposed Highway Service land uses. The interface area west of the proposed District Distributor B road is designated for residential development, consistent with the adjacent R20 coding. Title notifications will be applied to inform future landowners of aircraft noise, as the updated ANEF mapping now places this area within the 25–30 contour.

All development and subdivision will be guided by the requirements of HEASP Precinct 3A, ensuring the proposed residential and industrial uses maintain acceptable amenity and contribute to the strategic planning vision for the Hazelmere Enterprise Area.

City of Swan Guildford Hazelmere Local Area Plan, 2020 (GHLAP)

The Guildford-Hazelmere Local Area Plan (GHLAP), prepared by the City of Swan in consultation with the community, provides localised planning direction for infrastructure, services, and land use change.

The GHLAP recognises the Hazelmere Enterprise Area as a key strategic employment hub, expected to evolve into a specialist inter-regional freight and logistics centre, supported by proximity to major road, rail, and air infrastructure. It references the HEASP and highlights the need to manage aircraft noise impacts in accordance with State Planning Policy 5.1, particularly in relation to the future Perth Airport runway and sensitive land uses.

The GHLAP identifies the need for reticulated sewerage for any subdivision or development not classified as 'Dry Industry' under LPS17. It also highlights concerns with heavy vehicle traffic along Bushmead Road through nearby residential areas and supports the construction of a new north-south road linking to Lloyd Street to address this issue.

Road and drainage infrastructure is to be funded through the Hazelmere Industrial Area Special Area Rate (SAR). Where the City's delivery schedule does not align with landowner timeframes, developers may pre-fund the works, with reimbursement via a legal agreement with the City.

The Structure Plan aligns with the GHLAP by supporting orderly development, improved infrastructure delivery, and compatible land use outcomes for the Hazelmere Enterprise Area.

7.4.4 State Planning Policies

The proposed Structure Plan has been prepared in consideration of relevant State and local planning policies. The following sections outline key policy documents that inform the planning and design response, and demonstrate how the Structure Plan aligns with their objectives and requirements.

Table 9: State Planning Policies

Planning Policy/Guideline	Structure Plan Response
SPP 4.1 – Industrial Interface	The Structure Plan supports the intent of SPP 4.1 by incorporating a transitional buffer in Precinct 3A, separating residential areas to the west from industrial development to the east. Land uses designated as 'D' and 'A' under SU16 ensure compatibility, minimise land use conflict, and maintain amenity. The HEASP supports the application of transitional land uses, which have been implemented in the Structure Plan, particularly on Lot 651.
SPP 5.1 – Land Use Planning in the Vicinity of Perth Airport	The site is largely located within the ANEF 20-25 contour. Residential development is confined to land directly abutting existing residential zones to maintain continuity and mitigate land use conflict. Lot 651 is not proposed for residential development due to noise exposure and other constraints (e.g. power lines). Notifications on title and future building controls (e.g. insulation) will be applied. The Structure Plan aligns with SPP 5.1 and LPS17 Aircraft Noise Exposure Areas.
SPP 5.4 – Road and Rail Noise	The proposed District Distributor B spine road links industrial precincts to the broader freight network, potentially triggering SPP 5.4. While proposed industrial and commercial uses are not noise-sensitive, residential components will require acoustic assessment and mitigation where applicable. Compliance will be addressed at the subdivision and development stages.
DC 4.1 – Industrial Subdivision	The Structure Plan adopts appropriate industrial design standards, including minimum 1,000m² lot sizes, 20m road reserves, and avoidance of direct industrial access to residential areas. Separation via road and landscape buffers has been incorporated, and traffic access is controlled through a Traffic Impact Assessment. Access to the freight network is facilitated by the proposed District Distributor B spine road.

DC 2.3 – Public Open Space in Residential Areas	The Structure Plan provides a 10% public open space contribution through a combination of land and cash-in-lieu. POS will act as a functional buffer between residential and non-residential land uses. The proposed layout responds to local topography and supports the City's open space planning objectives.
SPP 3.7 – Planning in Bushfire Prone Areas	The site is identified as bushfire prone. A Bushfire Management Plan (BMP) has been prepared, demonstrating that BAL-29 or lower can be achieved for all lots. Future development and subdivision applications will refine bushfire measures in line with SPP 3.7 and the Guidelines for Planning in Bushfire Prone Areas.
SPP 2.9 – Water Resources	A Local Water Management Strategy (LWMS) has been prepared consistent with SPP 2.9 and the HEASP's District Water Management Strategy. It addresses surface and groundwater management, with further detail to be provided through Urban Water Management Plans at subdivision stage.
SPP 4.2 – Activity Centres for Perth and Peel	The Structure Plan supports the growth of the Midland Strategic Metropolitan Centre by facilitating local employment, service-based land uses, and retail opportunities. A Retail Needs Assessment identifies demand and justifies commercial related (Highway Service) land use on Lot 651, supporting local and regional activity centre functions.
WAPC Structure Plan Preparation Guidelines	The Structure Plan has been prepared in accordance with the WAPC Structure Plan Framework (2023), addressing zoning, land use, servicing, transport, environmental and bushfire considerations in a strategic and coordinated manner.
Better Urban Water Management (BUWM) Guidelines	Aligned with SPP 2.9, a Local Water Management Strategy has been prepared at the Structure Plan stage. Future Urban Water Management Plans will guide subdivision and development, ensuring integration of water-sensitive urban design principles across the precinct.

8. Site Characteristics & Context

8.1 Context

The Structure Plan area occupies a strategic transition zone between established residential land to the west and General Industrial land to the east. The proposed land uses facilitate an appropriate interface that manages existing site constraints while supporting orderly development.

The extension of the north – south District Distributor B road ('spine road'), including adjacent CAPs roads, ensures industrial traffic is diverted away from residential areas and integrates safely with the broader road network. All residential access roads and crossovers will be designed to ensure access if restricted from the District Distributor B Road and those of higher road and freight hierarchy, including Bushmead Road.

On the western side of the spine road, land use and interface treatments are designed to sensitively transition to the adjoining residential properties. The proposed realignment of the 132kV transmission line adjacent to Eric Street creates a managed buffer corridor for pedestrian and service access, reinforcing physical separation from existing residences. This design also satisfies WAPC expectations for appropriate setbacks and prohibits vehicle access to and from Eric Street.

8.2 Flora and Vegetation

Detailed environmental reporting has not been provided with this Structure Plan submission due to the historically cleared and modified nature of the site, the absence of significant environmental values, and the findings of previous site investigations, which confirm that further environmental assessment is not warranted at this stage.

The land comprising Lots 651 and 39 Stirling Crescent, Lots 58 and 83 Bushmead Road, and Lot 93 Hazelmere Circus has historically been cleared for agricultural grazing, cropping, and equestrian pursuits. As documented in the ENVAus Environmental Assessment (July 2023), the understorey has been completely removed, and the site has been substantially modified over time. Remaining vegetation consists primarily of scattered paddock trees, often retained for livestock shade or resulting from natural regrowth and/or private screen planting.

The site is not identified as containing any areas of Bush Forever, and no Threatened or Priority Flora or Fauna, Threatened Ecological Communities (TECs), or Ramsar wetlands have been mapped within the Structure Plan area.

While the site lies within the Geomorphic Wetlands dataset (specifically classified as 'Resource Enhancement' or 'Multiple Use'), this designation does not represent a conservation or ecological constraint. The Local Water Management Strategy has addressed these wetland areas in detail and proposed drainage outcomes that align with the Department of Water and Environmental Regulation (DWER) guidelines and Liveable Neighbourhoods requirements.

The Bushfire Management Plan (BMP) further supports this position by confirming that the subject land is not identified as containing native vegetation, and bushfire hazard levels can be managed through appropriate subdivision design and Asset Protection Zones. The BMP concludes that all lots can achieve a BAL-29 or lower without the need to clear or disturb any significant native vegetation.

Given these findings, and consistent with prior planning assessments, it is considered that further detailed environmental reporting, such as flora/fauna surveys or targeted ecological assessments, is not necessary at the Structure Plan stage. The planning framework and technical appendices submitted provide adequate information to assess the Structure Plan's environmental suitability and demonstrate that any future subdivision or development will not result in unacceptable environmental impacts.

Should more detailed assessment be required at future development stages (e.g., subdivision or clearing permits), it can be appropriately addressed through standard conditions of approval in consultation with relevant agencies such as DWER and DBCA.

8.3 Landforms and Soils

The site is generally flat with gentle gradients. Lot 93 Hazelmere Circus ranges from approximately 13m AHD at its southern end, sloping northward to 12m AHD at Bushmead Road. Lot 58 Bushmead Road is relatively level at 12m AHD. Lots 651 and 39 Stirling Crescent slope northwards, from approximately 8m AHD at the central portion to 6m AHD at the western boundary adjoining Eric Street.

According to the Geological Survey of Western Australia (Gozzard, 1986), the site is underlain by Guildford Formation (Qpa), comprising predominantly pebbly silt soils. Soil logs included in the Local Water Management Strategy (LWMS) identify surface materials as sandy clay overlying orange clay, confirming the site's moderate infiltration characteristics and informing drainage and water management planning.

8.4 Acid Sulphate Soils

Mapping by the Department of Water and Environmental Regulation (DWER) indicates that acid sulphate soil (ASS) risk areas are located within 30m to 175m south, south-west and south-east of the Structure Plan area, generally associated with current and former damplands. Groundwater sampling in and around the subject land has not identified the presence of ASS. Consequently, the site is considered to be low risk for ASS, and standard subdivision-stage precautionary management, if required, would address any future excavation in mapped risk areas.

8.5 Contamination

A review of the DWER Contaminated Sites Database confirms that there are no known contaminated sites within the subject land or directly adjacent lots. Historical aerial photography further confirms the land has been cleared and used predominantly for agricultural grazing and rural-residential activities since at least 1953. There is no evidence of past land uses likely to result in contamination.

8.6 Groundwater and Surface Water

A Local Water Management Strategy has been prepared for the site by Bayley Environmental Consulting (Appendix 1).

8.6.1 Groundwater

Maximum groundwater levels (MGL) range from 5.5m AHD in the north to 10.5m AHD in the south of the site. MGL is generally more than 2m below natural surface, except in the north-west corner where levels come within 0.5m. The proposed stormwater system is designed to minimise alteration of the groundwater regime. Subsoil drains and swale inverts will be set at or above the average annual maximum groundwater level (AAMGL), in accordance with Better Urban Water Management principles.

8.6.2 Surface Water

There is no natural surface watercourse within the site. However, minor artificial drains and areas of seasonal saturation are present. The LWMS outlines that stormwater will be managed through a network of bioretention swales and in-lot detention infrastructure, with overflows directed to external drainage systems via easements and the Westrail reserve. This network ultimately discharges into the Helena River. The design ensures post-development peak flows do not exceed pre-development rates, aligning with the City of Swan's drainage policy objectives.

8.7 Bushfire Hazard

The site is located within a designated bushfire-prone area, requiring compliance with State Planning Policy 3.7 and associated Guidelines. A Bushfire Management Plan (BMP) and indicative BAL Contour Plan have been prepared by a Level 3 BPAD Accredited Practitioner (refer Appendix 3). The BMP demonstrates that all proposed lots are capable of achieving a BAL-29 rating or less. No clearing of native vegetation is proposed as the site is already cleared or parkland cleared.

Development staging and road design have been structured to provide compliant access and egress arrangements. A perimeter road is proposed, and reticulated water will be extended to the site to provide adequate firefighting water supply. Lot 83, which contains land within BAL-FZ outside the Structure Plan area, will require hazard reduction measures and a site-specific BMP at subdivision or development stage to ensure compliance with SPP 3.7.

8.8 Heritage

8.8.1 Indigenous Heritage

The site is located within the spatial extent of Site 3758 – Helena River, which is broadly defined and extends along the river corridor. However, a review of the DPLH Aboriginal Heritage Inquiry System confirms no registered Aboriginal heritage sites are located within the structure plan boundary. No additional investigations are required at this stage, but further assessment may be triggered at subdivision should works impact previously undisturbed land near the river.

8.8.2 European Heritage

A review of the City of Swan Heritage list reveals there are no sites of significance in the Structure Plan Area.

8.9 Infrastructure

The implementation of the Structure Plan will require the coordinated delivery of infrastructure services, including power, sewer, water, road access and drainage. The site is currently partially serviced, and progressive development will trigger upgrades and extensions to facilitate full servicing of all proposed sub-precincts and/or individual land ownership. Detailed design and delivery of infrastructure will be subject to liaison with service providers and local government through the subdivision and development process. Figure 6 and various appendices as noted provides illustration for all design matters below.

8.9.1 Power

Western Power's network capacity mapping confirms that the Hazelmere Substation currently has less than 5 MVA available capacity. As a result, future development across the Structure Plan area will require network upgrades to increase supply capacity. Individual landowners are responsible for securing electricity connections in accordance with Western Power's standard requirements. It is anticipated that a coordinated response to infrastructure provision will be needed to ensure sufficient capacity is available to service both residential and non-residential precincts. (Refer Appendix 4 – Western Power Correspondence).

8.9.2 Sewer

Sewer servicing within the Structure Plan area is currently limited to Lot 651, with other lots operating on-site effluent disposal systems. The Water Corporation has prepared concept plans to extend reticulated sewerage throughout the Structure Plan area, including connection to the existing Wastewater Pump Station (WWPS) located at the southern edge of the precinct. The realignment of infrastructure through a proposed land exchange between Lot 651 and Lot 39 will create a dedicated corridor to accommodate sewer infrastructure via road reserves and easements (refer Appendix 5 – Sewer Concept Plan).

The existing WWPS is connected to the broader network via Flora Street and is capable of servicing the subject land. The Water Corporation has forward planning in place to upgrade this facility as demand increases. Upgrades include provision for inter-catchment transfer and additional underground wastewater storage. A 30m odour buffer is required around the WWPS wet well, within which residential land uses are restricted. The proposed transitional land uses in proximity to the buffer are considered compatible.

A maximum R20 residential coding is proposed for the Residential Zone Sub-Precinct to support the viability of sewer extension and to enable servicing of both the new residential area and adjacent unsewered residential properties to the west. Extension of sewer to this location will also facilitate the opportunity for future industrial land to the east to be connected.

8.9.3 Water

The site can be connected to the existing mains water network. The Water Corporation has advised that portions of the Structure Plan area, particularly those proposed for commercial or industrial use, may require the extension of 150mm water mains to achieve adequate fire flow capacity. The use of alternative fire service solutions may be considered at subdivision stage depending on land use and operational requirements.

The proposed land exchange between Lot 651 and Lot 39 provides a logical opportunity to create a shared corridor for coordinated installation of water, sewer, and power infrastructure. Water servicing to Lot 39 can be delivered through this shared service corridor in accordance with standard Water Corporation extension procedures.

8.9.4 Road and Drainage

The future road network within the Structure Plan area, including the proposed realignment of Stirling Crescent (as the northern portion of District Distributor B Road – Eric Lumsden Drive), will improve north-south connectivity and facilitate lot access across all precincts. While the City of Swan currently has some funding via Special Area Rates, infrastructure delivery may be facilitated through legal agreements allowing pre-funding by developers, with reimbursement provisions in place for future recovery.

Residential access roads and associated drainage infrastructure will be the responsibility of individual landowners at the time of subdivision.

Drainage from Bushmead Road is currently conveyed through an easement on Lot 89. The LWMS identifies that downstream drainage infrastructure, particularly pipe sizes, is constrained and will require future upgrading by the City to accommodate additional flows.

8.9.5 High Voltage Transmission Lines (330kV and 132 kV)

Lots 39 and 651 are impacted by high-voltage Western Power infrastructure. Lot 39 contains a 60m easement for a 330 kV transmission line and a 17m easement for a 132 kV line. Western Power has indicated that a similar 17m easement will be required over the 132 kV alignment through Lot 651.

These infrastructure easements represent significant development constraints and have influenced land use planning within the Structure Plan. To address these constraints, the Structure Plan proposes a land exchange between Lots 39 and 651 (see Plan 6), which will allow realignment of the 132 kV line and result in more usable development parcels for both lots. The reconfigured land will also serve as a service corridor and will provide a buffer between the residential precinct and adjacent industrial uses, supporting a more appropriate interface outcome as identified through initial consultation with the WAPC.

9. Structure Plan Design

9.1 Structure Plan Overview

The Structure Plan spatially defines land use zones, road hierarchy, R-Code densities, interface areas, and infrastructure upgrades in accordance with the Hazelmere Enterprise Area District Structure Plan (HEASP) and local planning objectives. The area is divided into three sub-precincts each with tailored planning provisions that manage land use, access, subdivision, and built form outcomes as detailed under Part One:

- Highway Service,
- Light Industry , and
- Residential.

The sub-precinct framework supports a transitional interface between industrial, commercial, and residential uses. It enables a coordinated and orderly approach to development while addressing key constraints such as bushfire risk, traffic impacts, aircraft noise exposure, and integration with the existing RAV 7 network.

Pursuant to Part One – Section 4.3, each sub-precinct sets out specific provisions related to lot size, frontage, land use permissibility, building setbacks, and when Local Development Plans (LDPs) may be required to manage site-specific issues, including access, amenity, and noise mitigation. All subdivision and development is to be consistent with the Structure Plan Map (Plan 1) under Part One of this Structure Plan.

9.2 Residential Densities

Residential development is to be undertaken at a Residential Density code of R20 consistent with the *Residential Design Codes – Part B* provisions.

The application of an R20 density code within the Structure Plan area reflects the intended role of this land as a transitional residential buffer between industrial and commercial uses to the east and existing residential areas to the west. This approach is consistent with the HEASP, which identifies Precinct 3A as a "buffer precinct" where low-density residential development is preferred to manage interface sensitivities, including traffic, noise, and land use compatibility.

R20 density ensures a moderate residential yield while maintaining amenity for future residents and protecting the operational integrity of adjoining Highway Service and Light Industry sub-precincts. The coding allows for flexibility in lot layout and dwelling typologies while avoiding the intensification of residential development in an area affected by aircraft noise exposure forecasts (ANEF 25–30) and adjacent to RAV-rated freight routes.

Furthermore, assessment by the City of Swan officers have supported R20 as an appropriate scale of development for this location in the previous (deferred) version of the Structure Plan, acknowledging that it aligns with the strategic intent of HEASP and provides a balanced interface outcome between residential and industrial land uses.

The R20 coding also allows for orderly subdivision consistent with WAPC policy and ensures that servicing, bushfire protection, and drainage infrastructure can be delivered efficiently across fragmented landholdings.

9.3 Local Development Plans

Local Development Plans (LDPs) may be required across all three sub-precincts where additional site-specific design guidance is needed. This includes:

- Highway Service and Light Industry Zones:

  LDPs may be required to address interface treatments, consolidate vehicular access to the RAV network, and manage site constraints such as overhead infrastructure or transitional boundaries.

  Where a subdivision or development proposal does not cover the entirety of the Parent Lot - a LDP can be required by the Local Government and the WAPC to consolidate access, in particular:

  - Vehicle access and egress points on the Distributor B Road shall be limited to consolidated locations through the use of right of way easements or other legally secure instruments, with the intent that there is no more than two (2) vehicle crossovers.

- Residential Zone:

  LDPs may be required where lots interface with non-residential uses, where aircraft noise mitigation is needed (in accordance with SPP 5.1), or where access limitations or irregular lot configurations necessitate specific design controls.

The application of LDPs ensures coordinated development outcomes, protects residential amenity, and supports infrastructure efficiency in accordance with the Structure Plan framework.

9.4 Movement Network

The Structure Plan area is supported by a coordinated road network designed to ensure safe and efficient movement for residential, commercial, and industrial traffic. The road hierarchy has been developed in consultation with the City of Swan and is consistent with the HEASP and Main Roads WA Functional Road Hierarchy. Key elements include the proposed District Distributor B spine road (Eric Lumsden Drive), strategic intersections with Bushmead Road and Amherst Road, and integration with regional transport infrastructure such as Lloyd Street, the Great Eastern Highway Bypass, and Roe Highway. The network also incorporates local access upgrades, including a proposed east–west link to Central Avenue and realignment of access from Hazelmere Circus. The delivery of these roads will be coordinated with landowners and the City, with funding contributions facilitated through the Hazelmere Industrial Area Special Area Rate (SAR) mechanism.

9.4.1 Great Eastern Highway Bypass and Roe Highway

These roads are both mapped in the Main Roads Functional Hierarchy as State Roads - Primary Distributors and are constructed dual carriageway roads with a median divide. These roads have been designed as part of major intermodal transport networks.

9.4.2 Lloyd Street Extension

The extension of Lloyd Street is currently underway, with sections already completed. Once fully delivered, it will provide a direct connection between the Midland Activity Centre and the industrial precincts of Hazelmere, Forrestfield, Kewdale, and Perth Airport. This strategic link will enhance regional connectivity, support employment growth, and help alleviate traffic congestion. Lloyd Street will function as a key north–south freight route for commercial vehicles, extending from Lakes Road to the Great Eastern Highway Bypass.

9.4.3 District Distributor B Road (Proposed Eric Lumsden Drive)

The alignment of the proposed north–south spine road has been determined in consultation with the City of Swan. A key objective of the City was to ensure that industrial traffic is not directed through existing residential areas. The HEASP specifies that the precise alignment of this road is to be resolved through the preparation of a (Local) Structure Plan.

A cross-section for this road is included as Figure 1 under Part One.

Following detailed discussions with the City, their preferred outcomes have been incorporated into the Structure Plan. The proposed spine road is intended to be RAV 7 rated, supporting efficient movement of industrial traffic. Further technical details are provided in the accompanying Transport Impact Statement (TIS).

Access and crossover provisions

- Vehicle access and egress points on the Distributor B Road shall be limited to consolidated locations through the use of right of way easements or other legally secure instruments, with the intent that there is no more than two (2) vehicle crossovers.
- A road access strategy is to be submitted with the development and subdivision application to demonstrate compliance and the suitability of the location proposed.
  - Where a subdivision or development proposal does not cover the entirety of the Parent Lot - a Local Development Plan can be required by the Local Government and the WAPC to consolidate access.

Coordination of Construction

Construction of the spine road will be coordinated between the landowners and the City of Swan, including consideration of timing and potential pre-funding arrangements. The road and associated drainage infrastructure are to be funded through the City's Hazelmere Industrial Area Special Area Rate (SAR) fund.

Future residential lots are proposed to gain access via the realigned Eric Lumsden Drive through and dedicated local access roads (including CAPs Roads).

9.4.4 Bushmead Road

Bushmead Road forms the southern boundary of Lot 58 and the northern boundary of Lot 83, intersecting with the proposed north–south spine road (Eric Lumsden Drive) via a planned roundabout.

It is classified as a Distributor B road under the Main Roads WA Road Hierarchy. Bushmead Road provides strategic east–west connectivity, linking to the Great Eastern Highway Bypass and Roe Highway via Stirling Crescent, and serves as a key freight route for the Hazelmere Industrial Area.

The road is a sealed, single-carriageway and supports commercial and industrial vehicle movements throughout the precinct. Existing residential dwellings on Lots 58 and 83 currently gain direct access from Bushmead Road, and this access will be retained under the proposed Structure Plan.

9.4.5 Amherst Road

Amherst Road is on the northern boundary of Lot 651 and is identified as a Local Distributor in the Main Roads Functional Road Hierarchy. Amherst Road will be extended as shown in the Structure Plan to achieve a suitable T-junction with the future spine road. The Traffic Impact Assessment recognised the need to achieve separation between large heavy vehicles through traffic on the spine road and vehicles entering Amherst Road. The provision of a right turning pocket and a left turning slip lane on the spine road is required to achieve this separation.

9.4.6 Eric Street

Eric Street is situated along the western periphery of the Highway Service Precinct and interfaces directly with an established residential area.

In addition to land use and development restrictions detailed under Part One, no vehicle access and egress is to be provided to and from Eric Street.

9.4.7 Hazelmere Circus

Hazelmere Circus forms the southern boundary of Lot 93 and Structure Plan boundary and is classified as an Access Road under the Main Roads WA Functional Road Hierarchy. It is a sealed, single carriageway that provides frequent connections to the local street network and supports "as of right" vehicle movements.

Lot 93 currently has direct access to Hazelmere Circus. Under the proposed Structure Plan, this access will be reconfigured to occur via a new internal residential access road to the west and the proposed north–south spine road (Eric Lumsden Drive) to the east.

9.4.8 Proposed East/West Link to Central Avenue

The City of Swan has proposed the inclusion of an east–west road connection linking Central Avenue to the proposed north–south spine road. This connection will remove the existing cul-de-sac at Central Avenue, improve traffic circulation, support drainage outcomes for the Central Avenue precinct, and facilitate through-movement for general industrial traffic. Funding for these road works is to be provided via the City of Swan's Hazelmere Industrial Area Special Area Rate (SAR) fund.

9.4.9 Transport Impact Assessment

A Traffic Impact Assessment (TIA) Report has been prepared by Donald Veal Consultants to support the Structure Plan (Appendix 2 refers). The TIA assessed the impact of the proposed Structure Plan on the traffic volume and surrounding road networks.

A summary of the TIA is outlined below:

- Comprehensive SIDRA modelling was undertaken for the proposed intersections across the Structure Plan area. The primary access point is via a realigned Stirling Crescent (and renamed Eric Lumsden Drive). This new alignment is intentionally designed to discourage Hazelmere Industrial Area traffic from entering the adjacent residential areas to the west.
- To support residential amenity and safety, no residential lot will have direct vehicular access to the spine road (Eric Lumsden Drive). Instead, residential traffic will connect via local access roads. Access to Bushmead Road from the residential catchment will be controlled through left-in/left-out treatments, thereby improving traffic safety and managing turning conflicts.
- A key feature of the design is the separation of through-traffic on Eric Lumsden Drive from Amherst Road, a local distributor. This requires slip lanes to facilitate safe and efficient traffic flow. Lots 651 and 39 will be accessed internally via a new RAV 7-compliant road network. Direct access from Eric Street is not proposed, preserving safety and flow consistency.
- The RAV 7 heavy vehicle route continues from Stirling Crescent to the east via Lakes Road. Approval from both the City of Swan and Main Roads WA will be required for any new links connecting to the existing RAV 7 network. Notably, the current 20m road reserve is sufficient to accommodate a 10m carriageway for RAV operations, so no external widening is needed.
- A shared footpath is proposed along the eastern side of Eric Lumsden Drive to provide pedestrian and cyclist connectivity throughout the precinct. This shared footpath can alternate verges subject to landowner agreement and detailed subdivision and engineering design to the City of Swan's satisfaction.
- The realigned Eric Lumsden Drive is intended to link the Hazelmere Structure Plan area with the future Lloyd Street extension. This connection will support industrial traffic movements and mitigate impacts on the residential precinct to the west. The modelling indicates that future traffic volumes on Eric Lumsden Drive are expected to be:
  - approximately 6,350 vehicles per day (vpd) north of Bushmead Road; and
  - 1,150 vpd south of Bushmead Road.

Peak hour volumes are estimated at 465vph (AM) and 600vph (PM), with overall reductions in traffic expected on the existing Stirling Crescent and Robertson Street alignments.

- The proposed road reserve for Eric Lumsden Drive is 25m, sufficient to accommodate all required infrastructure, including the 10m carriageway, drainage swales, and underground services. The TIA raised no safety concerns with the proposed design or access strategy.

9.5 Public Open Space

In accordance with the *Liveable Neighbourhoods* policy, the Structure Plan provides a minimum of 10% public open space (POS) across the net residential area. This equates to a requirement of ~0.323 hectares, as detailed the POS Schedule under **Table 5** of Part One. The two designated POS areas are centrally located to ensure walkable access for future residents, provides local amenity in the form of passive recreation and landscaping, and functions as a transitional buffer between residential and non-residential uses. The POS areas may also integrate with broader drainage and urban water management objectives, supporting a multi-functional and efficient open space outcome in line with WAPC policy.

The provision of POS applies only to parent lots zoned Residential and is calculated based on the net residential area, excluding all non-residential land uses and higher-order road reservations associated with non-residential development. A breakdown per parent lot is tabled below:

Table 10: Public Open Space – Landowner Compostion (Residential Zoned Land)

Public Open Space (POS) Calculation	Lot 58	Lot 83	Lot 93	Combined Total
Gross Residential Area (ha) *Incl Local Residential Roads.*	1.344	0.794	1.006	3.144
POS Required @ 10% (ha)	0.1344	0.0794	0.1006	0.3144
POS Provided (ha)	0.2000	0.0794	0.1006	0.38
Surplus (+) / Shortfall (-) (ha)	+0.0656	0	0	+0.0656

There is potential to utilise portion of the adjacent District Distributor B Road reserve for POS purposes (i.e. reducing the road verge where appropriate), however this subject to a detailed UWMP and landscaping plan including demonstrating ample space for trunk services and other public amenities (lighting, footpaths etc).

9.5.1 Northern POS – Lot 58

The proposed 2,000m² Public Open Space aligns with *Liveable Neighbourhoods* by providing a walkable, accessible local amenity within 150–300m of surrounding residents. While smaller than a neighbourhood park, it functions as a Local Open Space (LOS) intended for passive use, such as walking, sitting, and informal gatherings.

The POS offers visual relief, supports urban greening, and can integrate Water Sensitive Urban Design features (if required) for the Lot 58 development. The POS also acts as a suitable landscaping buffer to the Highway Service Precinct to the north and provides connection to the service corridor planned along the Eric Street frontage. It is not intended for active sport, which is catered for in nearby district facilities. This size is appropriate to meet local needs without overcommitting land or maintenance resources, consistent with the open space hierarchy and performance-based approach under *Liveable Neighbourhoods*.

As the proposed POS exceeds the 10% requirement relative to the parent landholding and its residential catchment, there is potential to reduce its size by 0.0656ha to achieve the minimum 10% (i.e. 0.1344ha) for the Structure Plan area, subject to the following:

- Stormwater drainage is not required on-site for the future development of Lot 58;
- The POS continues to provide an appropriate buffer to the adjacent Highway Service land;
- Any increase in residential-zoned land is supported by an extension of the CAPs road, with all residential access (crossovers/driveways) limited to that road; and
- Reconciling the 10% POS contribution across all POS in the Structure Plan area.

9.5.2 Southern POS – Lots 83 and 93

The proposed 1,800m² Public Open Space also aligns with *Liveable Neighbourhoods* by providing a walkable, accessible local amenity within 150–300m of surrounding residents proposed within Parent Lots 83 and 93. It too functions as a 'Local' Open Space intended for passive use, such as walking, sitting, and informal gatherings.

The POS primary function is to integrate Water Sensitive Urban Design (WSUD) features. Namely, the proposed basin has a 100-year top water level footprint of 1,344m² which will only activate during storm events above a 10-year ARI – with the downstream drain accommodating smaller events. The basin receives no direct inflow from internal drainage and is primarily designed to manage throughflow from Bushmead Road, including some runoff from the site.

The size of the POS achieves the 10% POS requirement for respective Lot 83 and Lot 93 landholdings; thus, no POS cash-in-lieu contribution arrangement is required between these landowners or Lot 58.

The POS also acts as a strategic landscaping buffer between the new District Distributor B Road and existing residential properties to the west.

9.5.3 Landscaping

Landscaping of the residential portions of primary road network (i.e. portion of CAPs road verges adjacent Eric Lumsden Drive) will focus on the use of species with low water demand. Suitable plantings will also be included within any road bioretention swales and basins, landscaped areas and street verges.

Any bioretention basins and swales will be densely planted with inundation tolerant species to both stabilise the structure and to take up nitrogen from the water. Landscaping within non-residential land will be as subject to standard LPS17 and local policy compliance.

9.6 Activity Centres

A Retail Needs Assessment (RNA) was prepared by Pracsys to support the inclusion of limited commercial and retail uses within the Highway Service (or 'Sub-Precinct No.1' as referenced in the RNA) of the Structure Plan area. The intent of this sub-precinct is to provide a small-scale, service-based commercial hub that complements surrounding land uses and caters to the immediate needs of the local catchment.

The assessment identified sufficient latent demand to support land uses such as 'Shop' and 'Convenience Store', each proposed to be capped at a maximum of 2,500m² of net lettable area. These uses were identified as contributing to the employment and service mix in the locality, while also facilitating walkable access to day-to-day retail needs for local residents and workers.

Notwithstanding, the HEASP identifies this location as a transitional interface between residential and industrial land uses and does not support 'Shop' as a preferred land use. In response, and in recognition of the City of Swan recommendations, this sub-precinct is now aligned with the 'Highway Service' zoning under Local Planning Scheme No.17, which excludes 'Shop' as a permitted use.

To address both the planning framework and identified demand, the Structure Plan proposes a tailored land use list for the Highway Service Sub-Precinct that enables a range of low-impact commercial and service uses including, but not limited to – as detailed under Part One – Section 4.3:

- Lunch Bar
- Medical Centre
- Restaurant
- Market
- Place of Assembly
- Place of Worship
- Exhibition Centre

Lot sizes within this sub-precinct are intended to support this function, with a minimum lot size of 1,000m² and minimum 28m frontage to ensure flexibility for future development and appropriate access.

The proposed approach balances local retail demand with strategic planning objectives, ensuring land use compatibility and employment diversity within the structure plan area.

9.7 Education & Community Facilities

The Structure Plan does not propose the creation of any new school sites; with the low residential yield to be encompassed within existing school catchments.

9.8 Water Management

The Local Water Management Strategy (LWMS) has been prepared in accordance with Better Urban Water Management (WAPC, 2008), State Planning Policy 2.9 – Water Resources, and the Hazelmere Enterprise Area District Stormwater Management Strategy (AECOM, 2010). It adopts an integrated water cycle management approach informed by the principles and practices of the Stormwater Management Manual for Western Australia.

The LWMS considers existing environmental and groundwater conditions, best practice stormwater treatment, the use of swales and vegetated basins, and outlines implementation and monitoring measures to support urban development within the Structure Plan area. Key features include:

- Groundwater Conditions: Groundwater levels across the site range from a Maximum Groundwater Level (MGL) of 5.5m AHD in the north to 10.5m AHD in the south.
- Acid Sulphate Soils (ASS): No evidence of ASS was found on site, although high-risk areas are mapped approximately 30m north (Helena River valley) and 30–175m south (damplands).
- Stormwater Management: Stormwater will be managed through vegetated swales and landscaped drainage basins, with the 1-in-1 year rainfall event detained onsite to maintain pre-development hydrological flows.
- Water Quality and Nutrient Management: Nutrient input will be minimised through the use of Waterwise landscaping and treatment of stormwater within vegetated swales and basins.
- Future UWMPs will incorporate nutrient attenuation measures, including wetland-style plantings (e.g., reeds and rushes).
- Drainage Infrastructure: The existing pipe system downstream of Mary Street is undersized and requires upgrading by the City of Swan to match the upstream 825mm diameter to prevent overland flooding. In the interim, an overflow basin is proposed in Lots 83 and 93 to manage exceedance flows.

The LWMS supports a sustainable and resilient urban water management approach and will be refined at subdivision stage through Urban Water Management Plans (UWMPs) for each development stage.

The full LWMS is provided in Appendix 1.

10. Infrastructure Servicing & Staging

10.1.1 Stormwater Management

Subdivision and development within the Structure Plan area shall be supported by an integrated stormwater management system that achieves appropriate water quality, quantity, and flow outcomes in accordance with Better Urban Water Management, State Planning Policy 2.9 – Water Resources, and relevant City of Swan requirements.

10.1.2 Water Supply

Reticulated water is able to be supplied to the subject site via an existing Water Corporation connection or the extension of service through existing road reserves. Through standard Water Corporation policy, the lots will need to extend the water main as part of the provision of roads.

10.1.3 Sewerage/Effluent Disposal

The Structure Plan site abuts the Hazelmere residential area which has reticulated sewer and will require the extension of this service to support subdivision. Lot 651 has an existing sewer connection. The proposed land swap will provide a service corridor that accommodates the provision of sewer and water connection to lot 39 through lot 651.

10.1.4 Electricity

The existing sites are serviced by Western Power, there is low voltage overhead and high voltage underground cable installed in the road verge.

10.1.5 Telecommunication

The subject site can be serviced from the existing infrastructure or extension of existing pits located in the adjacent road reserves.

10.1.6 Roads and Drainage

The provision of the spine road proposed (Eric Lumsden Drive) is to be funded through Special Area Rates as addressed in Part One and sections below. The extent of road and drainage work is, where practical, to provide a through link to existing roads and drainage.

10.1.7 Development Contribution Area

The site is not located in an area identified as requiring development contributions, and recognising the City of Swan Hazelmere Special Area Rates applicable to this area.

10.1.8 Staging and Implementation

Recognising the individual landownerships in the Structure Plan area, the proposed staging may be simultaneous and include as follows:

- Stage 1 – South: Land between Bushmead Road and Hazelmere Circus – Lots 83 and 93
- Stage 2 – Central: Land north of Bushmead Road – Lot 58
- Stage 3 – North: Land north of Lot 58 and between Stirling Crescent – Lots 651 and 39

Staging maybe subject to change depending on individual land ownership preferences and prevailing economic conditions. It is anticipated that the entire Structure Plan area may be developed concurrently, contingent on the timing and landowner collaboration and coordination of the following key enablers:

- Construction of the north–south spine road (Eric Lumsden Drive), identified as the District Distributor B road.
  - critical to the functionality, internal connectivity and orderly movement of vehicles, particularly to segregate industrial traffic from adjacent residential areas. Its early delivery is imperative to ensure safe and efficient circulation throughout the Structure Plan area and to support staged subdivision and development outcomes.
  - The delivery of this road and its key intersections and tie in with existing road infrastructure shall be coordinated in consultation with the City of Swan, and is subject to detailed engineering design, and/or conditions of subdivision approval; and contribution arrangements via Special Area Rates addressed in the following section.
- Drainage infrastructure consistent with an approved LWMS;
- Provision of essential services including:
  - Reticulated water and sewerage; and
  - Electrical and NBN services.
- Perimeter roads or other management controls for bushfire protection.

10.2 Infrastructure Contributions and Responsibilities

Development within the Structure Plan area is contingent upon the coordinated delivery of road and drainage infrastructure. In accordance with the City of Swan's adopted framework for the Hazelmere Industrial Area, SUZ16 falls within an area subject to a Special Area Rate (SAR), levied specifically to fund road and drainage upgrades that support the area's planned growth.

The SAR is applied at a contribution ratio of 25% (SAR) to 75% (Municipal Funds), which collectively fund Distributor B and Local Distributor Road infrastructure and associated drainage works. These upgrades are necessary to facilitate the strategic movement network and stormwater outcomes outlined in the endorsed Structure Plan and supporting Local Water Management Strategy.

To achieve timely and efficient implementation, landowners are expected to liaise directly with the City of Swan regarding their responsibilities for key intersection upgrades:

Table 11 – Road Infrastructure – Landowner Responsibilities

Lots	Landowner Responsibility
651 and 39	• Part coordination with the City of Swan regarding the *Local Distributor Road* northern intersection of Stirling Crescent and Amherst Road.
39	• Coordination with the City of Swan regarding the tie in of the *District Distributor B* Road with Stirling Crescent.

Lots	Landowner Responsibility
39 and 58	• Part coordination with the City of Swan regarding the T-intersection and tie-in with the future *Local Distributor Road* heading east within Lot 59 Bushmead Road.
58 and 83	• Part coordination with the City of Swan regarding the new Bushmead Road roundabout with *District Distributor B* Road.
93	• Coordination with the City of Swan regarding the *District Distributor B* T-intersection and road tie-in with the Hazelmere Circus reservation.

All distributor and industrial access roads are to be constructed to meet RAV 7 specifications to accommodate the expected freight and logistics movements. While these works are to be funded through the Hazelmere Infrastructure Reserve (via the SAR mechanism), the City has advised that funds may not be presently available to fully deliver these upgrades. As such, proponents may be required to enter into legal agreements with the City to forward-fund infrastructure works, with repayment to occur in accordance with agreed terms and available SAR funds. In contrast, the construction of internal residential access roads is the sole responsibility of individual landowners undertaking residential subdivision and development within SUZ16.

Appendix 1 – Local Water Management Strategy

LOTS 39 & 651 STIRLING CRESCENT, LOT58 & 83 BUSHMEAD ROAD AND LOT 93 HAZELMERE CIRCUS, HAZELMERE

LOCAL WATER MANAGEMENT STRATEGY

Prepared for

GP & NL Callo
and
Maiolo Nominees Pty Ltd

Report No. J24048
2 May 2025

BAYLEY ENVIRONMENTAL SERVICES
30 Thomas Street
SOUTH FREMANTLE WA 6162

Sundowner Nominees Pty Ltd as trustee for the Bayley Cook Family Trust ABN 20 822 598 897
trading as Bayley Environmental Services

EXECUTIVE SUMMARY

Introduction

The owners of Lots 83 Bushmead Rd and Lot 93 Hazelmere Circus, Hazelmere have prepared a draft structure plan for Special Use Zone SU16, comprising Lots 39 & 651 Stirling Crescent, Lots 58 & 83 Bushmead Road and Lot 93 Hazelmere circus, Hazelmere. The structure plan area, which is currently vacant or used for low-intensity rural-residential pursuits, is proposed to be subdivided and developed for a mixture of residential and transitional service industry type land uses.

The total area of SU16 is approximately 21 hectares. A further 0.7ha of land in the south-east is not formally part of SU16 but is part of Lot 83 Bushmead Road and is likely to be developed as part of the subdivision of Lot 83, and is included here for drainage design purposes.

Existing Environment

Hazelmere has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. The long-term average annual rainfall for Perth Airport (located 3km south-west of SU16) is 762.1mm.

SU16 is located on a low, gently undulating plain south of the Helena River. The project area is largely flat except at the northern end, where it slopes gently north at a gradient of less than 3%. The soils consist of Guildford Formation pebbly silt, with a small area at the southern end overlain by thin grey Bassendean Sand. The Guildford Formation soils generally have a low permeability and a high phosphorus retention index (PRI). Groundwater sampling in the surrounding areas has found no evidence of acid sulphate soils (ASS), although high ASS risk areas are mapped in the Helena River valley 30m to the north and in damplands 30m to 175m to the south.

There is no natural defined surface drainage within SU16, although a few small artificial drains have been created to drain limited parts of the site. Areas of seasonal saturation exist in the north of the site, apparently caused by perching of surface water.

All drainage from the site flows into the Helena River via roadside drains, drainage easements and the Westrail railway reserve. The 100-year ARI floodway of the Helena River reaches to within 70m of the north-west corner of the project area. The 100-year flood fringe encroaches about 10m into the site in the north-west corner.

Groundwater flows north-west beneath the site towards the Helena River at a gradient of about 0.005. In wet winters, rainfall infiltration may be impeded by the low-permeability subsoils, creating a perched water table. Mapping by ENV (2010) suggests that the elevation of the Maximum Groundwater Level (MGL) ranges from 5.5m AHD at the northern end to

10.5m at the southern end. The calculated MGL is more than 2m below the ground surface over most of the site except for the north-west corner, where it reaches within 0.5m of the surface.

Sampling in and around the project area since 2008 shows that the groundwater is mildly acidic to slightly alkaline (pH 5.43–8.12) and fresh (EC 455–3540 *u*S/cm), with moderate to low levels of nutrients (FRP 0.02-0.11mg/L; NO_x 0.15-8mg/L.

No surface water quality data for the project area are available. Monitoring in the Helena River since 1999 by the DWER at a site in Bellevue, just upstream of the project area, shows that the water quality in the river is moderate, and since 2003 has met the DWER's "Healthy Rivers Action Plan" targets for both nitrogen and phosphorus (DWER, 2018).

The whole of SU16 is mapped as Multiple Use dampland (seasonally waterlogged basin) or palusplain (seasonally waterlogged plain) by the DBCA. The floodplain of the Helena River, located about 170m north of the site, is mapped as Conservation category floodplain. Multiple Use category wetlands are degraded and are regarded by the DBCA as developable, provided that the hydrological functions (mainly drainage) of the wetland are maintained or replicated.

The project area ranges from fully cleared farm paddocks to parkland cleared. In the north-east of the site, trees planted in 2004 form patches of near-continuous canopy but there is little understorey. There is no native vegetation in good or better condition in the project area.

Historical Landgate aerial photography shows that the project area has been cleared and used primarily for farming since before 1953. The photographs show no evidence of any potentially contaminating activities within the site at any time since 1953.

The DWER Contaminated Sites Database (https://dow.maps.arcgis.com/apps/webappviewer/index.html?id=c2ecb74291ae4d a2ac32c441819c6d47) shows no contaminated sites within the project area. It does, however, show an area approximately 420m to the east and partly upgradient of the site, as associated with a former wastewater treatment plant/intensive agriculture operation/carcass burial site, where known groundwater contamination by metals (arsenic, copper, zinc and lead) and nitrate exists.

Water Use Sustainability

The development will be supplied with potable water provided by the Water Corporation. The availability of shallow groundwater for non-potable supply is uncertain. Site-specific investigations may identify sources sufficient for domestic or public landscape irrigation. All landscaping within public areas (mainly road verges) will employ waterwise native plants that do not require ongoing irrigation.

All developments on the site will be sewered.

Stormwater Management

The drainage system will be designed to maintain surface flow rates and volumes within and from the developed site at or below their pre-development levels. The drainage design presented here is conceptual and will be refined in the detailed subdivision designs.

Given the low-permeability soils that predominate in Hazelmere, it is likely that on-site infiltration of all stormwater runoff will not be feasible. This is recognised by the City of Swan which states in its *Planning Application Stormwater Drainage Plan - Customer Checklist* that the design objective for the Hazelmere/South Guildford Industrial Area is "…onsite detention via basins or underground storage method with a controlled outflow into City's system."

Arterial Drainage
An open drain currently runs south from Bushmead Road within a 2.6m easement along the western boundary of Lot 83 then west along the northern boundary of Lot 93, carrying drainage from Bushmead Road and adjacent land. When it reaches the western boundary of Lot 93 the drain enters a pipe that travels via easements beneath Mary Street and into Anthea Street, from where it travels south to the Anthea Street basin.

Preliminary flow calculations based on Manning's open pipe flow formula suggest that the pipe drain has insufficient capacity to convey the runoff from critical storms of 10-yr ARI (10% AEP) or greater. In larger storms the open drain upstream will back up and overtop, flooding the surrounding paddocks.

One way to solve the overtopping problem in the open drain would be to increase the outflow capacity. If the diameter of the pipe downstream of Mary Street were increased to 825mm to match the diameter of the upstream section, then the flow calculations suggest that the pipe would be able to accommodate flows from all sizes of storm up to and including 100-year ARI, with limited backup that was well within the capacity of the existing open drain. This is a matter for the City to resolve in line with Council Policy POL-C-062: *Hazelmere (Residential Areas) Drainage Improvement Reserve Fund.*

The City of Swan has advised that it has no current plans or funding to upgrade the pipe network in the vicinity. In the interim, the drainage solution for SU16 incorporates an overflow drainage compensating basin in the south-west of Lot 83. This basin will be the same depth as the open drain (1.5m) and will receive water from the drain only when the water level in the open drain reaches the top of the outlet pipe.

The overflow basin will have no surface outflow, but will empty slowly by infiltration. At a permeability of 0.4m/day (typical for Guildford Formation soils), this would take 3.75 days after a 100-year storm.

Options for improving the form of the open drain itself are limited, given the ground levels in the area and the need to maintain a workable fall in the drain. In order to create a shallow living stream with the same base level and 1:6 side slopes while still accommodating the 100-year flows, the top of the excavated channel would be about 20m wide, which would make

much of the western part of Lot 83 undevelopable. For this reason, retaining the drain in its current form is considered to be the only viable option.

Internal Road Drainage

Drainage from the internal roads will be captured in roadside bioretention swales, with overflows conveyed north to Stirling Crescent, south and north to Bushmead Road and south to Hazelmere Circus. In the southern half of the site, the roads are likely to require filling by up to 1m to provide a stable road base and fall for the drainage system.

The swales will be constructed with low internal weirs set at a height that captures the 1-year 1-hour storm. The configuration of the swales and internal weirs will be subject to detailed design at subdivision stage.

The swales and weirs may be designed and constructed either as detention structures with low-flow outlets from each weir, or as infiltration structures with bases of imported permeable soil and underdrains.

The swales and weirs will be designed with sufficient capacity to detain and compensate the flow from critical storms up to 100-year ARI. Excess runoff will overtop the weirs and flow along the swales to join the existing external road drainage network. The rate and volume of drainage out of the site will be controlled to be no greater than those existing before development.

Lot Drainage

In accordance with City of Swan requirements, commercial lots in the structure plan area will be required to capture and detain or retain the runoff from critical storms up to 100-year ARI.

Commercial lots will generate an estimated 108m^3 of runoff per hectare from a 1-year ARI 1-hour storm. Therefore, to retain the 1-year 1-hour runoff will require about 108m^3 of bioretention basin per hectare of lot. Residential lots will generate about 71m^3 per hectare from the 1-year 1-hour storm, requiring in-lot storage of 71m^3/ha (3.4m^3 for a 480m^2 lot).

The in-lot storages will also be sized to capture and detain the runoff from a 100-year critical storm before releasing it to the road drainage system at a rate no greater than 16 litres/second/hectare, in line with City of Swan requirements. This will result in the overall rate of runoff leaving the project area after development being less than that before development.

Like the roadside swales, the in-lot basins may be designed and constructed either as detention structures with low-flow outlets or as infiltration structures with bases of imported permeable soil and underdrains.

Water Quality Management
The drainage system will maximise on-site retention of nitrogen and phosphorus by:

- Retaining and infiltrating or detaining all lot runoff from the first 15.9mm of rainfall in any storm within densely vegetated in-lot bioretention basins or soakwells.

- Detaining lot runoff from critical storms up to 100-year ARI within bioretention basins or soakwells, allowing sediments and entrained nutrients to settle out.

- Infiltrating or detaining all road runoff from the first 15.9mm of rainfall in any storm in densely vegetated roadside bioretention swales.

- Conveying all road runoff from storms between 1-year and 100-year ARI in densely vegetated bioretention swales to allow suspended particles to be filtered out.

Maintenance
The drainage system has been designed to require minimal maintenance. The following will be required to ensure that the system continues to function as designed:

- Regular (possibly annual) cleaning of side entry and junction pits, inlet pits and small culverts. More frequent cleaning may be required during the construction phase.

- Tending and maintenance of basins, swales and other vegetated drainage features to remove litter, control weeds and encourage the growth of native species.

- Pruning, mulching or removal of vegetation in basins and swales as necessary to maintain ground fuel loads below 8 tonnes/ha.

Groundwater Management

The drainage system for the site is designed to minimise changes to the existing groundwater regime. Roadside swales and subsoil drains will be set with their inverts at or above the AAMGL. Subsoil drainage within lots will be limited to filled areas used for buildings or stormwater disposal. The subsoil drains will discharge into roadside swales or in-lot bioretention basins via free-draining outlets.

Subsoil drains may also be employed within road reserves to prevent groundwater rise from damaging the road base and pavement.

Nutrient inputs to the groundwater will be minimised by limiting nutrient inputs to the site. Measures available to minimise nutrient inputs and exports in the development will include:

- regular street sweeping to remove accumulated contaminants; and
- selection of native species with low water and fertiliser requirements for landscape areas.

Landscaping Strategy

Landscaping of the site will focus on the use of species with low water demand. Plantings will include bioretention swales and basins, landscaping areas and street trees. The total area of public land to be landscaped will be about one hectare. The plantings will not be irrigated after the establishment phase. No turf grass will be planted.

Fertiliser use will be minimal. New tube stock plantings will be fertilised with slow-release nitrogen and phosphorus tablets on establishment and thereafter will be unfertilised.

Monitoring

Given the low permeability and high adsorption capability of the clayey soils, there would be little point in conducting post-development monitoring of groundwater quality.

Surface water quality in constructed roadside swales will be monitored on an opportunistic basis as drain flows permit, with the aim being to sample drain flows on two occasions in early and late winter each year. The sampling will be carried out at the swale outflows at Stirling Crescent, Bushmead Road (north and south sides) and Hazelmere Circus.

Implementation and Further Management Plans

Further planning and subdivision of the subject land will be carried out in accordance with the general water management principles set out in this LWMS. Subdivision of lots in the structure plan area may be carried out by individual owners as they see fit, in accordance with the framework of the LWMS.

An Urban Water Management Plan (UWMP) may be required as a condition of subdivision approval for each stage of subdivision. The UWMP will present the detailed design of the stormwater drainage system within that stage.

The developer of each stage of subdivision will maintain the drainage system, landscaped areas and water monitoring program within that stage until two years after that stage of subdivision is completed. At the end of that time the responsibility for monitoring and management will be handed over to the City of Swan.

TABLE OF CONTENTS

		Page
1.0	**INTRODUCTION**	**1**
1.1	**Background**	**1**
1.2	**Previous Studies**	**1**
1.2.1	Hazelmere Drainage Management Plan – Initial Strategy Report (BSD, 2000)	1
1.2.2	Hazelmere Enterprise Area District Structure Plan – Environmental Assessment (Env, 2010)	1
1.2.3	Hazelmere Enterprise Area District Stormwater Management Strategy (AECOM, 2010)	2
1.2.4	Hazelmere Enterprise Area Structure Plan (CoS and DoP, 2011)	3
1.3	**Relevant Guidelines and Policies**	**3**
1.3.1	State Planning Policy 2.9	3
1.3.2	Better Urban Water Management	4
1.3.3	City of Swan Local Planning Scheme No. 17	5
1.4	**Scope of the LWMS**	**5**
1.5	**Design Objectives**	**6**
2.0	**EXISTING ENVIRONMENT**	**8**
2.1	**Rainfall**	**8**
2.2	**Physiography**	**10**
2.2.1	Topography	10
2.2.2	Geology, Landforms and Soils	10
2.2.3	Soil Permeability	10
2.2.4	Acid Sulphate Soils	11
2.2.5	Phosphorus Retention Index	11
2.3	**Hydrology**	**11**
2.3.1	Surface Water	11
2.3.2	Groundwater	12
2.4	**Water Resources**	**13**
2.5	**Water Quality**	**13**
2.5.1	Groundwater	13
2.5.2	Surface Water	14
2.6	**Wetlands**	**14**
2.7	**Vegetation**	**14**
2.8	**Land Uses and Potential Contamination**	**15**
3.0	**WATER USE SUSTAINABILITY**	**16**
3.1	**Water Supply**	**16**
3.2	**Water Efficiency Measures**	**16**
3.2.1	Public Areas	16
3.3	**Wastewater Management**	**16**

4.0 STORMWATER MANAGEMENT 17
4.1 Principles and Objectives 17
4.2 Drainage Management System 17
4.2.1 Arterial Drainage 18
4.2.2 Internal Road Drainage 19
4.2.3 Lot Drainage 20
4.3 Surface Water Quality Management 21
4.4 Maintenance 21

5.0 GROUNDWATER MANAGEMENT STRATEGY 23
5.1 Groundwater Levels 23
5.2 Subsoil Drainage 23
5.3 Groundwater Quality 23

6.0 LANDSCAPING STRATEGY 25

7.0 MONITORING 26

8.0 IMPLEMENTATION AND FURTHER MANAGEMENT PLANS 27

9.0 REFERENCES 28

LIST OF TABLES

Table	Title	Page
1.1	Design Objectives	7
2.1	Rainfall Intensity for Hazelmere	9
2.2	Groundwater Quality	13

LIST OF FIGURES

Figure	Title
1	The Site and Surroundings
2	Structure Plan
3	Perth Airport Mean Rainfall (p. 8 of document)
4	Physiography
5	Surface Hydrology
6	Groundwater Hydrology
7	Western Drain Long Section
8	Overflow Basin Concept
9	Drainage Concept
10	Swale Options
11	Basin Options
12	In-Lot Detention Pit

LIST OF APPENDICES

Appendix	Title
A	Soil Logs
B	Groundwater Measurements
C	Flow Calculations

1.0 INTRODUCTION

1.1 Background

The owners of Lots 83 Bushmead Rd and Lot 93 Hazelmere Circus, Hazelmere have prepared a draft structure plan for Special Use Zone SU16, comprising Lots 39 & 651 Stirling Crescent, Lots 58 & 83 Bushmead Road and Lot 93 Hazelmere circus, Hazelmere. The structure plan area, which is currently vacant or used for low-intensity rural-residential pursuits, is proposed to be subdivided and developed for a mixture of residential and transitional service industry type land uses. The structure plan proposes to create 4.21ha of residential lots and 12.9ha of commercial/industrial lots.

The total area of SU16 is approximately 21 hectares. A further 0.7ha of land in the south-east is not formally part of SU16 but is part of Lot 83 Bushmead Road and is likely to be developed as part of the subdivision of Lot 83, and is included here for drainage design purposes. Figure 1 shows an aerial view of the site and surroundings. Figure 2 shows the Structure Plan.

1.2 Previous Studies

1.2.1 Hazelmere Drainage Management Plan – Initial Strategy Report (BSD, 2000)

The Hazelmere Drainage Management Plan dealt with an area of about 66ha directly abutting SU16 to the west, including the section of Bushmead Road within SU16. The Plan divided the study area Hazelmere into three drainage regions, with options identified including use of existing detention basins and drainage to a detention basin west of the railway line.

1.2.2 Hazelmere Enterprise Area District Structure Plan – Environmental Assessment (Env, 2010)

The EAR was prepared in support of the Hazelmere Enterprise Area Structure Plan (HEASP). The EAR identified high water tables and limited infiltration capacity as physical constraints in the HEA, and noted that the existing stormwater drainage network was fragmented and poorly documented.

The EAR produced estimated Maximum Groundwater Level (MGL) contours based on readings from 17 bores (including one DWER long-term monitoring bore) located around and to the south-east of SU16.

1.2.3 Hazelmere Enterprise Area District Stormwater Management Strategy (AECOM, 2010)

The AECOM report sets out an overall drainage strategy for the Hazelmere Enterprise Area Structure Plan (2010), which was adopted by the City of Swan and the WAPC in late 2011. The SU16 study area is located in the Residential North East, Bushmead Road and Residential South existing sub-catchments of the DSMS. The Residential North East and Bushmead Road catchments drain to the Helena River via piped and open drains, while the Residential South catchment drains to a constructed sump in Anthea Street and then, via an overflow, west beneath the railway line to eventually join a tributary of the Helena River.

A portion of Bushmead Road drains south via an open drain in an easement on Lots 83 and 93, before entering an underground pipe across Mary Street to the Anthea Street sump. This pipe has limited capacity and is a choke point in the drainage.

The DSMS places the subject land in the post-development catchments of Helena Foreshore West, Residential Basin and Additional Catchments. The DSMS objectives for these catchments are:

- Helena Foreshore West
  - Limit the discharge from Lots to 16 litres per second per hectare to ensure that the size of drainage infrastructure can be minimised as much as possible.
  - Maintain the existing discharge point ultimately reaching the Helena River.
  - Formalise an open channel system in available areas such that sufficient land is allocated for drainage purposes.
  - Make use of overland flow paths through the Western Power buffer zone.

- Residential Basin
  - Maintain existing piped systems.
  - Increase the water quality and storage function of the existing open channel through vegetation and reforming, making it a functional feature within the 10 m buffer proposed in the District Structure Plan.
  - Maintain existing discharge point.

- Additional Catchments
  - Limit the discharge from industrial lots to 16 litres per second per hectare to ensure that the size of drainage infrastructure can be minimised as much as possible.
  - Maintain the existing discharge points.
  - Formalise an open channel system such that sufficient land is allocated for drainage purposes.

The DSMS presents modelling of 10-year and 100-year ARI storm events before and after full development of the area, and identifies the Anthea Street Park as a key element in both existing and post-development drainage. The modelling suggests that in a 100-year storm the floodwaters would fill the Anthea Street Park and extend over parts of the adjoining lots.

The DSMS bases its post-development drainage calculations on the assumption that there will be no discharge of runoff from private lots to the street drainage system from storm events of 10-year ARI or less, and lot discharge from major storms up to 100-year ARI will be limited to 16 litres/second/hectare.

1.2.4 Hazelmere Enterprise Area Structure Plan (CoS and DoP, 2011)

The Hazelmere Enterprise Area Structure Plan (HEASP) attempted to rationalise and coordinate planning for the Hazelmere Enterprise Area, which until that time had suffered from ad-hoc planning and land use conflicts as a result of its fragmented ownership and uncoordinated infrastructure planning. The HEASP identified the HEA as an ideal location for industry and logistics uses.

The SU16 study area was mapped as Precinct 3 in the HEASP and was shown as a "Special Use Zone" (SUZ13), to be developed mostly for light industry, with residential on the western side separated from the light industry zone by a road and ecological corridor. Land directly abutting existing residential is proposed for residential land uses. Lot 651 is proposed for non-residential land uses.

1.3 Relevant Guidelines and Policies

1.3.1 State Planning Policy 2.9

State Planning Policy 2.9: *Water Resources* (WAPC, 2006) lists the following key principles for total water cycle management:

- Consideration of all water sources (including wastewater) in water planning, maximising the value of water resources.
- Integration of water and land use planning.
- Sustainable and equitable use of all water sources, having consideration of the needs of all water users including the community, industry and the environment.
- Integration of water use and natural water processes.
- A whole-of-catchment integration of natural resource use and management.

SPP 2.9 also lists the following general objectives for water-sensitive urban design:

- to manage a water regime;
- to maintain and, where possible, enhance water quality;
- to encourage water conservation;

- to enhance water-related environmental values; and

- to enhance water-related recreational and cultural values.

Element 5 of *Liveable Neighbourhoods* Edition 3 (WAPC, 2004) identifies specific objectives and requirements for Urban Water Management. These are based on Best Planning Practices which are defined as the best practical approach for achieving water resource management objectives within an urban framework.

1.3.2 Better Urban Water Management

Better Urban Water Management (WAPC, 2008) sets out the following objectives for water sensitive urban design:

Water Conservation

- Consumption of 100kL/pp/yr including less than 40-60 kL/p/yr scheme water.

Water Quantity

- Ecological Protection – Maintain pre-development flow rates and volumes for the 1 year ARI event. Maintain or restore desirable environmental flows and/or hydrological cycles.

- Flood Management – Maintain pre-development flow rates and volumes for the 100 year ARI event.

Water Quality

- Maintain pre-development nutrient outputs (if known) or meet relevant water quality guidelines (e.g. ANZECC & ARMCANZ, 2000).

- Treat all runoff in the drainage network prior to discharge consistent with the Stormwater Management Manual.

- As compared to a development that does not actively manage stormwater quality, achieve:
  - at least 80% reduction of Total Suspended Solids;
  - at least 60% reduction of Total Phosphorus;
  - at least 45% reduction of Total Nitrogen; and
  - at least 70% reduction of gross pollutants.

Mosquitoes and Midges

- Design detention structures so that, between the months of November and May, stormwater is fully infiltrated within 96 hours.

- Design permanent water bodies (where accepted by DWER) to maximise predation of mosquito larvae by native fauna.

1.3.3 City of Swan Local Planning Scheme No. 17

The City of Swan LPS No. 17 contains the following provisions in relation to SU16:

" 1. Subdivision and development shall be in accordance with a Structure Plan prepared and approved in accordance with the provisions of Part 4 of the deemed provisions.

2. A Structure Plan shall include all lots within this Special Use Zone and be prepared and approved prior to any additional land use, development proposal or subdivision of a lot, with the exception that the Local Government may consider granting an approval for the following land use, development or subdivision, without the prior requirement for a Structure Plan:

a) single House and associated residential structures and activities such as a Home Business; Home Occupation; Home Office; Home Store on a lot, or

b) minor lot boundary changes.

3. The Structure Plan is required to observe the Land Use Intent and Development Requirements as detailed within Precinct 3A "HEA Buffer Area" within the Local Government and WAPC approved Hazelmere Enterprise Area Structure Plan."

1.4 Scope of the LWMS

The scope of this LWMS is to:

- Document the existing environment on the site, in relation to soils, drainage, erosion, watercourses, groundwater and water-dependent ecosystems.
- Briefly describe the proposed development in relation to water management.
- Address relevant regulatory requirements and design criteria for water harvesting, setbacks to watercourses, groundwater management and drainage.
- Describe the strategies to be implemented for water conservation, watercourse protection, groundwater management and stormwater drainage.
- Outline a proposed monitoring program.
- Outline what is to be addressed in future Urban Water Management Plans.

1.5 Design Objectives

Table 1.1 summarises the water-related design objectives for SU16 and the means by which they will be achieved in the LWMS and subsequent management plans.

Table 1.1 Design Objectives

Design Aspect	*Design Objective*	*How Objective is to be Achieved*
Water Conservation	Ensure efficient and sustainable use of water resources	Use water efficient fixtures. Use non-potable water for irrigation. Use water-efficient native species for landscaping. Irrigate landscape plantings only for 2 years.
Groundwater Management	Minimise impacts on groundwater level and flows Minimise impacts on groundwater quality	Subsoil drains set at or above pre-existing AAMGL. Treat runoff from minor storms in bioretention/detention swales and/or basins. Minimise fertiliser and chemical use in landscaping areas.
Surface Water Management	Minimise impacts on surface water flow rates, volumes and quality	Retain and infiltrate or detain runoff from 1-year ARI 1-hour storms in bioretention swales and/or basins. Detain runoff from larger storms and control release from lots and overall site to 16 L/s/ha. Sweep streets regularly to remove accumulated contaminants.

2.0 EXISTING ENVIRONMENT

2.1 Rainfall

Hazelmere, like the rest of the greater Perth region, has a strongly seasonal rainfall, with most of the annual rain falling between May and September in association with winter cold fronts. Occasional heavy falls may occur from summer thunderstorms. The long-term average annual rainfall for Perth Airport (located 3km south-west of SU16) is 762.1mm, of which 79% falls between the months of May and September.

Figure 3 shows a rainfall occurrence chart for Perth Airport. Table 2.1 shows rainfall intensity, frequency and duration for Hazelmere.

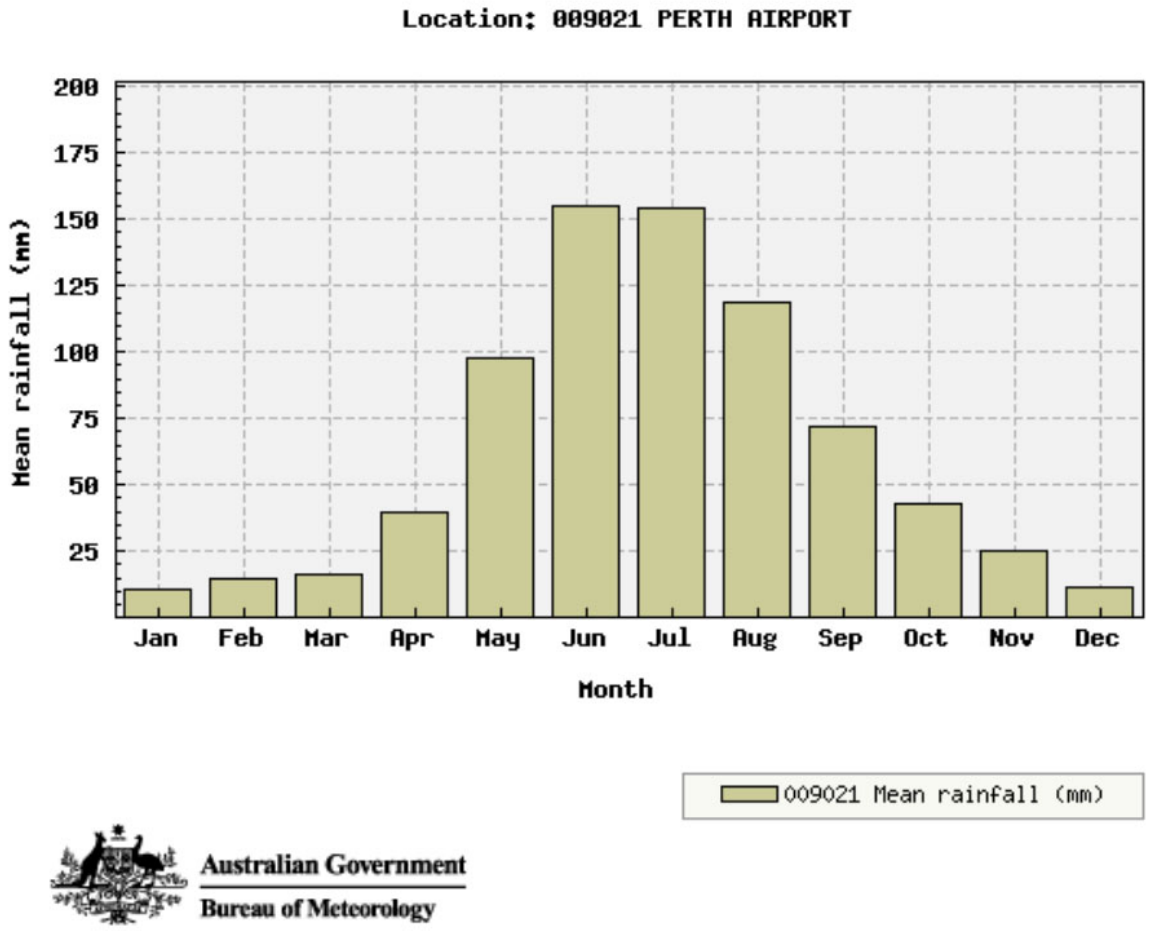


Figure 3 Perth Airport Mean Rainfall

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	97.0	107	142	167	192	228	257
2 min	84.1	92.6	120	140	161	190	214
3 min	75.4	83.0	108	127	145	172	194
4 min	68.5	75.7	99.2	116	134	159	179
5 min	63.0	69.7	91.7	108	124	147	166
10 min	46.0	51.1	67.7	79.6	91.9	109	123
15 min	37.1	41.2	54.5	64.1	74.0	87.6	98.5
20 min	31.5	34.9	46.1	54.2	62.5	74.0	83.1
25 min	27.5	30.5	40.3	47.3	54.5	64.5	72.5
30 min	24.6	27.3	36.0	42.2	48.6	57.5	64.7
45 min	19.1	21.1	27.7	32.5	37.4	44.4	50.0
1 hour	15.9	17.6	23.0	26.9	31.0	36.9	41.7
1.5 hour	12.3	13.5	17.6	20.7	23.9	28.5	32.4
2 hour	10.2	11.2	14.6	17.2	19.9	23.9	27.3
3 hour	7.90	8.64	11.2	13.3	15.4	18.7	21.5
4.5 hour	6.11	6.68	8.69	10.3	12.0	14.7	17.0
6 hour	5.10	5.57	7.25	8.60	10.1	12.3	14.3
9 hour	3.95	4.31	5.63	6.68	7.85	9.64	11.2
12 hour	3.29	3.60	4.69	5.57	6.54	8.03	9.33
18 hour	2.54	2.78	3.62	4.28	5.00	6.11	7.07
24 hour	2.11	2.31	3.00	3.53	4.10	4.97	5.72
30 hour	1.82	1.99	2.59	3.03	3.50	4.21	4.81
36 hour	1.61	1.77	2.29	2.67	3.06	3.65	4.15
48 hour	1.33	1.46	1.88	2.17	2.47	2.91	3.27
72 hour	1.01	1.11	1.42	1.62	1.82	2.11	2.33
96 hour	0.839	0.921	1.17	1.33	1.48	1.69	1.86
120 hour	0.728	0.799	1.01	1.15	1.27	1.45	1.59
144 hour	0.652	0.715	0.904	1.03	1.14	1.31	1.43
168 hour	0.597	0.653	0.828	0.945	1.06	1.21	1.33

Note:
The 50% AEP IFD **does not** correspond to the 2 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 1.44 ARI.
* The 20% AEP IFD **does not** correspond to the 5 year Average Recurrence Interval (ARI) IFD. Rather it corresponds to the 4.48 ARI.

Table 2.1 Rainfall Intensity for Hazelmere

2.2 Physiography

2.2.1 Topography

SU16 is located on a low, gently undulating plain south of the Helena River. The northern part of the site slopes north towards the Helena River at a gradient of less than 3%. The southern part of the site has no overall gradient. The elevation of the site ranges from 13m in the centre and south to 6m in the north-west corner. The gradient averages less than 1% with the steepest slopes reaching less than 5% in the north-east. Figure 4 shows the topography.

2.2.2 Geology, Landforms and Soils

SU16 is mapped by the GSWA (Gozzard, 1986) as Guildford Formation (Qpa), with soils consisting of pebbly silt (Mgs_1). This unit is described as having generally low permeability and shallow groundwater, with a low to moderate capability for drainage disposal. The foundation stability may vary, with differential settling possible in clayey areas. Sand pads are generally necessary for foundations.

A small area at the southern end is mapped as Bassendean Sand over Guildford Formation (Qpb/Qpa). This unit has high permeability in the surface sands with low permeability in the subsoil, a high water table and low to moderate capability for drainage disposal. Figure 4 shows the GSWA mapping.

ENV drilled five test bores to between 5.7m and 7.5m around the SU16 area in September 2008. Coterra drilled a further four bores to 6-9.5m within the project area in October 2015. The bores generally showed a silty sand topsoil between 0m and 0.5m deep over sandy/silty clay, with the clay content generally increasing past 1m depth. The clay was generally closer to or at the ground surface in the north of the project area, with the depth of sand increasing in the south.

Figure 1 shows the locations of the test bores. Soil logs from the test drilling are attached in Appendix A.

2.2.3 Soil Permeability

The permeability of the site soils will vary depending on the clay content. Previous testing of Guildford Formation soils elsewhere in the Hazelmere locality by Bayley Environmental Services (BES, 2012) returned permeabilities ranging from 0.46 m/day in Guildford Formation pebbly silt to 37.2 m/day in the overlying Bassendean Sand.

For preliminary drainage design purposes, zero permeability has been assumed. Constant-head permeability tests in accordance with Australian Standard AS1547:2012 will be undertaken prior to subdivision.

2.2.4 Acid Sulphate Soils

The DBCA maps the site as having Low to Nil risk of Acid Sulphate Soils (ASS). The floodplain of the Helena River, located within 30m north of the site, has an assessed Moderate ASS risk, while High ASS risk areas are mapped over current and former damplands within 30m to 175m south, south-west and south-east of the site. Figure 4 shows the nearby mapped high-risk areas.

Bore sampling by Coterra between 2015 and 2019 found no indications of potential or actual ASS in the groundwater. No further investigation of ASS is considered to be necessary, although monitoring of pH and acidity during any dewatering is likely to be required.

2.2.5 Phosphorus Retention Index

Previous experience has shown that the gravelly and silty clay soils of the Guildford Formation and other alluvial and colluvial soils generally have a high phosphorus retention index (PRI).

PRI is a measure of the ability of a soil to adsorb and retain phosphorus from solution. A high PRI indicates that a soil is unlikely to leach phosphorus to the water table. Typical ranges for PRI values in soils are as follows:

PRI Range	*Rating*	*Typical soils*
0 – 0.5	Very Low	Bassendean Sand
2 – 4	Low – Moderate	Karrakatta Sands
5 – 12	Moderate – High	Cottesloe Sands
12 – 20	High	Crushed Limestone, Limesand
20 – 1000+	Very High	Clay

The DWER recommends a minimum PRI of 15 for soils beneath infiltration basins and swales. The site soils are expected to meet or exceed this requirement. PRI testing of soils beneath proposed infiltration basins will be undertaken before subdivision, and soil modification with high-PRI soils carried out if necessary.

2.3 Hydrology

2.3.1 Surface Water

There is no natural defined surface drainage within SU16, although a few small artificial drains have been created to drain limited parts of the site. Figure 5 shows the existing surface drainage.

Areas of seasonal saturation exist in the north of the site, apparently caused by perching of surface water. Figure 5 shows the areas of saturation observed in early September 2020, during a drier than average winter.

All drainage from the site flows into the Helena River via roadside drains, drainage easements and the Westrail railway reserve. The Helena River is a major tributary of the Swan River, contributing approximately 9.8 GL/yr (2007-2011 average) or 5% of the annual flow in the Swan River from a catchment of 175km^2.

The 100-year ARI floodway of the Helena River reaches to within 70m of the north-west corner of the project area. The 100-year flood fringe encroaches about 10m into the site in the north-west corner (Figure 5).

The water quality in the Helena River is generally good, probably due largely to its forested upper catchment. Between 2003 and 2011 the river met both short-term and long-term targets for total nitrogen and total phosphorus established by the DWER.

2.3.2 Groundwater

Groundwater flows north-west beneath the site towards the Helena River at a gradient of about 0.005. Given the low permeability of the soils, the flow rate is expected to be very low.

In wet winters, rainfall infiltration may be impeded by the low-permeability subsoils, creating a perched water table.

Mapping by the DWER (Figure 6) shows superficial groundwater present at minimum elevations of 2.2m to 5.8m AHD.

ENV (2010) mapped maximum groundwater level (MGL) contours over SU16 and surrounding areas based on measurements in 17 bores, including one DWER long-term monitoring bore. The calculated MGL within SU16 ranged from 5.5m AHD at the northern end to about 10.5m AHD at the southern end. The calculated MGL is more than 2m below the ground surface over most of the site except for the north-west corner, where it reaches within 0.5m beneath the surface. Figure 6 shows the calculated MGL and Depth to MGL contours.

It is notable that the north-east corner, where the calculated MGL is more than 3m below ground, was subject to significant saturation in September 2020 (Section 2.3.2), suggesting that this saturation is a result of a perched water table.

Appendix B summarises groundwater measurements collected at or near the site since 2008.

2.4 Water Resources

The project area lies within the City of Swan South Subarea of the Perth Groundwater Area. The DWER Water Register (maps.water.wa.gov.au/#/webmap/register) shows that both the superficial and Leederville aquifers in this subarea are fully allocated.

There are no existing groundwater licences held in the project area. If groundwater is required for irrigation of public open space, either an existing licence will need to be acquired from elsewhere in the subarea or the supply will need to be drawn from the City of Swan's existing entitlement.

2.5 Water Quality

2.5.1 Groundwater

Groundwater sampling has been carried out in and around the project area since 2008 by ENV (2010) and Coterra (2015). The results show that the groundwater is mildly acidic to slightly alkaline (pH 5.43–8.12) and fresh (EC 455–3540 *u*S/cm), with moderate to low levels of nutrients (FRP 0.02-0.11mg/L; NO_x 0.15-8mg/L). Table 2.2 summarises the key groundwater quality data.

Table 2.2 Groundwater Quality

Bore (Figure 5)	*Date*	*pH*	*EC (us/m)*	*Total P (mg/L)*	*FRP (mg/L)*	*Total N (mg/L)*	*NOx (mg/L)*
X3		6.82	3540	0.36		0.5	
X5		6.54	1830	1.05		3.65	
X6		8.12	3500	2.31		5.5	
X7		8.11	481	0.12		1.2	
HAZ01	28/10/15	6.78	455	0.86	0.2	22	8
	24/11/15	6.49	656				
HAZ02	28/10/15	6.54	1520	1.7	0.05	8	0.19
	24/11/15	6.29	1441				
	28/10/19	5.43	1281	19	0.02	4.7	0.21
HAZ03	28/10/15	5.87	2970	4.1	0.1	4.1	0.85
	24/11/15	5.87	3040				
	28/10/19	5.54	2686	22	0.02	4.8	0.15
HAZ04	28/10/15	6.78	720	8.2	0.11	7.5	5.1
	24/11/15	6.49	625				
Aquatic Ecosystems[a]		6.5-8.0	120-300	0.065	0.04	1.2	0.15
Irrigation[b]		6-8.5	1300	0.05	ng	5	ng
Notes		ng denotes "no guideline". a. ANZECC (2000) Aquatic Ecosystem trigger values for lowland rivers. b. ANZECC (2000) Irrigation trigger values (long-term irrigation up to 100 years).					

2.5.2 Surface Water

No surface water quality data for the project area are available.

Water quality in the Helena River has been monitored by the DWER at a site in Bellevue, just upstream of the project area, since 1999. The monitoring data show that the water quality in the river is moderate, and since 2003 has met the DWER's "Healthy Rivers Action Plan" targets for both nitrogen and phosphorus (DWER, 2018).

2.6 Wetlands

The whole of SU16 is mapped as Multiple Use dampland (seasonally waterlogged basin) or palusplain (seasonally waterlogged plain) by the DBCA. The floodplain of the Helena River, located about 170m north of the site, is mapped as Conservation category floodplain. Figure 6 shows the mapped wetlands.

Multiple Use category wetlands are degraded and are regarded by the DBCA as developable, provided that the hydrological functions (mainly drainage) of the wetland are maintained or replicated.

2.7 Vegetation

The project area ranges from fully cleared farm paddocks to parkland cleared. In the north-east of the site, trees form patches of near-continuous canopy but there is little understorey.

Historical Landgate aerial photography shows that the site was fully cleared before 1953 except for scattered mature trees, mostly in the central and southern parts. The degree of clearing increased until about 2004, when only a few trees (mostly mature flooded gums) remained, mostly in Lots 83 and 93.

In 1995 a small area in the north of Lot 651 was fenced off from stock, and by 2000 this had begun to visibly regrow. In 2004 a substantial part (about 3.6ha) of Lot 39 was planted to provide screening from the power lines, with species including Flooded Gum, *Eucalyptus caesia*, Acacias, Marri, Casuarinas and Grevilleas.

Heddle *et al.* (1980) mapped the north-west of SU16 as Swan Complex, the central part as Guildford Complex and the southern end as Southern River Complex, described as follows:

- Swan Complex - Woodland of flooded gum-swamp paperbark with localised occurrences of low open-forest of swamp sheoak and saltwater paperbark. This complex was subject to early disturbances associated with the settlement of the south-western corner of Western Australia; therefore there are only a few remnant undisturbed areas.

- Guildford Complex - Mixture of open-forest, ranging from tall open-forest of marri-wandoo-jarrah to a woodland of wandoo, with minor components including woodland of flooded gum and swamp paperbark along the streams. Most of this complex has been subject to logging and clearing since European settlement.

- Southern River Complex - Open-woodland of marri-jarrah-banksia on the elevated areas and fringing woodland of flooded gum-swamp paperbark along the streams.

All of these complexes are associated with the heavier soils and higher water tables of the alluvial plains and river valleys. All are heavily cleared and poorly reserved: the Swan Complex has 13.84% of its original extent remaining and 0.56% represented in secure reserves, the Guildford Complex has 5.87% remaining and 0.27% reserved, and the Southern River Complex has 19.69% remaining and 2.16% reserved (Local Biodiversity Program, 2013). None of these complexes remains in functional form within the project area.

The DBCA and WA Herbarium databases show no recorded rare or priority flora or threatened ecological communities within the site. Given the degree of clearing and degradation, it is unlikely that any rare or threatened species or communities would be present.

2.8 Land Uses and Potential Contamination

Historical Landgate aerial photography shows that the project area has been cleared and used primarily for farming since before 1953. The photographs show no evidence of any potentially contaminating activities within the site at any time since 1953.

The Hazelmere area has been used for industrial purposes for a number of years, and a number of contaminated sites are known in the area. ENV (2010) found elevated levels of nutrients and heavy metals in several bores within 1km of the project area.

The DWER Contaminated Sites Database (https://dow.maps.arcgis.com/apps/webappviewer /index.html?id=c2ecb74291ae4d a2ac32c441819c6d47) shows no contaminated sites within the project area. It does, however, show two areas approximately 420m to the east and 350m to the north as “Remediated for restricted use”. These areas are associated respectively with a former wastewater treatment plant/intensive agriculture operation/carcass burial site and the former Midland Railway Workshops. The former WWTP site is upgradient of parts of the project area and has known groundwater contamination by metals (arsenic, copper, zinc and lead) and nitrate at above ANZECC Freshwater Ecosystem Guideline levels.

3.0 WATER USE SUSTAINABILITY

3.1 Water Supply

The development will be supplied with potable water provided by the Water Corporation.

Due to the site's geology, the availability of shallow groundwater for abstraction across most of the site is uncertain and possibly limited. Site-specific investigations may identify sources sufficient for domestic or landscape irrigation. As the property is in the Perth Groundwater Area, a licence will be required from the DWER to abstract groundwater for commercial use.

As discussed in Section 2.4, the superficial aquifer in the local subarea is fully allocated. There are no existing groundwater licences held in the project area. If groundwater is required for irrigation of public open space, either an existing licence will need to be acquired from elsewhere in the subarea or the supply will need to be drawn from the City of Swan's existing entitlement.

Deeper groundwater sources are not likely to be available, as the DWER advises that "no long term licences for accessing the fresh groundwater resources of the Leederville or Yarragadee aquifers are to be granted for additional groundwater entitlements, other than for extenuating circumstances" (DoW, 2006).

3.2 Water Efficiency Measures

3.2.1 Public Areas

All landscaping within public areas (mainly road verges) will employ waterwise native plants that do not require ongoing irrigation.

3.3 Wastewater Management

All developments will be sewered. Grey water recycling may be implemented by individual lot owners. Any person wishing to install a grey water reuse system must lodge an Application to Construct or Install an Apparatus for the Treatment of Sewage with the City of Swan.

4.0 STORMWATER MANAGEMENT

4.1 Principles and Objectives

The stormwater management strategy aims to comply with the principles and objectives for stormwater management identified in the *Stormwater Management Manual for WA* (DoW, 2004) and *Better Urban Water Management* (WAPC, 2008).

Nutrient concentrations and loads in water leaving the site will be managed to comply with the long-term targets of the *Swan Canning Water Quality Improvement Plan* (SRT, 2009), as follows:

- Winter median TP concentration: 0.1 mg/L
- Winter median TN concentration: 1.0 mg/L
- Annual TP yield: 0.013 kg/ha
- Annual TN yield: 0.2 kg/ha.

4.2 Drainage Management System

The drainage system will be designed to maintain surface flow rates and volumes within and from the developed site at their pre-development levels. The drainage design presented here is conceptual and will be refined in the detailed subdivision designs.

The priorities for managing the various sizes of storm event will be:

- 1 year ARI Infiltrate all flows as close to the source as possible. Where infiltration is not feasible, detain runoff to maintain pre-development flow rates and volumes. Minimise export of nutrients and sediments.

- 5 year ARI Detain water prior to discharge. Maintain pre-development flow rates and volumes. Maintain amenity and serviceability. Prevent scouring and damage.

- 100 year ARI Maintain pre-development flow rates and volumes. Prevent flooding and damage.

Given the low-permeability soils that predominate in Hazelmere, it is likely that on-site infiltration of all stormwater runoff will not be feasible. This is recognised by the City of Swan which states in its *Planning Application Stormwater Drainage Plan - Customer Checklist* that the design objective for the Hazelmere/South Guildford Industrial Area is "…onsite detention via basins or underground storage method with a controlled outflow into City's system."

4.2.1 Arterial Drainage

An open drain currently runs south from Bushmead Road within a 2.6m easement along the western boundary of Lot 83 then west along the northern boundary of Lot 93, carrying drainage from Bushmead Road and adjacent land. When it reaches the western boundary of Lot 93 the drain enters a pipe that travels via easements beneath private property across Mary Street and into Anthea Street, from where it travels south to the Anthea Street basin. Figure 5 shows the open and pipe drains. Figure 7 shows a long section of the drain from its origin on Bushmead Road to its end in the Anthea Street basin.

The open drain is narrow and steep-sided, measuring about 1.5m deep and 1m wide at the base. The gradient of the drain is very low. The pipe drain is constructed of concrete and has a diameter of 825mm at its entry from Lot 93. However, after crossing Mary Street the diameter decreases to 450mm and remains at this size for most of its remaining path to the Anthea St basin. At the Mary St and Anthea St junctions the drain is joined by other street drains.

Preliminary flow calculations based on Manning's open pipe flow formula suggest that the pipe drain has sufficient capacity to convey the 1-year ARI 1-hour storm and the 4.48-year (20% AEP) critical storm (not including contributions from Mary and Anthea Streets), but that the open drain upstream will back up and overtop during critical storms of 10-year ARI (10% AEP) or above. This overtopping could be reduced but not eliminated by enlarging the open drain to a swale 10m wide.

One way to solve the overtopping problem in the open drain would be to increase the outflow capacity. If the diameter of the pipe downstream of Mary St were increased to 825mm to match the diameter of the upstream section, then the flow calculations suggest that the pipe would be able to accommodate flows from all sizes of storm up to and including 100-year ARI, with limited backup that was well within the capacity of the existing open drain.

Runoff from parts of the project area currently enters the open drain via roadside drains on Bushmead Road. With the proposed development of the project area and the restriction of lot runoff to 16 L/s/ha (as per City of Swan requirements), the contribution of the project area to flows in the open drain is expected to decrease. However, despite this reduction the constraints posed by the drain will persist without an increase in the outflow capacity of the pipe. This is a matter for the City to resolve in line with Council Policy POL-C-062: *Hazelmere (Residential Areas) Drainage Improvement Reserve Fund.*

The City of Swan has advised (Y. Wong, 2022 pers. comm.) that it has no current plans or funding to upgrade the pipe network in the vicinity. In the interim, the drainage solution for the subject land incorporates an overflow drainage compensating basin in the south-west of Lot 83 (at the cost of one lot). This basin will be the same depth as the open drain (1.5m) and will receive water from the drain only when the water level in the open drain reaches the top of the outlet pipe. Figure 8 shows the layout of the basin and a conceptual arrangement of the overflow structure from the open drain.

The overflow basin will have no surface outflow, but will empty slowly by infiltration. At a permeability of 0.4m/day (typical for Guildford Formation soils), this would take 3.75 days.

Options for improving the form of the open drain itself are limited. The depth of the drain is made necessary by the low gradients in the area. The ground level at the western extremity of the drain catchment in Bushmead Road (12m AHD) is the same as at the drain's exit via the pipe from Lot 93, a distance of over 700m. In order to maintain a minimal gradient of 1:400, the drain must be over 1.5m deep at its exit point. In order to create a shallow living stream with the same base level and 1:6 side slopes while still accommodating the 100-year flows, the top of the excavated channel would be about 20m wide, which would make much of the western side of Lot 83 undevelopable. For this reason, retaining the drain in its current form is considered to be the only viable option.

4.2.2 Internal Road Drainage

Minor Storms

The internal roads have been provisionally divided into four catchments, with drainage flowing north to Stirling Crescent, south and north to Bushmead Road and south to Hazelmere Circus. In the southern half of the site, the roads are likely to require filling by up to 1m to provide a stable road base and fall for the drainage system.

Runoff from roads from up to the 1-year ARI 1-hour (63.2% AEP) storm (about 16mm) will be retained or detained in roadside swales. The inverts of the swales will be at or above the AAMGL. The roads may be flush-kerbed to allow direct drainage to the swales, or conventionally kerbed with side-entry pits. Figure 9 shows the preliminary layout of the roadside swales.

The swales will be constructed with low internal weirs set at a height that captures the 1-year 1-hour storm. Calculations using the rational method (Institute of Engineers Australia, 1987) indicate that a series of trapezoidal swales 0.5m deep with 2m-wide bases, 1:3 sides and 0.3m high weirs at 393-75m spacing will be sufficient to capture the runoff from a 1-year 1-hour storm. Appendix C shows the calculations.

The swales and weirs may be designed and constructed either as detention structures with low-flow outlets from each weir, or as infiltration structures with bases of imported permeable soil and underdrains. Figure 10 illustrates these alternative concepts.

The configuration of the swales and internal weirs will be subject to detailed design at subdivision stage including:

- the height of the swale inverts;
- the width and composition of the swale floors, designed to maximise nutrient uptake;
- the height and spacing of the weirs and the overall depth of the swales;
- planting of the swales with dense sedges and shrubs to maximise nutrient uptake; and
- the configuration of the swales with low-flow outlets or underdrains to promote infiltration.

Major Storms

The swales and weirs will be designed with sufficient capacity to detain and compensate the flow from critical storms (those producing the highest peak flow) up to 100-year ARI (1% AEP). Appendix C shows the flows and storage requirements for the 100-year ARI critical storm, calculated using a modified COPAS equation in accordance with MRWA guidelines.

Road runoff in excess of the storage requirements will overtop the weirs and flow along the swales to join the existing external road drainage network. The rate and volume of drainage out of the site will be controlled to be no greater than those existing before development. Appendix C shows estimated flow depths in the swales, calculated using Manning's Open Channel Flow Equation.

Figure 9 shows the overall drainage layout and the 100-year ARI flow paths. The flow calculations are detailed in Appendix C.

4.2.3 Lot Drainage

In accordance with City of Swan requirements, commercial lots will be required to capture and detain or retain the runoff from critical storms up to 100 years ARI.

Given the low permeability of soils in the Hazelmere area, the City of Swan sets a target of infiltrating the 1-year 1-hour runoff if possible, with a minimum standard of infiltrating the 6-month 1-hour runoff. In practice, this only reduces the rainfall to be infiltrated from 15.9mm to about 14mm, a reduction of about 12% in total runoff volume.

Calculations using the Rational Method (Institution of Engineers Australia, 1987) with runoff coefficients as set out in the City of Swan's *Handbook of Drainage Design* (2002) suggest that commercial lots in the structure plan area will generate about 108m^3 of runoff per hectare from a 1-year ARI 1-hour storm. Appendix C shows the calculations. Therefore, to capture the 1-year 1-hour runoff will require about 108m^3 of bioretention basin per hectare of commercial land. For example, a 1,000m^2 lot could be served by a basin with base dimensions of 4m x 6m, 1-in-4 side slopes, a 1-year ARI water depth of 0.3m, an effective volume (allowing no infiltration) of 11.4m^3 and a 1-year 1-hour inundated area of 54m^2.

For larger storms (up to 100 year ARI), the City of Swan requires that the peak flow off site following development is no greater than 16 litres/sec/ha, in order to avoid exceeding the capacity of the existing road drainage system. This requires that the post-development runoff from the critical storm (that producing the highest peak flow) be captured and detained, to be released at a rate no greater 16 L/s/ha.

Rational Method calculations (Appendix C) show that a basin sized for the 1-year 1-hour storm on a 1ha lot as described above would have sufficient capacity to capture and compensate the flow from a 100-year critical storm (allowing outflow at 16 L/s/ha) if deepened to approximately 0.44m. Flow compensation could be achieved by an overflow

structure set at or above the 1-year ARI top water level (0.3m), sized to regulate the outflow to the City's limit of 16 L/s/ha.

Like the roadside swales, the in-lot basins may be designed and constructed either as detention structures with low-flow outlets or as infiltration structures with bases of imported permeable soil and underdrains. Figure 11 illustrates these alternative concepts.

The preliminary calculations suggest that residential lots will generate about 71m^3 of runoff per hectare from a 1-year ARI 1-hour storm (Appendix C). To capture the 1-year 1-hour runoff and to maintain the pre-development discharge rate from larger storms, an in-lot storage of 71m^3/ha (3.4m^3 for a 480m^2 lot) will be required. This storage may be achieved by soakwells, gully pits or basins. The in-lot storages may be drained to the roadside swale network by overflow structures that limit the outflow to no more than 16 L/s/ha. Figure 12 shows a typical layout of an in-lot detention pit.

Appendix C shows the combined flows from roads, POS and lots (at 16 L/s/ha) in a 100-year ARI critical storm.

4.3 Surface Water Quality Management

The drainage system will be designed to maximise on-site retention of nitrogen and phosphorus. This will be achieved by:

- Retaining and infiltrating or detaining all lot runoff from the first 15.9mm of rainfall in any storm within densely vegetated in-lot bioretention basins or soakwells.
- Detaining lot runoff from critical storms up to 100-year ARI within bioretention basins or soakwells, allowing sediments and entrained nutrients to settle out.
- Infiltrating or detaining all road runoff from the first 15.9mm of rainfall in any storm in densely vegetated roadside bioretention swales.
- Conveying all road runoff from storms between 1-year and 100-year ARI in densely vegetated bioretention swales to allow suspended particles to be filtered out.

4.4 Maintenance

The drainage system has been designed to require minimal maintenance. The following will be required to ensure that the system continues to function as designed:

- Regular (possibly annual) cleaning of side entry and junction pits, inlet pits and small culverts. More frequent cleaning may be required during the construction phase.

- Tending and maintenance of basins, swales and other vegetated drainage features to remove litter, control weeds and encourage the growth of native species.

- Pruning, mulching or removal of vegetation in basins and swales as necessary to maintain ground fuel loads below 8 tonnes/ha.

5.0 GROUNDWATER MANAGEMENT STRATEGY

5.1 Groundwater Levels

Regional groundwater measurements suggest that the depth from the ground surface to the recorded maximum groundwater level (MGL) ranges from 0.5m in the north-west corner of the structure plan area to 5m in the centre of the site, although the presence of visible saturation in September 2020 suggests that ponding of rainfall and possibly a perched water table occur over parts of the site in winter.

The drainage system for the site is designed to minimise changes to the existing groundwater regime. Roadside swales and subsoil drains will be set with their inverts at or above the AAMGL. Subsoil drainage within lots will be limited to filled areas used for buildings or stormwater disposal.

5.2 Subsoil Drainage

Subsoil drainage may be employed within some lots where necessary to maintain existing maximum groundwater levels beneath building pads and stormwater disposal areas. The subsoil drains will discharge into roadside swales or in-lot bioretention basins via free-draining outlets.

Subsoil drains may also be employed within road reserves to prevent groundwater rise from damaging the road base and pavement.

All subsoil drains will be set with their invert at or above the AAMGL. Therefore, changes to the groundwater hydrology of the site will be minimal.

5.3 Groundwater Quality

The sampling undertaken to date indicates that the groundwater beneath the site contains low to moderate concentrations of nitrogen and phosphorus. This is to be expected given the nature of the soils and the land use history of the site.

The relationship between nutrient inputs and exports is complex, especially in the case of phosphorus, which travels through the soil profile as a “front” in a complex series of adsorption and desorption reactions. Nitrogen is subject to denitrification and mineralisation in the soil and groundwater. As a result, nutrient exports from the site at present will be a reflection of nutrient inputs over the last several decades, modified by soil hydrology and nutrient retention capacity.

The aim of nutrient management will be to limit nutrient inputs to the site so that nutrient outputs are minimised. As a largely commercial precinct, the area of fertilised gardens and lawns will be small. Landscaping areas including street trees, swales and vegetation buffers will be established with minimal fertilisers and irrigation.

Measures available to minimise nutrient inputs and exports in the development will include:

- regular street sweeping to remove accumulated contaminants; and
- selection of native species with low water and fertiliser requirements for landscape areas.

6.0 LANDSCAPING STRATEGY

Landscaping of the site will focus on the use of species with low water demand. Plantings will include bioretention swales and basins, landscaping areas and street trees. The plantings will not be irrigated after the establishment phase. No turf grass will be planted.

Fertiliser use will be minimal. New tube stock plantings will be fertilised with slow-release nitrogen and phosphorus tablets on establishment and thereafter will be unfertilised.

The bioretention basins and swales will be densely planted with inundation-tolerant species including sedges and low shrubs in order to stabilise the basins and maximise their ability to take up nitrogen from the water. The density of planting will be controlled to keep flammable ground fuel loads below 8 tonnes/ha.

The total area of public land to be planted, including swales and road verges, is approximately one hectare. If all of this area were planted simultaneously during the establishment phase, approximately 4.75 ML of water would be required to irrigate the new plantings for the first year. As the project area is likely to be developed in a number of stages, the requirement for irrigation water is likely to be spread out over a number of years, with only a small part of the total demand being required in any one year.

The DWER advises that the superficial aquifer in the vicinity of the project area is fully allocated. If groundwater is required for POS irrigation it will need to be supplied by purchase of an existing groundwater licence or drawn from the City of Swan's existing entitlement. Alternatively, the relatively small and short-term supply required may be sourced from scheme water.

7.0 MONITORING

Baseline water quality results for the site are shown in Table 2.2. Given the low permeability and high adsorption capability of the clayey soils, there would be little point in conducting post-development monitoring of groundwater quality.

Surface water quality in constructed roadside swales will be monitored on an opportunistic basis as drain flows permit, with the aim being to sample drain flows on two occasions in early and late winter each year. The sampling will be carried out at the swale outflows at Stirling Crescent, Bushmead Road (north and south sides) and Hazelmere Circus.

Detailed water monitoring and response procedures will be developed as part of the Urban Water Management Plans to be prepared for each stage of subdivision.

8.0 IMPLEMENTATION AND FURTHER MANAGEMENT PLANS

Further planning and subdivision of the subject land will be carried out in accordance with the general water management principles set out in this LWMS. Subdivision of lots in the structure plan area may be carried out by individual owners as they see fit, in accordance with the framework of the LWMS.

An Urban Water Management Plan (UWMP) is expected to be required as a condition of subdivision approval for each stage of subdivision. The UWMP will present the detailed design of the stormwater drainage system within that stage.

The developer of each stage of subdivision will maintain the drainage system, landscaped areas and water monitoring program within that stage until two years after that stage of subdivision is completed. At the end of that time the responsibility for monitoring and management will be handed over to the City of Swan.

9.0 REFERENCES

AECOM (2010). *Hazelmere Enterprise Area District Stormwater Management Strategy.* Prepared for Hassell.

BES (2012). *Lot 65 Anthea Street, Hazelmere and Surrounding Properties: Local Water Management Strategy.* Report prepared for Brockman Park Developments Pty Ltd.

BoM (2020). *Climate Statistics for Australian Locations.* http://www.bom.gov.au/climate/averages/tables/ca_wa_names.shtml#name_n Accessed 26/8/2020. Bureau of Meteorology, Perth.

BSD Consultants (2000). *Hazelmere Drainage Management Plan – Initial Strategy Report*. Prepared for the City of Swan.

City of Swan (2002). *Development Design Specification D5: Stormwater Drainage Design.* City of Swan, Midland.

City of Swan (2002). *Handbook of Stormwater Drainage Design*. City of Swan, Midland.

City of Swan (2013). *Stormwater Drainage Plan – Customer Checklist.* City of Swan, Midland.

Coterra (2015). Hazelmere Groundwater Monitoring. Report prepared for Stirling Brass Founders Pty Ltd.

David Wills & Associates (2001). *Hazelmere Drainage Study: Bushmead Road Area, City of Swan TPS 15.* City of Swan, Midland.

DER (2004). *Potentially Contaminating Activities and Land Uses.* Contaminated Sites Management Series No. 8. Department of Environmental Regulation, Perth.

DWER (2018). *Swan Canning Catchment Nutrient Report 2018: Helena River*. Department of Water & Environmental Regulation, Perth.

ENV (2010). *Hazelmere Enterprise Area District Structure Plan: Environmental Assessment.* Prepared for Hassell.

Fang X. (2000). *Open Channel Flow Calculator.* https://www.eng.auburn.edu/~xzf0001/Handbook/Channels.html Accessed 30/11/2020. Lamar University, USA.

Gozzard J.R. (1986). *Perth Sheet 2034 II and part 2034 III and 2134 III. Perth Metropolitan Region Environmental Geology Series.* Geological Survey of Western Australia, Perth.

Institute of Engineers, Australia (1987). *Australian Rainfall and Runoff: A Guide to Flood Estimation.* Institute of Engineers, Australia, Barton, ACT.

Parker Consultants WA Pty Ltd (2010). *A Report on Civil Engineering Aspects of Groundwater, Stormwater and Other Matters Relevant to the Development of a Local Water Management Strategy for the Proposed Subdivision of Lot 65 Anthea Street, Hazelmere.* Report prepared for Brockman Park Development Pty Ltd.

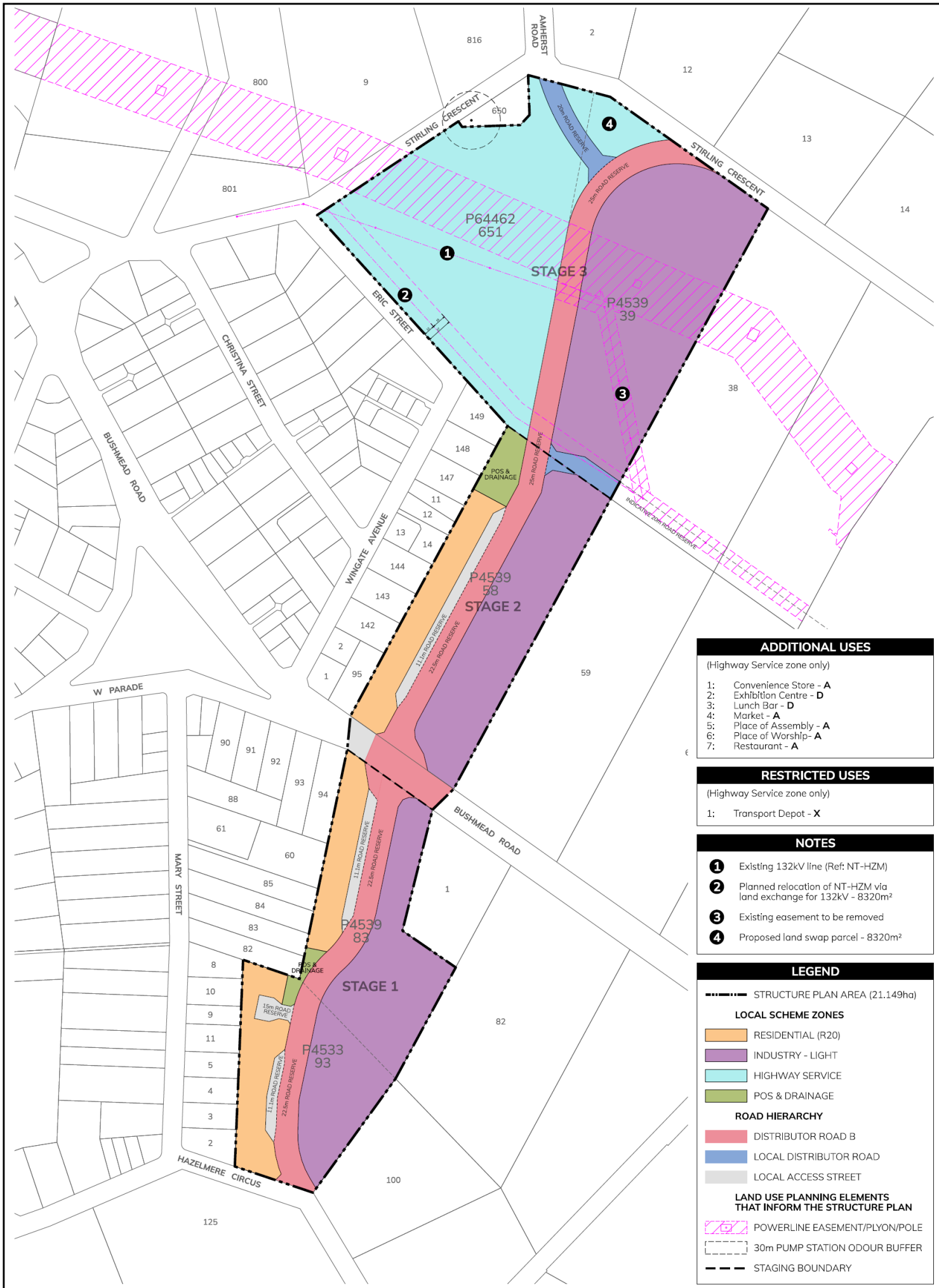
Figures



Figure 1

THE SITE AND SURROUNDINGS

bayley environmental services



ADDITIONAL USES

(Highway Service zone only)

1: Convenience Store - **A**
2: Exhibition Centre - **D**
3: Lunch Bar - **D**
4: Market - **A**
5: Place of Assembly - **A**
6: Place of Worship- **A**
7: Restaurant - **A**

RESTRICTED USES

(Highway Service zone only)

1: Transport Depot - **X**

NOTES

1. Existing 132kV line (Ref: NT-HZM)
2. Planned relocation of NT-HZM via land exchange for 132kV - 8320m²
3. Existing easement to be removed
4. Proposed land swap parcel - 8320m²

LEGEND

- STRUCTURE PLAN AREA (21.149ha)

LOCAL SCHEME ZONES

- RESIDENTIAL (R20)
- INDUSTRY - LIGHT
- HIGHWAY SERVICE
- POS & DRAINAGE

ROAD HIERARCHY

- DISTRIBUTOR ROAD B
- LOCAL DISTRIBUTOR ROAD
- LOCAL ACCESS STREET

LAND USE PLANNING ELEMENTS THAT INFORM THE STRUCTURE PLAN

- POWERLINE EASEMENT/PLYON/POLE
- 30m PUMP STATION ODOUR BUFFER
- STAGING BOUNDARY

URPS

CALLO
BUSHMEAD ROAD, HAZELMERE CIRCUS & STIRLING CRESCENT, HAZELMERE

NORTH
0 35 70 105m

LOCAL STRUCTURE PLAN
04/04/2025
1:3500 @ A3

Figure 2

STRUCTURE PLAN

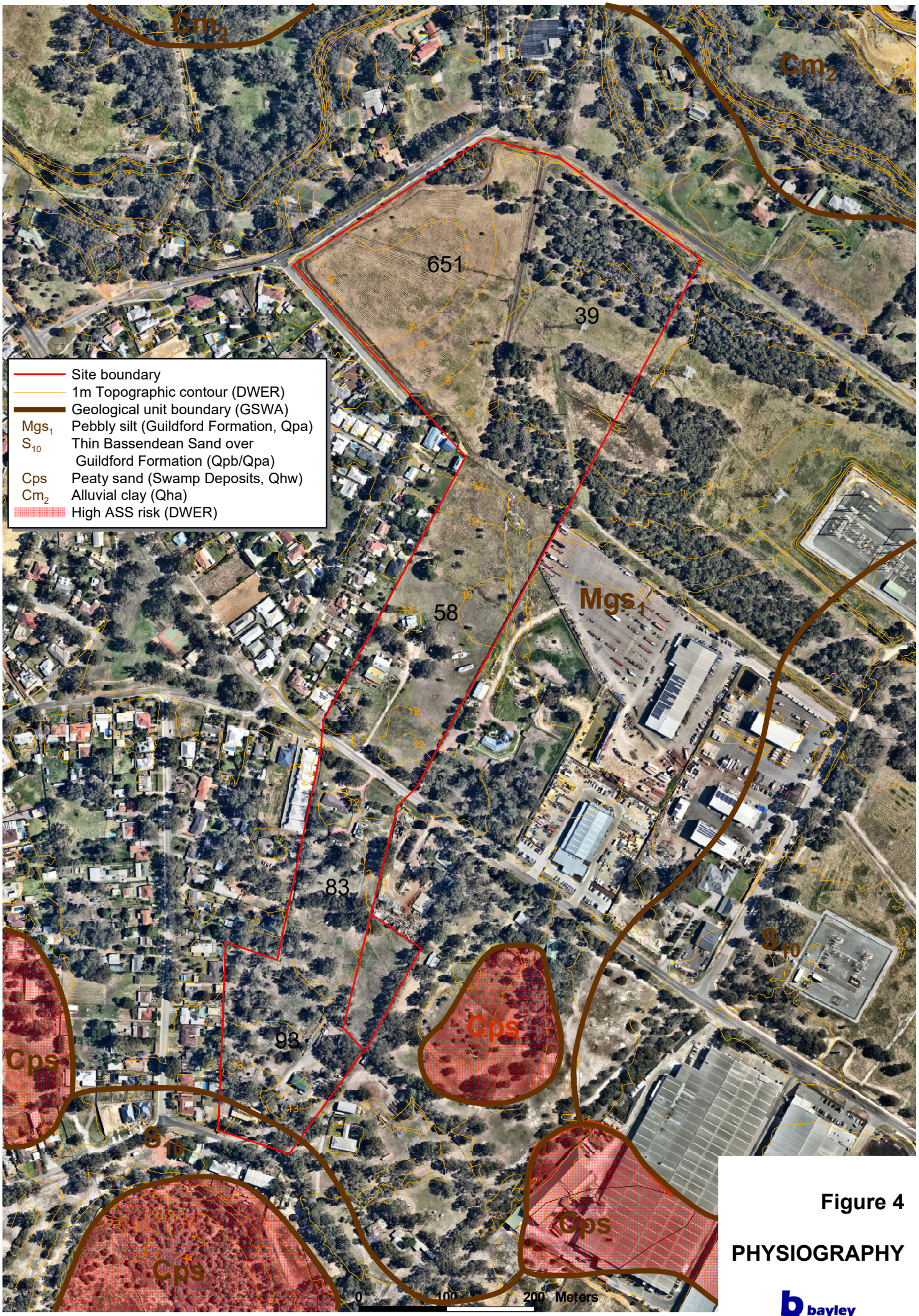


Figure 4

PHYSIOGRAPHY

bayley environmental services

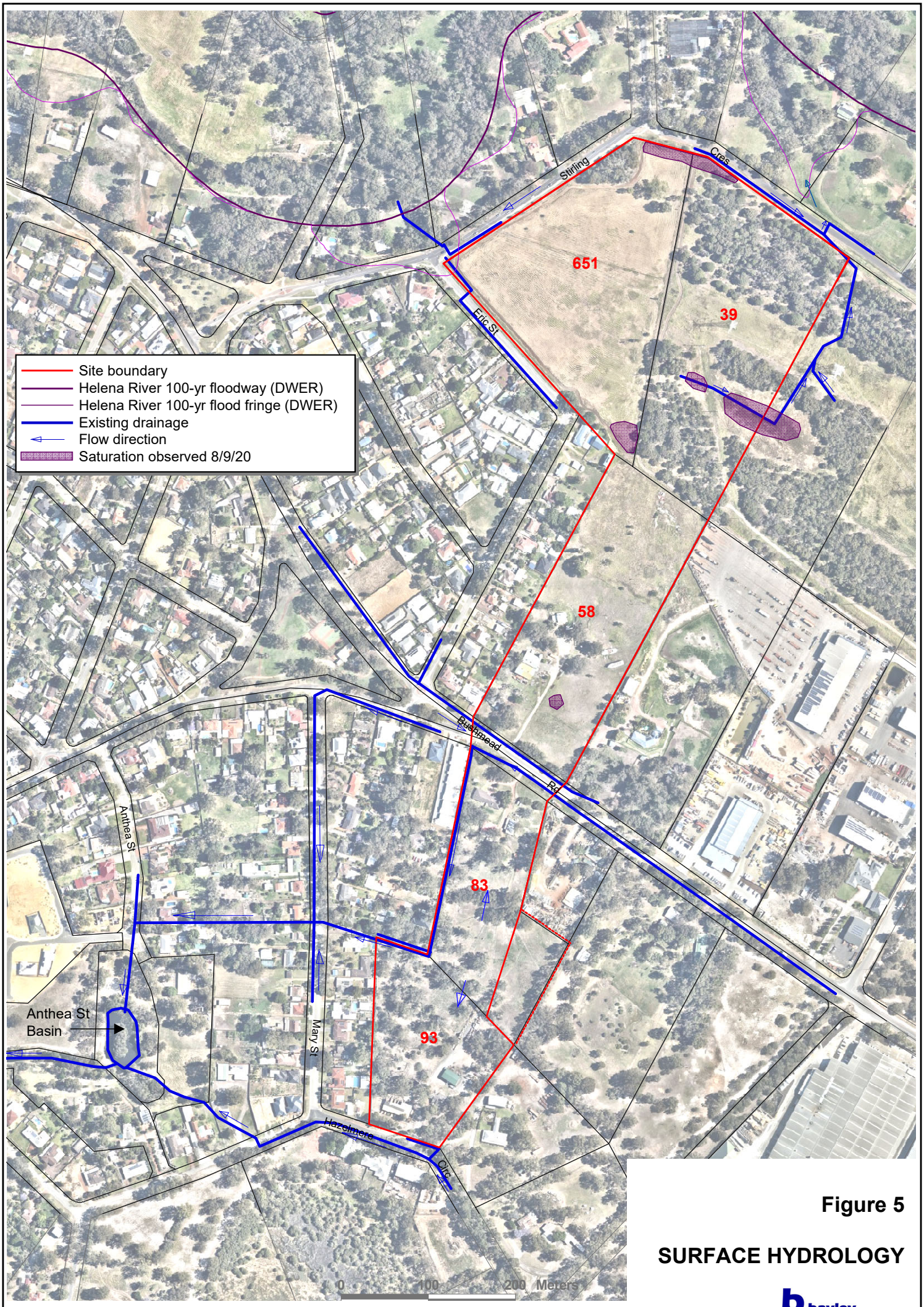


Figure 5

SURFACE HYDROLOGY

bayley environmental services

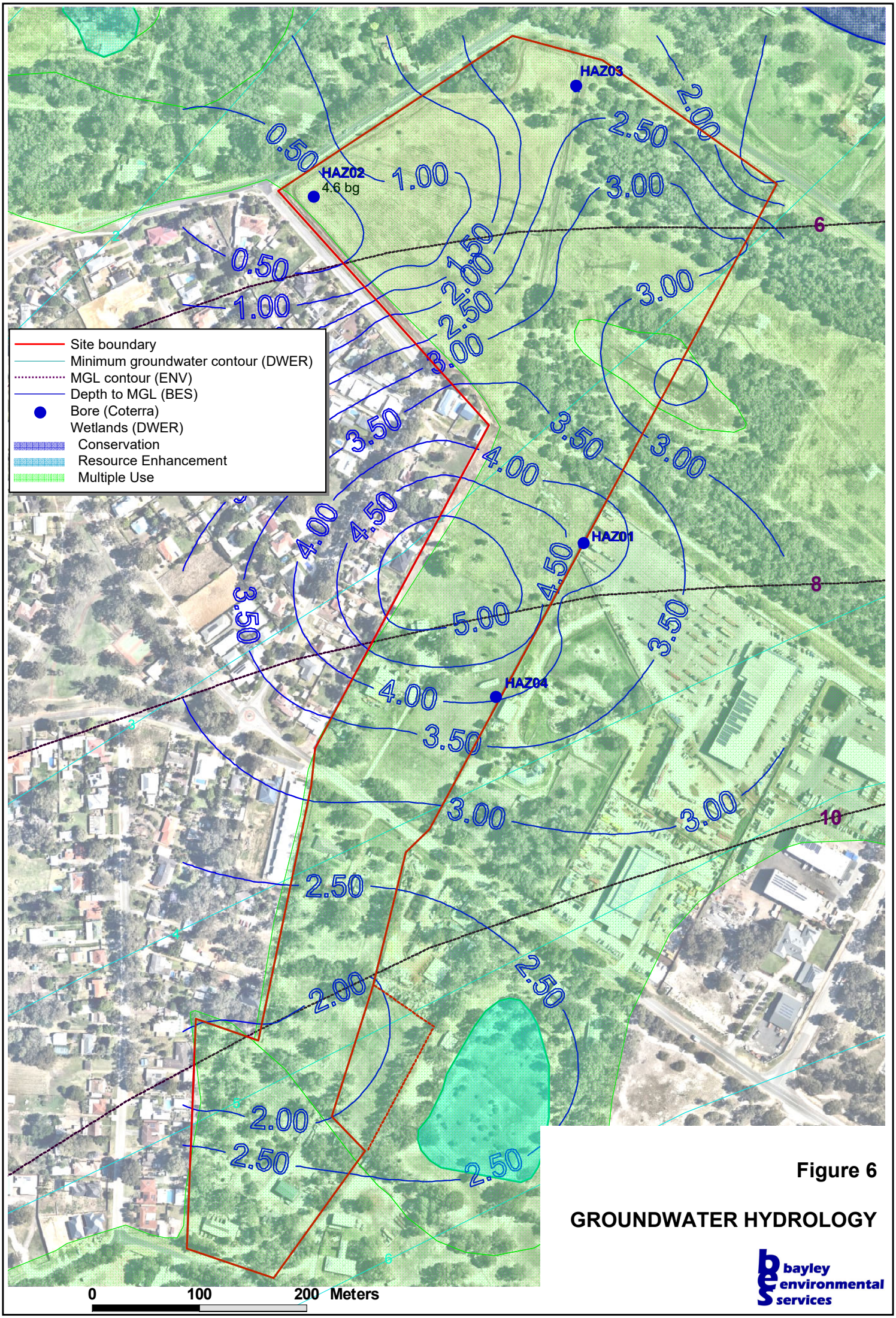


Figure 6

GROUNDWATER HYDROLOGY

bayley environmental services

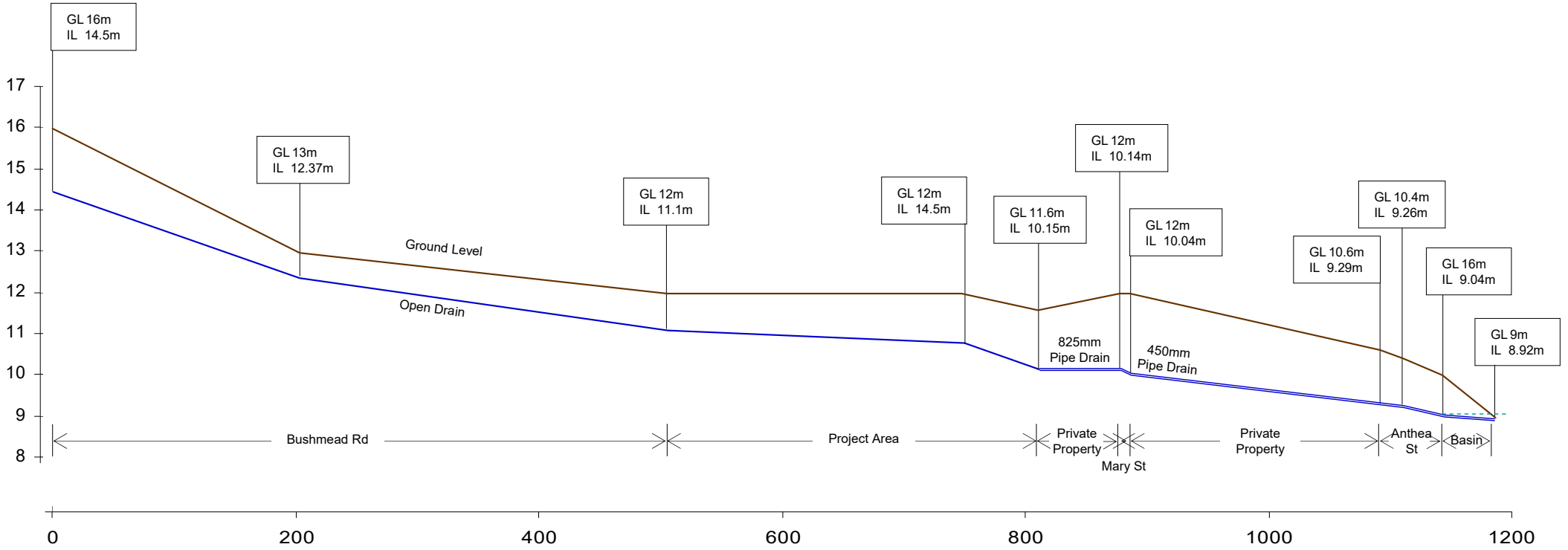


Figure 7

WESTERN DRAIN
LONG SECTION

bayley environmental services

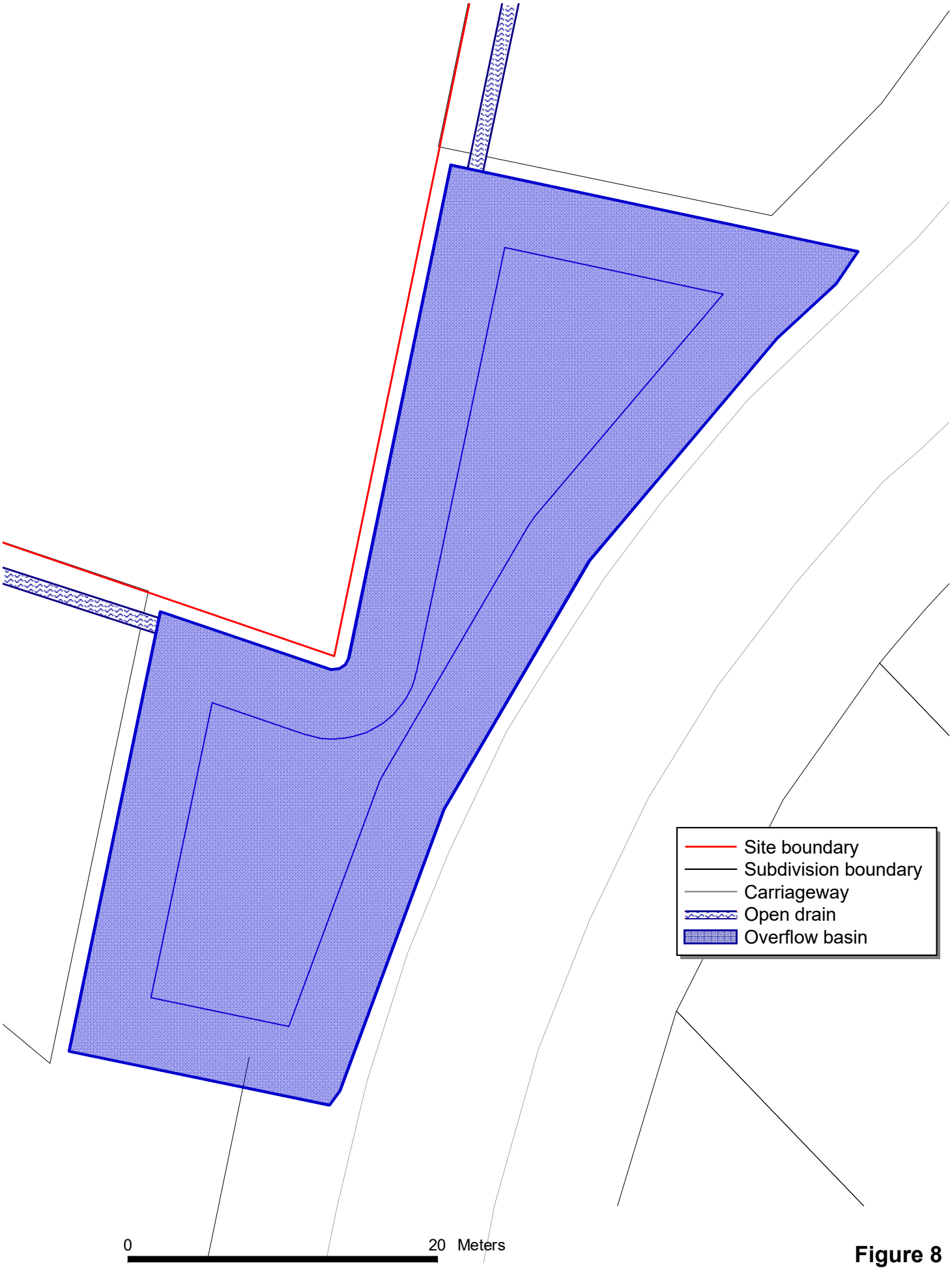


Figure 8

OVERFLOW BASIN CONCEPT

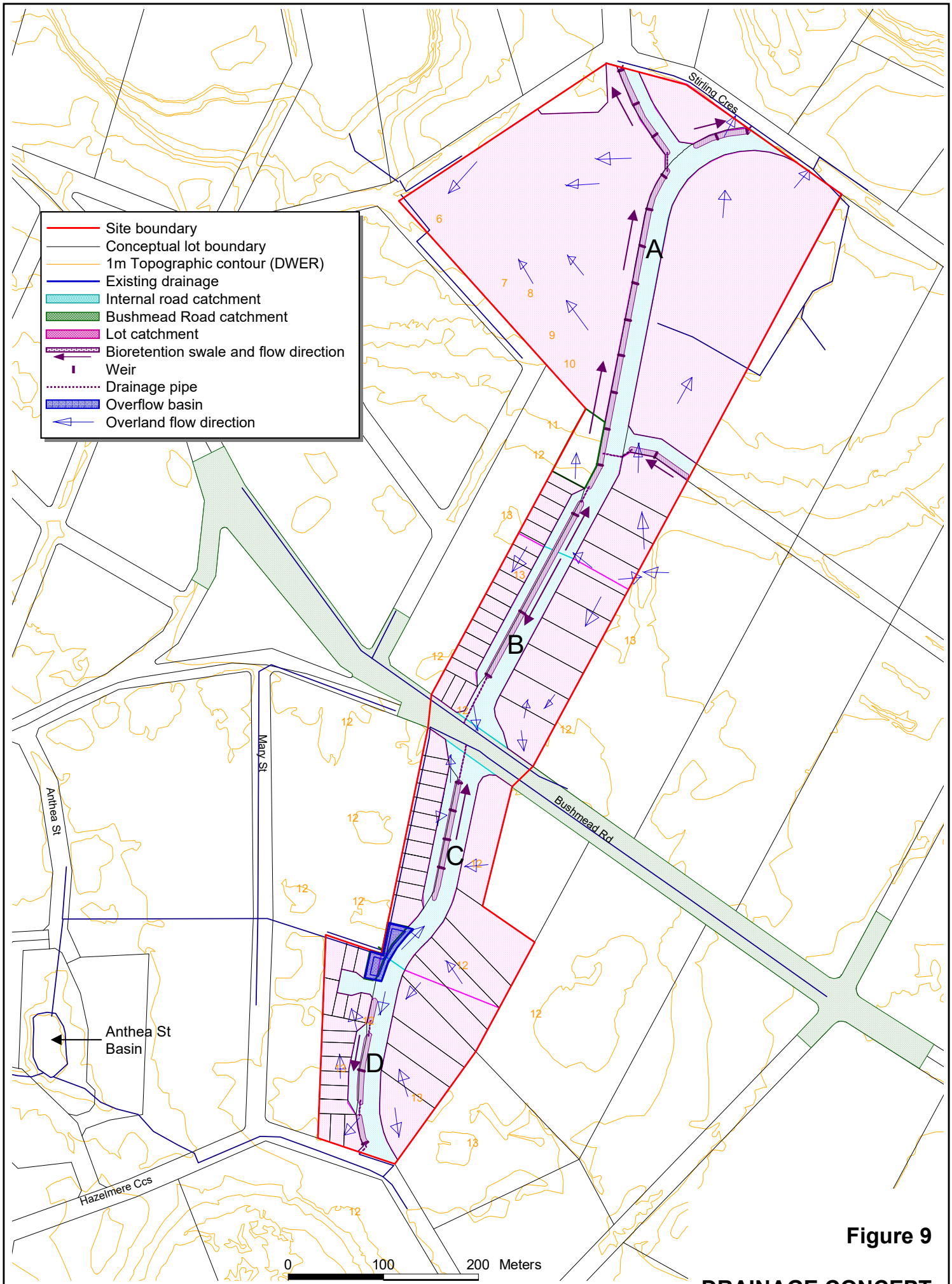
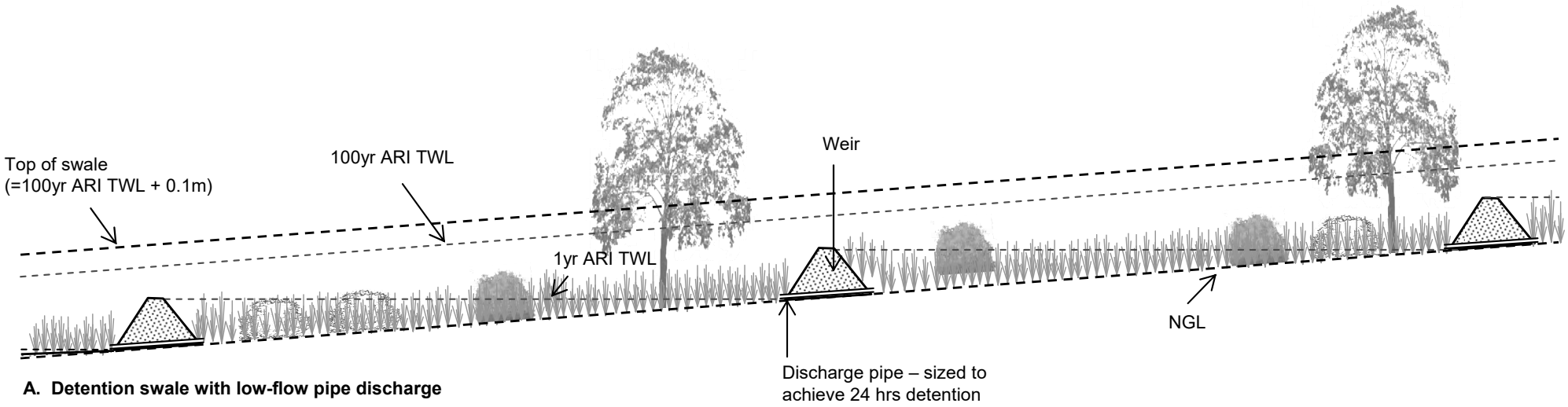


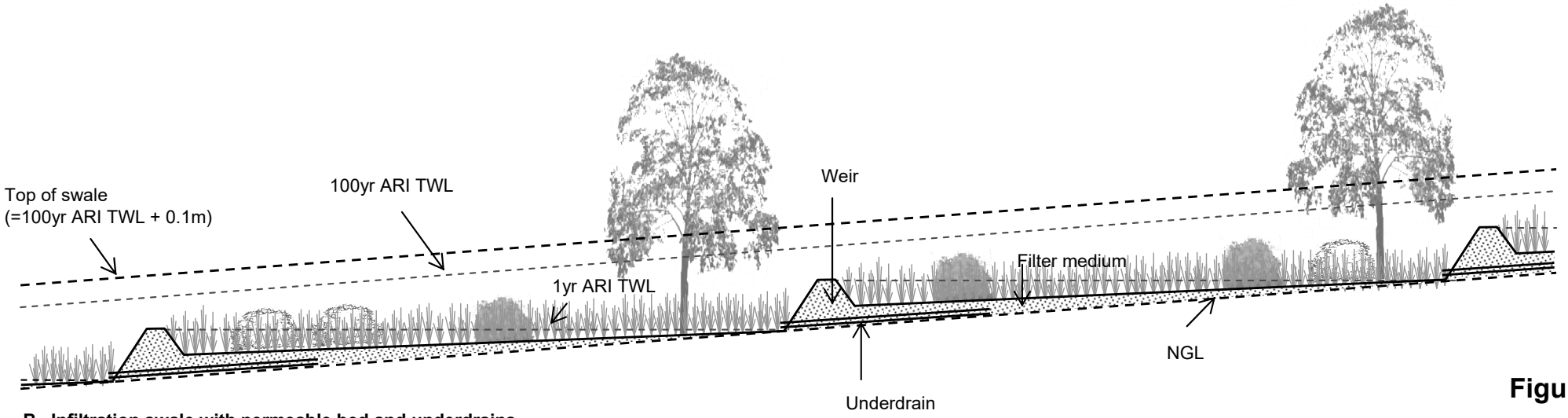
Figure 9

DRAINAGE CONCEPT

bayley environmental services



A. Detention swale with low-flow pipe discharge

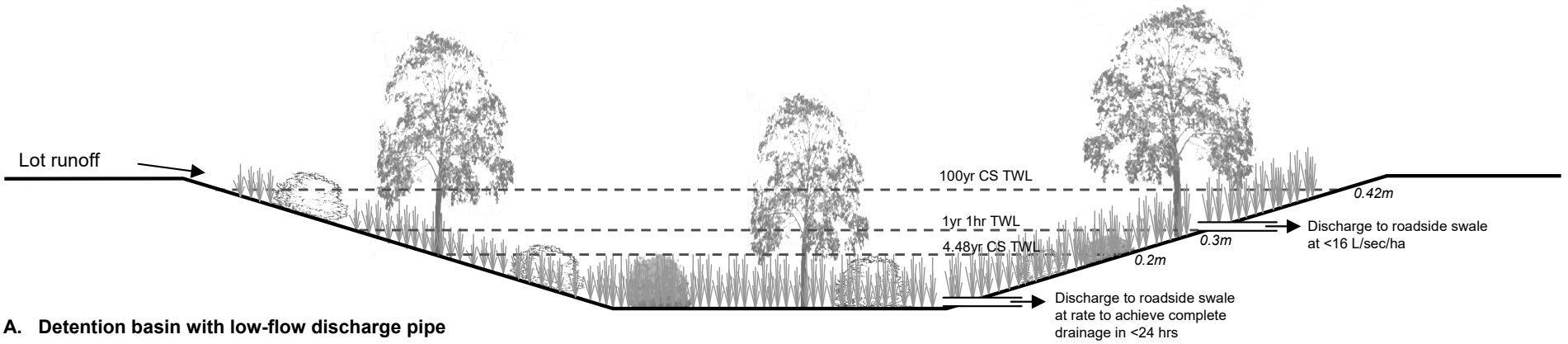


B. Infiltration swale with permeable bed and underdrains

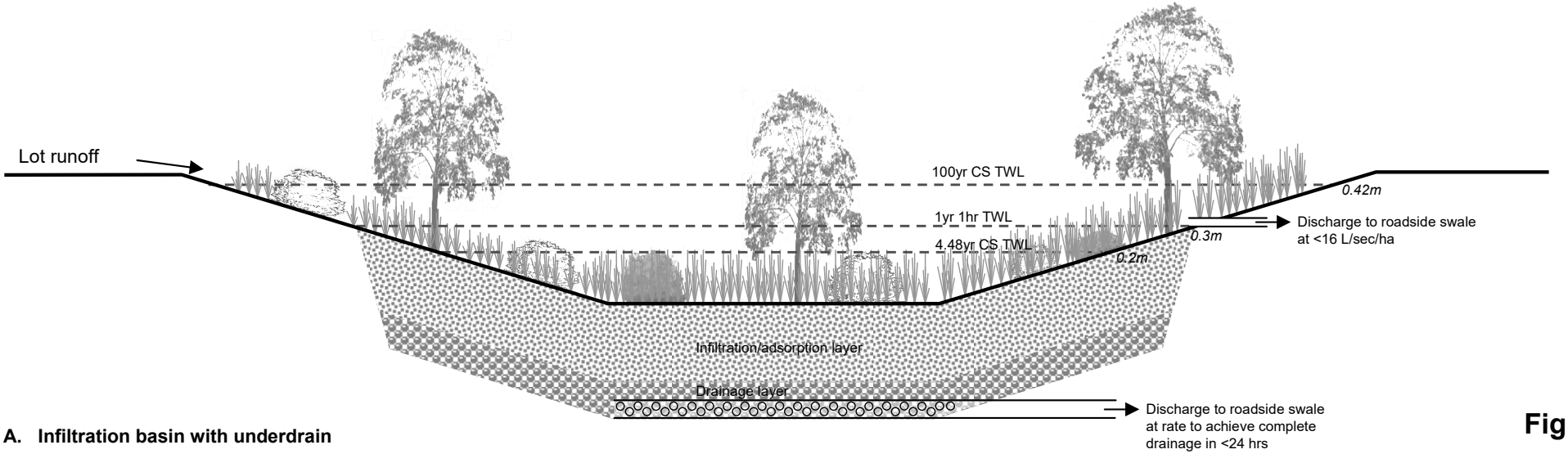
Figure 10

SWALE OPTIONS

bayley environmental services



A. Detention basin with low-flow discharge pipe



A. Infiltration basin with underdrain

Figure 11

BASIN OPTIONS

bayley environmental services

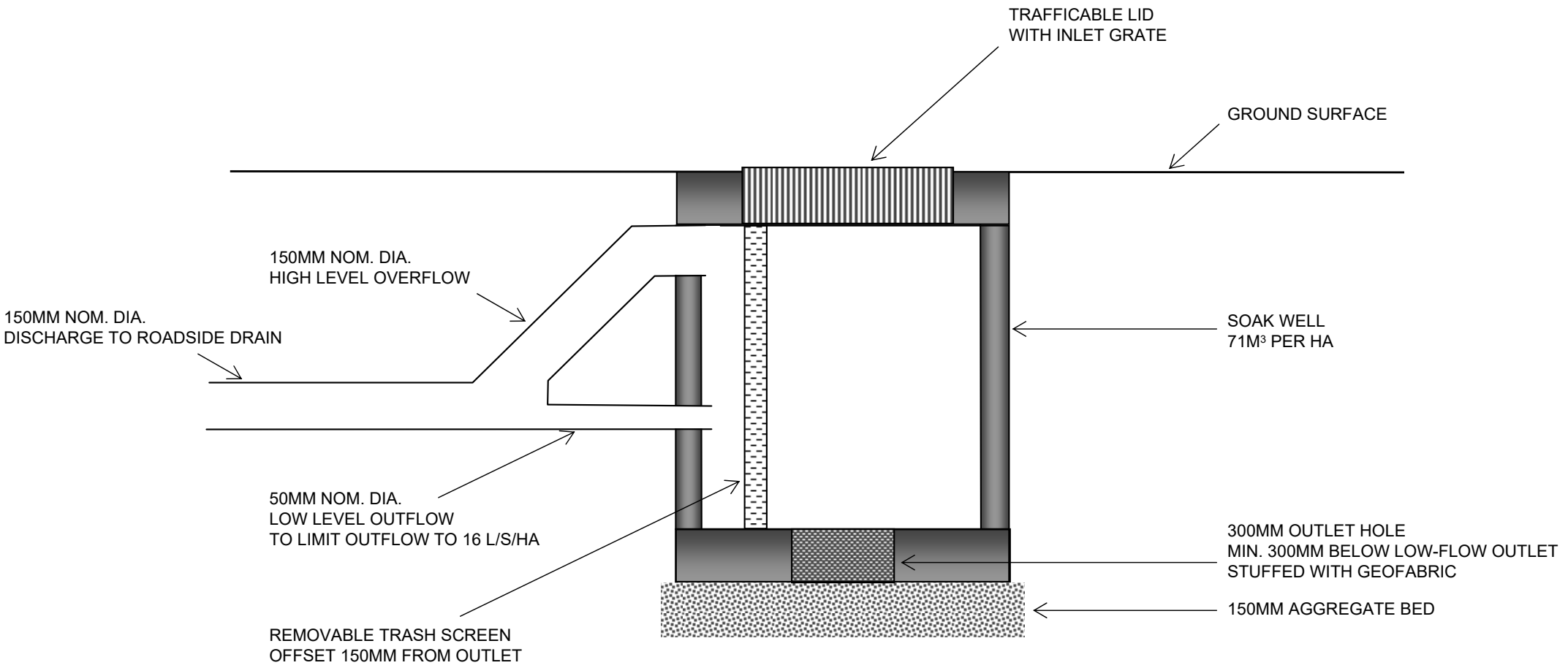


Figure 12

IN-LOT DETENTION PIT

bayley environmental services

Appendix A

Soil Logs

Client: DPI & City of Swan
Logged By: ENV
Drilled By: E Drill
Monitoring Bore No: X1
E: 404364.623

Project: Surface and Groundwater Monitoring
Job No: 08.293
Date Logged: 23/09/2008
Installation Method: Direct Probe
N: 6470515.501

Depth BGL (m)	Monitor Well Log	Profile (m)	Lithology	Observations
			Steel Raiser	
		0 - 0.5	SAND Black, Organic Matter and Sand and Some Laterite Pebbles, Damp	
		0.5 - 2	CLAY, Creamy Brown, Moderately Sorted, Damp	
1.0				
2.0				
		2 - 3.5	CLAY, Creamy Brown, Well Sorted	Sorting Increasing with Depth
3.0				
		3.5 - 5.00	SANDY CLAY, brown, slightly silty, damp	
4.0				
5.0				
		5.0 - 5.8	SAND, grey	
	▽			WL: 5.50m
6.0				EOH: 5.80m
7.0				
8.0				
9.0				
10.0				

Well Screen
Gravel Pack
Bentonite Layer
Sand Fill
Cement Grout
Undrilled profile

Initial water table at time drilling
Water table after first gauging 14/10/2008

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: DPI & City of Swan
Logged By: ENV
Drilled By: E Drill
Monitoring Bore No: X3
E: 405767.526

Project: Surface and Groundwater Monitoring
Job No: 08.293
Date Logged: 22/09/2008
Installation Method: Direct Probe
N: 6470177.001

Depth BGL (m)	Monitor Well Log	Profile (m)	Lithology	Observations
			Steel Raiser	
		0 - 2.8	SANDY CLAY and organic matter, brown/white, some peletal gravel, sperical, up to 5mm in size	
1.0				
2.0				
		2.8 - 4.3	CLAY, creamy brown, fine grained, typical clay, some larger pebbles cemented silicates	
3.0				
4.0				
		4.3 - 6.84	CLAY, interlayered with sandy clay (light clay), brown with heavier brown clay	
5.0				
6.0	▽ ▼			
7.0				
8.0				
9.0				
10.0				

Well Screen
Gravel Pack
Bentonite Layer
Sand Fill
Cement Grout
Undrilled profile

Initial water table at time drilling
Water table after first gauging 14/10/2008

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: DPI & City of Swan
Logged By: ENV
Drilled By: E Drill
Monitoring Bore No: X5
E: 406168.546

Project: Surface and Groundwater Monitoring
Job No: 08.293
Date Logged: 22/09/2008
Installation Method: Direct Probe
N: 6469827.83

Depth BGL (m)	Monitor Well Log	Profile (m)	Lithology	Observations
			Steel Raiser	
		0 - 1.5	SAND, Black/Brown/Grey, Organic Matter, Dry	
1.0				
		1.5 - 3.0	CLAY, Red/Orange, some white	Soft Spherical Granules, Early Stages of Laterite Formation
2.0				
3.0				
		3.0 - 4.0	CLAY Brown, sand content~ 40%	Beginning to Coarsen
4.0				
		4.0 - 6.8	CLAYEY SAND, Brown, Medium Coarse Grains.	Colour due to Iron (Fe) Staining Near the Water Table
5.0				
				WL: 5.72m
6.0				
		6.8 - 7.35		
7.0				
				EOH: 7.35
8.0				
9.0				
10.0				

Well Screen
Gravel Pack
Bentonite Layer
Sand Fill
Cement Grout
Undrilled profile

Initial water table at time drilling
Water table after first gauging 14/10/2008

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: DPI & City of Swan
Logged By: ENV
Drilled By: E Drill
Monitoring Bore No: X6
E: 404600.496

Project: Surface and Groundwater Monitoring
Job No: 08.293
Date Logged: 22/09/2008
Installation Method: Direct Probe
N: 6469262.386

Depth BGL (m)	Monitor Well Log	Profile (m)	Lithology	Observations
			Steel Raiser	
		0 - 2	SAND, Grey/Cream/Brown, Damp, Moderately Sorted	
1.0				
				WL: 1.72
2.0		2 - 7	GRAVEL, grey/cream, Large Quartz Grains, Saturated Highly Silicious	
3.0				
4.0				
5.0				
6.0				
7.0				
		7 - 7.5	CLAY, Green, Loamy with Some Larger Quartz Grains, Saturated	Possibly Gilgai, Most Likely Due to Reduction
				EOH: 7.25
8.0				
9.0				
10.0				

Well Screen
Gravel Pack
Bentonite Layer
Sand Fill
Cement Grout
Undrilled profile

Initial water table at time drilling
Water table after first gauging 14/10/2008

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

Client: DPI & City of Swan
Logged By: ENV
Drilled By: E Drill
Monitoring Bore No: X7

Project: Surface and Groundwater Monitoring
Job No: 08.293
Date Logged: 22/09/2008
Installation Method: Direct Probe

E: 405800.476 **N:** 6469303.983

Depth BGL (m)	Monitor Well Log	Profile (m)	Lithology	Observations
			Steel Raiser	
		0 - 0.3	SAND, Black, organic matter present	
		0.3 - 5	SAND, Grey/White, Coarse Grains, Wet, Moderately Sorted	
1.0				
				WL: 1.5m
2.0				
				Saturation Zone at 2m
3.0				
4.0				
5.0				
				5.5m EOH
6.0				
7.0				
8.0				
9.0				
10.0				

Well Screen
Gravel Pack
Bentonite Layer
Sand Fill
Cement Grout
Undrilled profile

Initial water table at time drilling
Water table after first gauging 14/10/2008

ENV. Australia
Level 7
182 St Georges Terrace
Perth, WA, 6000.

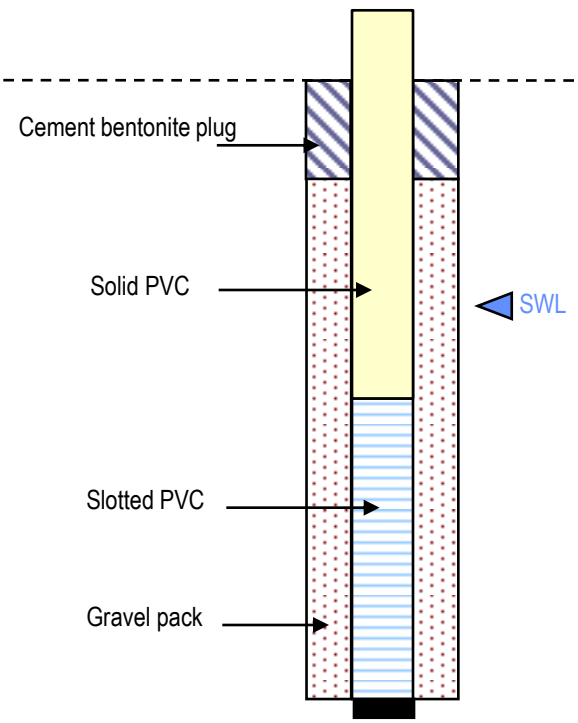
BOREHOLE NUMBER: HAZ01

COTERRA ENVIRONMENT
2/460 Roberts Road
Subiaco W.A. 6008
Ph: 9381 5513 Fax: 9381 5514
Email: info@coterra.com.au

PROJECT NUMBER: LHGHAZ01
LOCATION: Lot 58, Bushmead Road, Hazelmere
DRILLING COMPANY: Strataprobe
DRILLING METHOD: Rotary
DRILLER: John Metcalf
WEATHER: Sunny
SCIENTIST: C.Hopkirk
DATE COMPLETED: 8 Oct 2015
BORE DEPTH (mbtoc): 6.28

COLLAR ELEVATION (A) (mAHD): To be surveyed
DEPTH TO WATER TABLE (B) (mbtoc): 2.14
STANDING WATER LEVEL (C=A-B) (mAHD):
STICK UP (D) (m): 0.82
GROUND SURFACE ELEVATION (E=A-D) (mAHD):

DEPTH (m)	LITHOLOGY DESCRIPTION	BORE INSTALLATION
1.0		
GL	0 – 0.1 m Topsoil. Brown, fine grained with sand and silt.	Cement bentonite plug
-1.0	0.1 – 1.2 m Sandy CLAY. Brown, sand is fine grained. Some silt present	Solid PVC, SWL
-2.0	1.2 – 2.0 m Sandy CLAY. Brown, sand is fine to medium grained.	
-3.0		
-4.0	3.8 – 6.28 m CLAY. Orangey brown, some sand present. Sand is medium grained.	Slotted PVC
-5.0		Gravel pack
-6.0		
-7.0		
-8.0		
-9.0		
-10.0		



Casing Material: PVC
Casing Diameter: 50 mm
Geotextile Stocking: No
Lockable Borehead: YES

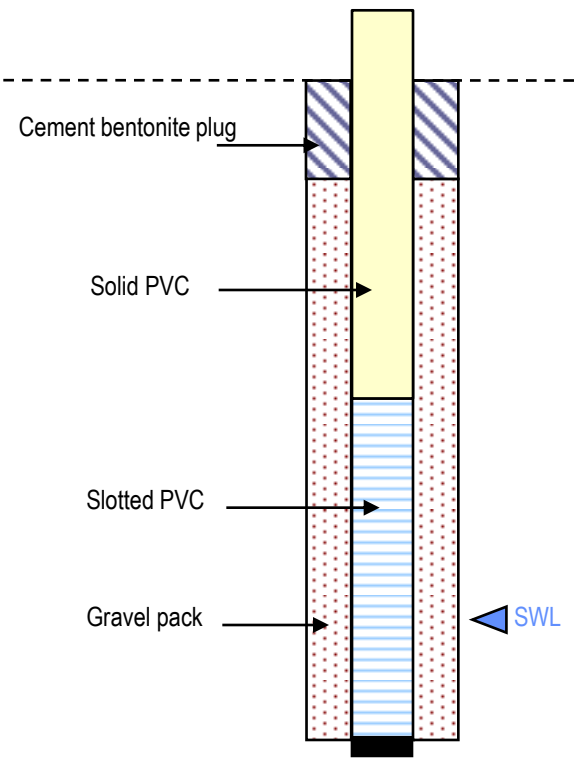
BOREHOLE NUMBER: HAZ02

COTERRA ENVIRONMENT
2/460 Roberts Road
Subiaco W.A. 6008
Ph: 9381 5513 Fax: 9381 5514
Email: info@coterra.com.au

PROJECT NUMBER: LHGHAZ01
LOCATION: Lot 651, Stirling Crescent, Hazelmere
DRILLING COMPANY: Strataprobe
DRILLING METHOD: Rotary
DRILLER: John Metcalf
WEATHER: Sunny
SCIENTIST: C.Hopkirk
DATE COMPLETED: 8 Oct 2015
BORE DEPTH (mbtoc): 6.62

COLLAR ELEVATION (A) (mAHD): To be surveyed
DEPTH TO WATER TABLE (B) (mbtoc): 5.47
STANDING WATER LEVEL (C=A-B) (mAHD):
STICK UP (D) (m): 0.82
GROUND SURFACE ELEVATION (E=A-D) (mAHD):

DEPTH (m)	LITHOLOGY DESCRIPTION	BORE INSTALLATION
1.0		
GL	0 – 0.1 m Topsoil. Brown fine grained with sand and silt.	
-1.0	0.1 – 2.5 m. CLAY. Brown to orange. Plastic, sticky. Minor sand content.	
-2.0		
-3.0	2.5 – 5.5 m. CLAY. Orangey brown. Some sand and gravel. Plastic, sticky.	
-4.0		
-5.0		
-6.0	5.5 – 6.62 m. Grey sandy SILT with minor gravel and minor clay.	
-7.0		
-8.0		
-9.0		
-10.0		



Casing Material: PVC
Casing Diameter: 50 mm
Geotextile Stocking: No
Lockable Borehead: YES

BOREHOLE NUMBER: HAZ03

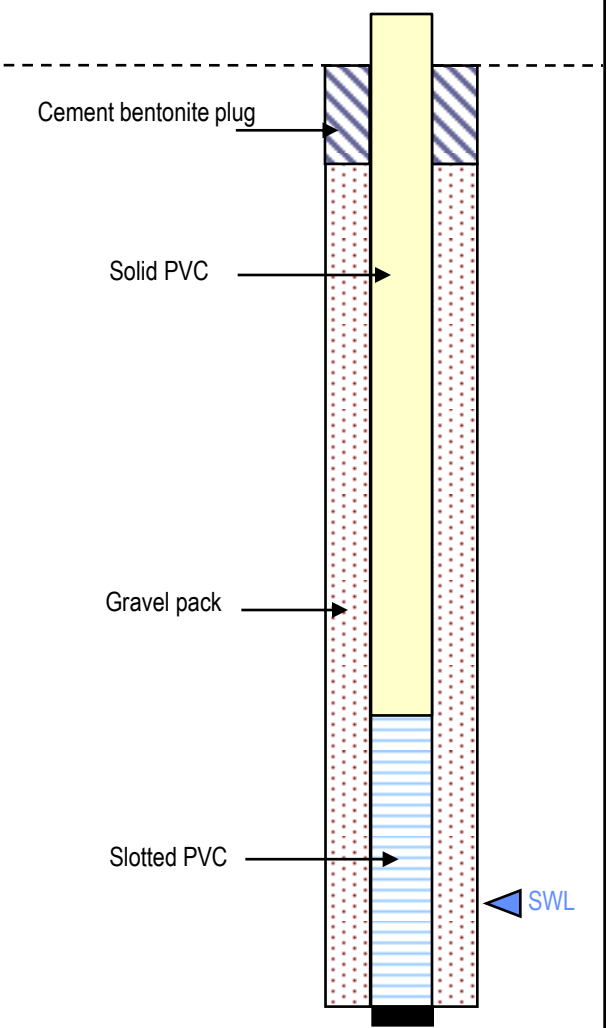
COTERRA ENVIRONMENT
2/460 Roberts Road
Subiaco W.A. 6008
Ph: 9381 5513 Fax: 9381 5514
Email: info@coterra.com.au

PROJECT NUMBER: LHGHAZ01
LOCATION: Lot 651, Stirling Crescent, Hazelmere
DRILLING COMPANY: Strataprobe
DRILLING METHOD: Rotary
DRILLER: John Metcalf
WEATHER: Sunny
SCIENTIST: C.Hopkirk
DATE COMPLETED: 8 Oct 2015
BORE DEPTH (mbtoc): 9.60

COLLAR ELEVATION (A) (mAHD): To be surveyed
DEPTH TO WATER TABLE (B) (mbtoc): 8.5
STANDING WATER LEVEL (C=A-B) (mAHD):
STICK UP (D) (m): 0.65
GROUND SURFACE ELEVATION (E=A-D) (mAHD):

DEPTH (m)	LITHOLOGY DESCRIPTION
GL	0 – 1.0 m Red Brown CLAY. Plastic, sticky. Colour becomes lighter with depth.
-1.0	1.0 – 1.5 m Hard orange brown CLAY. Plastic
-2.0	1.5 – 2.1 m Brown sandy CLAY with some gravel. Plastic. Sand is medium grained.
-3.0	2.1 – 3.0 m Brown sandy clayey SILT. Sand is medium grained.
-4.0	3.0 – 4.5 m Orangey brown sandy CLAY
-5.0	4.5 – 9.60 m Orangey brown sandy CLAY. Plasticity increasing with depth. Sand finer with depth.
-6.0	
-7.0	
-8.0	
-9.0	
-10.0	

BORE INSTALLATION



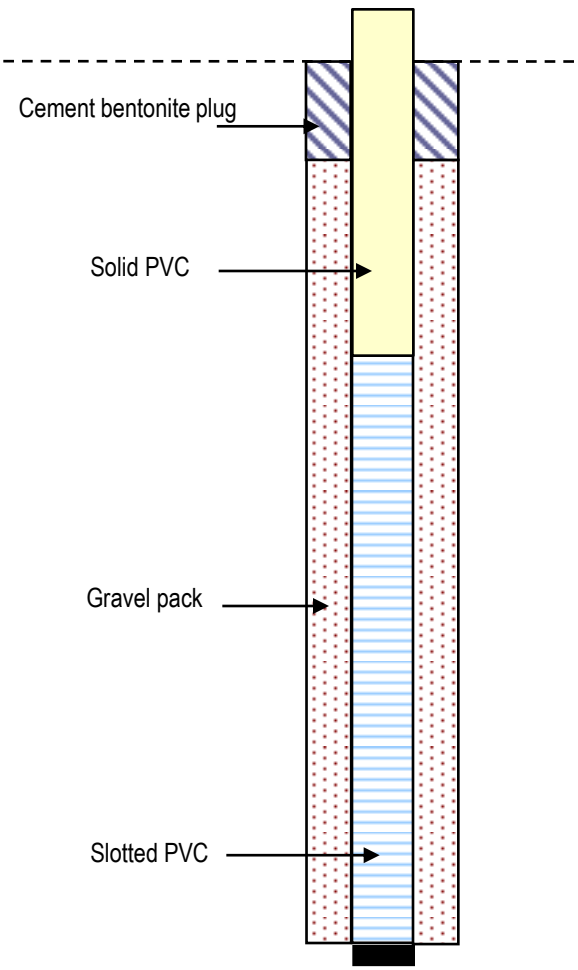
Casing Material: PVC
Casing Diameter: 50 mm
Geotextile Stocking: No
Lockable Borehead: YES

BOREHOLE NUMBER: HAZ04

COTERRA ENVIRONMENT
2/460 Roberts Road
Subiaco W.A. 6008
Ph: 9381 5513 Fax: 9381 5514
Email: info@coterra.com.au

PROJECT NUMBER: LHGHAZ01
LOCATION: Lot 58 Bushmead Road, Hazelmere
DRILLING COMPANY: Strataprobe
DRILLING METHOD: Rotary
DRILLER: John Metcalf
WEATHER: Sunny
SCIENTIST: C.Hopkirk
DATE COMPLETED: 8 Oct 2015
BORE DEPTH (mbtoc): 9.07

COLLAR ELEVATION (A) (mAHD): To be surveyed
DEPTH TO WATER TABLE (B) (mbtoc):
STANDING WATER LEVEL (C=A-B) (mAHD):
STICK UP (D) (m): 0.65
GROUND SURFACE ELEVATION (E=A-D) (mAHD):

DEPTH (m)	LITHOLOGY DESCRIPTION	BORE INSTALLATION
1.0 GL -1.0 -2.0 -3.0 -4.0 -5.0 -6.0 -7.0 -8.0 -9.0 -10.0	0 – 0.5 m Topsoil. Light brown – grey sandy silt. Fine grained. 0.5 – 1.3 m Orange brown sandy CLAY. Fine grained. 1.3 – 1.7 m Red Brown CLAY 1.7 – 2.1 m Light brown SILT. Minor sand and clay content 2.1 – 2.5 m Reddish brown sandy CLAY. 2.5 – 3.5 m Red CLAY. Plastic. Minor white fine grained sand in band between 3.2 – 3.5 m. 3.5 – 9 m Red CLAY. Plastic. Colour becomes lighter red with depth.	

Casing Material: PVC
Casing Diameter: 50 mm
Geotextile Stocking: No
Lockable Borehead: YES

Appendix B

Groundwater Measurements

ENV GROUNDWATER MONITORING 2008-2009

Depth Below GL (m)						
Sample ID	**20/10/2008**	**19/11/2008**	**22/12/2008**	**21/01/2009**	**17/02/2009**	**17/03/2009**
X1	4.62	4.76	4.97	#N/A	#N/A	#N/A
X3	5.12	5.01	5.00	5.18	5.38	5.63
X4	1.47	1.55	1.63	1.83	1.96	2.07
X5	3.43	3.57	#N/A	#N/A	4.15	4.34
X6	2.10	2.69	3.47	4.71	4.87	5.18
X7	0.88	1.12	1.24	1.49	1.67	1.84

Groundwater Level (mAHD)						
Sample ID	**20/10/2008**	**19/11/2008**	**22/12/2008**	**21/01/2009**	**17/02/2009**	**17/03/2009**
X1	2.09	1.95	1.74	#N/A	#N/A	#N/A
X3	4.41	4.52	4.53	4.35	4.15	3.90
X4	13.00	12.92	12.84	12.64	12.52	12.40
X5	9.66	9.52	#N/A	#N/A	8.94	8.75
X6	9.08	8.49	7.70	6.46	6.31	5.99
X7	13.88	13.64	13.52	13.27	13.09	12.92

Source: ENV (2010). *Hazelmere Enterprise Area District Structure Plan: Environmental Assessment.*

COTERRA GROUNDWATER MONITORING 2015 - 2019

Hazelmere Groundwater Levels

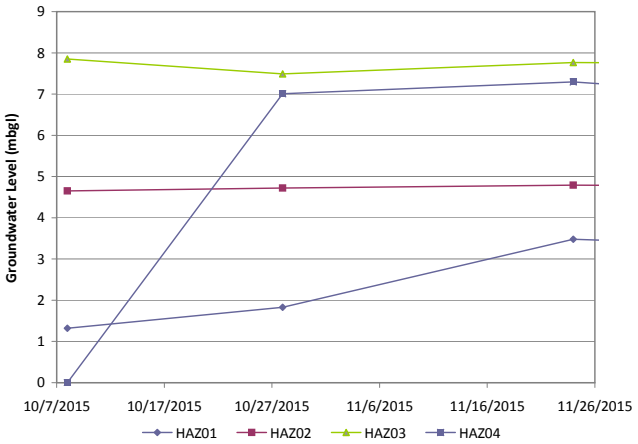
Meters below top of collar (mbtoc)				
Stick up (m)	0.82	0.82	0.65	0.65
Date	HAZ01	HAZ02	HAZ03	HAZ04
08/10/2015 (installation)	2.14	5.47	8.50	dry
28-Oct-15	2.65	5.54	8.14	7.66
24-Nov-15	4.30	5.61	8.42	7.95
28-Oct-19	-	5.12	7.90	-

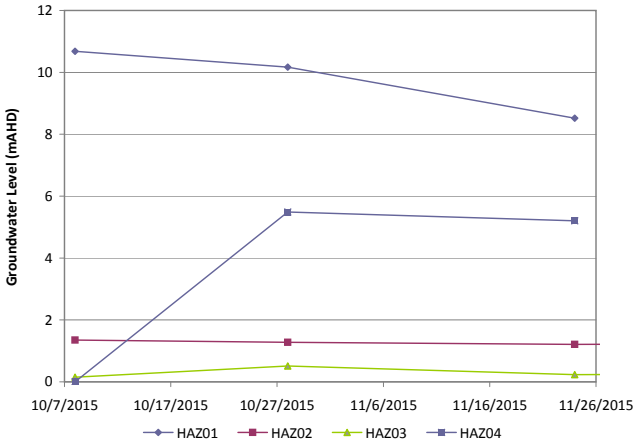
Meters below ground level (mbgl)				
Date	HAZ01	HAZ02	HAZ03	HAZ04
8-Oct-15	1.32	4.65	7.85	dry
28-Oct-15	1.83	4.72	7.49	7.01
24-Nov-15	3.48	4.79	7.77	7.30
28-Oct-19	-	4.30	7.25	-

Meters below ground level (mAHD)				
Ground elevation (mAHD)	12	6	8	12.5
Date	HAZ01	HAZ02	HAZ03	HAZ04
8-Oct-15	10.68	1.35	0.15	dry
28-Oct-15	10.17	1.28	0.51	5.49
24-Nov-15	8.52	1.21	0.24	5.21
28-Oct-19	-	1.70	0.75	-

Ground elevations estimated from regional topographic contours

Bore Details	HAZ01	HAZ02	HAZ03	HAZ04
Total Depth (mbgl)	6.28	6.62	9.6	9.07
Screened interval (mbgl)	3.28 - 6.28	3.62 - 6.62	6.6-9.6	3.07-9.07
Screen length (m)	3	3	3	6
Total Depth (mAHD)	5.72	-0.62	-1.6	3.43
Top of screen (mAHD)	8.72	2.38	1.4	9.43





Source: Coterra (2015). Hazelmere Groundwater Monitoring. Report prepared for Stirling Brass Founders Pty Ltd.

Appendix C

Flow Calculations

1 YEAR ARI 1 HOUR FLOWS - LOTS

Rainfall Intensity i (mm/h)	15.9	(1 Yr, 1 Hr Storm)
Cr Road reserves	0.5	City of Swan Handbook of Drainage Design, 2002
Cr Residential lots	0.45	
Cr Commercial lots	0.6	
Cr Basin	1	
Cr OS	0.19	
Permeability k (m/hr)	0.0000	

Catchment	Road Reserves	Res Lots	Comm Lots	Basin	OS	Ai	Q (L/s)	Vinflow (m3)
Residential Lot (480m2)	0	480	0	0	0	216	0.95	3.4
Commercial Lot (1,000m2)	0	0	952	48	0	619	2.74	9.9
Commercial Lot (1ha)	0	0	9628	372	0.00	6149	27.18	97.8

Basin Sizing

	Depth	Left Slope 1:x	Right Slope 1:x	Base Width	Base Length	Top Width (m)	Top Length (m)	Volume	Effective Volume	Surface Area (m2)	Volume check
Commercial Lot (1,000m2)	0.3	4	4	**4**	**5.1**	6.4	7.5	10.0	10.0	48	ok
Commercial Lot (1ha)	0.3	4	4	**16**	**17.8**	18.4	20.2	98.2	98.2	372	ok

4.48 YEAR ARI (20% AEP) FLOWS - LOTS

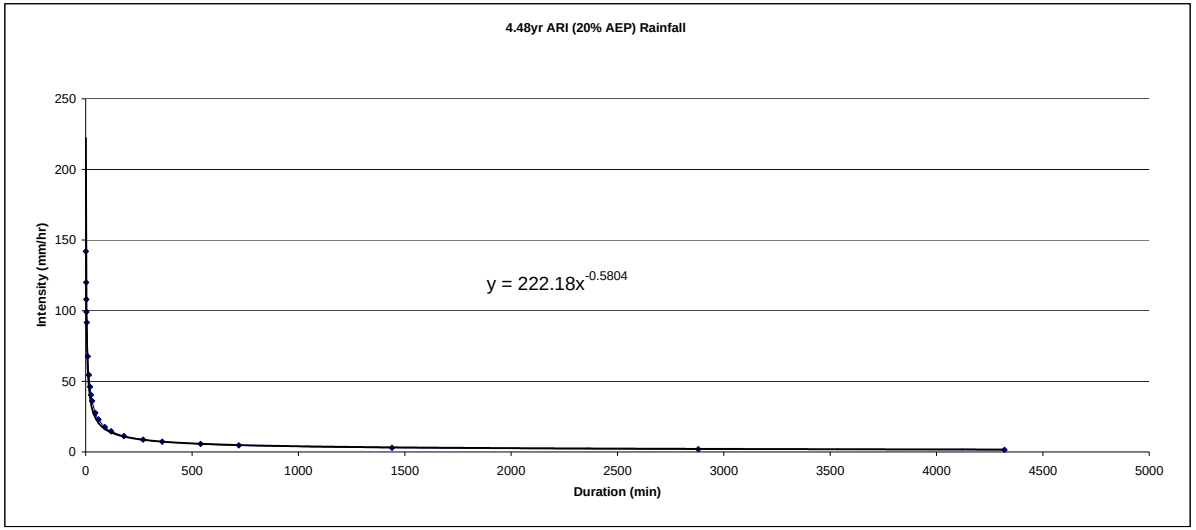
CATCHMENT	AREAS (m2)						EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		Flow (L/s)			Storage			
	Road Reserves	Res Lots	Comm Lots	Basin	OS	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (min)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (min)	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev	Total Flow (m3)	Storage Req (m3) (allowing max 16 L/s/ha discharge)	Total Storage (m3)	Volume Check	Water Depth (m)
Residential Lot (480m2)	0	480	0	0	0	480	110	254	40	12.2	12	5.00	4.2	40	12.2	12	5.00	3.8	96.8	101.6	2.97	7.18	1.66	0.57	3.00	ok	
Commercial Lot (1,000m2)	0	0	952	48	0	1000	230	724	55	12.2	12	3.64	5.7	55	12.2	12	3.64	5.1	81.0	86.5	5.17	17.40	5.30	2.62	3.32	ok	0.1
Commercial Lot (1ha)	0	0	9628	372	0	10000	2300	7208	138	13	12	3.00	11.8	138	13	12	3.00	10.5	53.0	56.7	33.89	113.49	71.65	52.87	65.46	ok	0.2

Runoff Coefficients	Pre-Dev	Post-Dev
Roads	0.23	0.6
Res Lots	0.23	0.53
Comm Lots	0.23	0.71
Swales/Basins	0.23	1
OS	0.23	0.23

City of Swan Handbook of Drainage Design, 2002

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	142
2 min	2	120
3 min	3	108
4 min	4	99.2
5 min	5	91.7
10 min	10	67.7
15 min	15	54.5
20 min	20	46.1
25 min	25	40.3
30 min	30	36
45 min	45	27.7
1 hr	60	23
1.5 hr	90	17.6
2 hr	120	14.6
3 hr	180	11.2
4.5 hr	270	8.69
6 hr	360	7.25
9 hr	540	5.63
12 hr	720	4.69
24 hr	1440	3
48 hr	2880	1.88
72 hr	4320	1.42



100 YEAR ARI FLOWS - LOTS

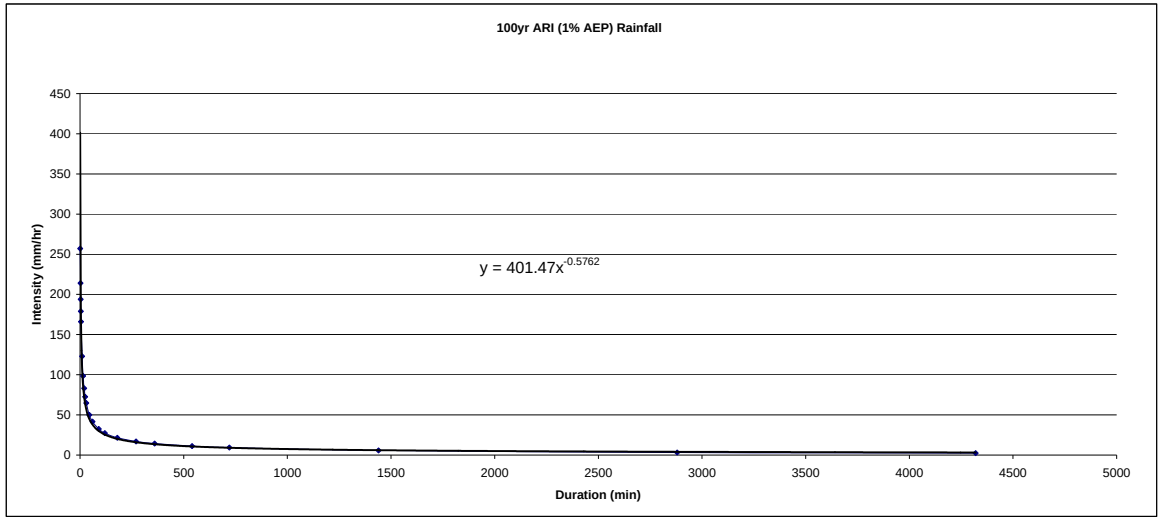
CATCHMENT	AREAS (m2)						EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		Flow (L/s)			Storage			
	Road Reserves	Res Lots	Comm Lots	Basin	OS	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (min)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (min)	Pre-Dev	Post-Dev	Pre-Dev	Post-Dev	Total Flow (m3)	Storage Req (m3) (allowing max 16 L/s/ha discharge)	Total Storage (m3)	Volume Check	Water Depth (m)
Residential Lot (480m2)	0	480	0	0	0	480	139	322	40	12.2	12	3.00	4.5	40	12.2	12	3.00	4.2	168.2	176.5	6.50	15.77	3.94	1.36	3.00	ok	
Commercial Lot (1,000m2)	0	0	952	48	0	1000	290	905	55	12.2	12	4.00	5.5	55	12.2	12	4.00	4.9	151.0	161.2	12.16	40.52	11.84	5.80	9.97	ok	0.3
Commercial Lot (1ha)	0	0	9628	372	0	10000	2900	9037	138	13	12	3.00	11.5	138	13	12	3.00	10.3	98.2	104.8	79.07	263.09	162.38	143.23	144.00	ok	0.44

Runoff Coefficients	**Pre-Dev**	**Post-Dev**
Roads	0.29	0.9
Res Lots	0.29	0.67
Comm Lots	0.29	0.9
Swales/Basins	0.29	1
OS	0.29	0.29

City of Swan Handbook of Drainage Design, 2002

Rainfall IFD

Event	**Duration (mins)**	**Intensity (mm/hr)**
1 min	1	257
2 min	2	214
3 min	3	194
4 min	4	179
5 min	5	166
10 min	10	123
15 min	15	98.5
20 min	20	83.1
25 min	25	72.5
30 min	30	64.7
45 min	45	50
1 hr	60	41.7
1.5 hr	90	32.4
2 hr	120	27.3
3 hr	180	21.5
4.5 hr	270	17
6 hr	360	14.3
9 hr	540	11.2
12 hr	720	9.33
24 hr	1440	5.72
48 hr	2880	3.27
72 hr	4320	2.33



1 YEAR ARI 1 HOUR FLOWS - ROADS

Rainfall Intensity i (mm/h)	15	15mm storm
Runoff Coefficient Road Reserves	0.5	City of Swan Handbook of Drainage Design, 2002
Runoff Coefficient Swale	1	
Runoff Coefficient Res Lots	0	
Runoff Coefficient Comm Lots	0	
Runoff Coefficient OS	0.19	
Permeability k (m/hr)	**0.0000**	
Swale Depth (m)	0.60	
Weir Height (m)	0.30	
Driveway Width (m)	5.0	
Swale Side Slope (1/x)	3.00	
Trapezoidal Swale Base Width (m)	2.00	
Swale top width (m)	5.60	

	W drain base width	W drain side slopes
	1	0

Segment	Road Reserve (m2)	Swales (m2)	Res Lots (m2)	Comm Lots (m2)	POS (m2)	Total (m2)	Ai	Segment Peak Flow (L/s)	Segment Total Flow (m3)
A (4.6m swales)	13934	3648	2303	103456	2484	125825	11087	46	166.3
B (was C)	5929	974	6164	13270		26337	3939	16	59.1
C (Was D)	6332	1172	6406	13131		27041	4338	18	65.1
D (was E)	6036	928	8263	13353		28580	3946	16	59.2
Bushmead Rd	37350	0	0	0		37350	18675	77.87	280.35

Trapezoidal Swales

Swale Segment	No. Driveways	No. Weirs	Length	Weir Spacing (m)	Long Slope	Max U/S Reach (m)	Upstream Ht (m)	1 hr Inflow per Weir (m3)	Storage per Weir (m3)	Total Storage (m3)	Effective Total Storage (m3)	Volume Check
A	0	16	621	39	0.00824	36.4	0.0	10.39	10.56	168.93	168.93	ok
B	0	2	150	75	0.00331	75.0	0.1	29.54	32.33	64.65	64.65	ok
C	0	4	120	30	0.00485	30.0	0.2	16.27	18.26	73.04	73.04	ok
D	0	2	122	61	0.00247	61.0	0.1	29.60	36.59	73.18	73.18	ok
Western Drain (inc overflow basin)	0	1	306	306	0.00674	192.9	0.0	280.35	83.58	1000.54	1000.54	ok

1 YEAR ARI CRITICAL FLOWS - ROADS

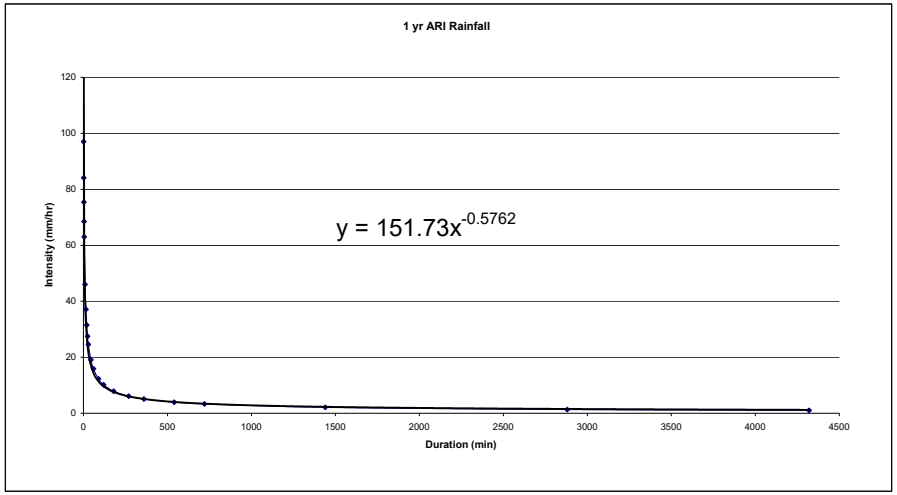
CATCHMENT	AREAS (m2)						EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE			FLOW DEPTH	
	Road Reserve (m2)	Swale	Res Lots (m2)	Comm Lots (m2)	POS (m2)	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mIn)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mIn)	Pre-Dev	Post-Dev	Pre Dev (W Drain pre <= pipe capacity of 143 L/s)	Post Dev (inc Lots @ 16l/s/ha)	Total Flow (m3)	Storage Req (m3)	Total Storage (m3)	Volume Check	Manning's *n*	Height Over Weir (m)
A	13934	3648	2303	103456	2484	125825	23907	73161	624	13	6.5	10.42	32.9	624	13	8	8.01	31.0	20.3	21.0	134.61	230.13	428.10	73.76	168.93	ok	0.07	0.16
B (was C)	5929	974	6164	13270	0	26337	5004	11901	209	13.2	12	5.74	14.5	280	13.2	12	4.29	18.9	32.5	27.9	45.15	51.75	58.70	0.95	64.65	ok	0.07	0
C (Was D)	6332	1172	6406	13131	0	27041	5138	12217	321	12.2	12	0.62	34.7	308	12.2	12	0.65	30.3	19.7	21.3	28.07	46.64	84.67	13.43	73.04	ok	0.07	0.07
D (was E)	6036	928	8263	13353	0	28580	5430	11958	207	13	12	4.83	14.8	294	14	13	3.40	20.8	32.2	26.4	48.52	50.32	62.74	0.08	73.18	ok	0.07	0.09
Western Drain (c overflow basin)	37350	0	0	0	0	37350	18675	18675	945	16.2	10.15	6.40	56.3	945	16.2	10.15	6.40	56.3	14.9	14.9	77.16	77.16	260.63	0.00	1000.54	ok	0.07	0

Runoff Coefficients	**Pre-Dev**	**Post-Dev**
Roads	0.19	0.5
Swales/Basins	0.19	1
Res Lots	0.19	0
Comm Lots	0.19	0.6
OS	0.19	0.19

City of Swan Handbook of Drainage Design, 2002

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	97
2 min	2	84.1
3 min	3	75.4
4 min	4	68.5
5 min	5	63
10 min	10	46
15 min	15	37.1
20 min	20	31.5
25 min	25	27.5
30 min	30	24.6
45 min	45	19.1
1 hr	60	15.9
1.5 hr	90	12.3
2 hr	120	10.2
3 hr	180	7.9
4.5 hr	270	6.11
6 hr	360	5.1
9 hr	540	3.95
12 hr	720	3.29
24 hr	1440	2.11
48 hr	2880	1.33
72 hr	4320	1.01



4.48 YEAR ARI CRITICAL FLOWS - ROADS

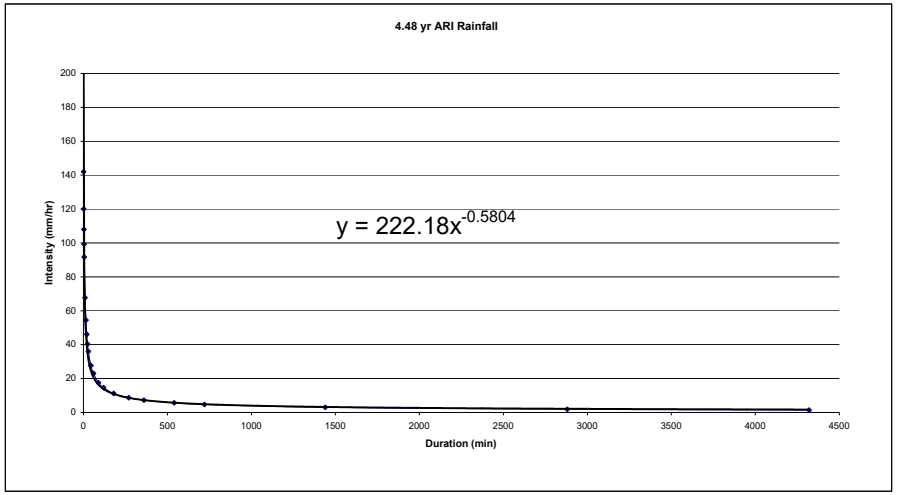
CATCHMENT	AREAS (m2)						EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE			FLOW DEPTH	
	Road Reserve (m2)	Swale	Res Lots (m2)	Comm Lots (m2)	POS (m2)	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mIn)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mIn)	Pre-Dev	Post-Dev	Pre Dev (W Drain pre <= pipe capacity of 143 L/s)	Post Dev (inc Lots @ 16l/s/ha)	Total Flow (m3)	Storage Req (m3)	Total Storage (m3)	Volume Check	Manning's *n*	Height Over Weir (m)
A	13934	3648	2303	103456	2484	125825	28940	87254	624	13	6.5	10.42	32.3	624	13	8	8.01	30.5	29.6	30.6	237.75	276.09	504.64	9.73	168.93	ok	0.07	0.18
B (was C)	5929	974	6164	13270	0	26337	6058	17220	209	13.2	12	5.74	14.2	280	13.2	12	4.29	18.2	47.6	41.2	80.02	82.97	90.71	0.12	64.65	ok	0.07	0.11
C (Was D)	6332	1172	6406	13131	0	27041	6219	17689	321	12.2	12	0.62	34.0	308	12.2	12	0.65	29.2	28.7	31.4	49.57	74.58	130.47	14.68	73.04	ok	0.07	0.1
D (was E)	6036	928	8263	13353	0	28580	6573	18410	207	13	12	4.83	14.5	294	14	13	3.40	19.9	47.1	39.2	85.99	84.07	100.40	0.00	73.18	ok	0.07	0.13
Western Drain (c overflow basin)	37350	0	0	0	0	37350	22410	22410	945	16.2	10.15	6.40	55.3	945	16.2	10.15	6.40	55.3	21.6	21.6	134.73	134.73	446.86	0.00	1000.54	ok	0.07	0

Runoff Coefficients	**Pre-Dev**	**Post-Dev**
Roads	0.23	0.6
Swales/Basins	0.23	1
Res Lots	0.23	0.53
Comm Lots	0.23	0.71
OS	0.23	0.23

City of Swan Handbook of Drainage Design, 2002

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	142
2 min	2	120
3 min	3	108
4 min	4	99.2
5 min	5	91.7
10 min	10	67.7
15 min	15	54.5
20 min	20	46.1
25 min	25	40.3
30 min	30	36
45 min	45	27.7
1 hr	60	23
1.5 hr	90	17.6
2 hr	120	14.6
3 hr	180	11.2
4.5 hr	270	8.69
6 hr	360	7.25
9 hr	540	5.63
12 hr	720	4.69
24 hr	1440	3
48 hr	2880	1.88
72 hr	4320	1.42



10 YEAR ARI CRITICAL FLOWS - ROADS

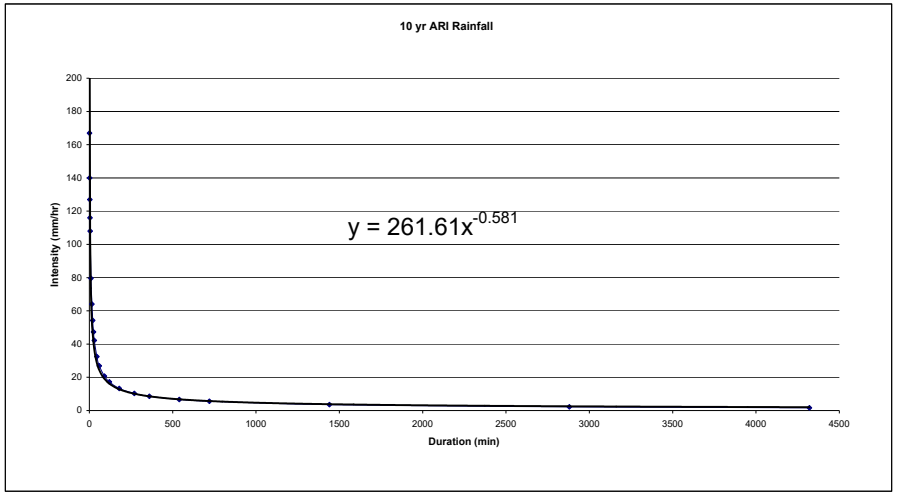
CATCHMENT	AREAS (m2)						EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE			FLOW DEPTH	
	Road Reserve (m2)	Swale	Res Lots (m2)	Comm Lots (m2)	POS (m2)	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mIn)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mIn)	Pre-Dev	Post-Dev	Pre Dev (W Drain pre <= pipe capacity of 143 L/s)	Post Dev (inc Lots @ 16l/s/ha)	Total Flow (m3)	Storage Req (m3)	Total Storage (m3)	Volume Check	Manning's *n*	Height Over Weir (m)
A	13934	3648	2303	103456	2484	125825	30198	91904	624	13	6.5	10.42	32.1	624	13	8	8.01	30.3	34.8	36.0	292.23	299.62	544.80	0.33	168.93	ok	0.07	0.18
B (was C)	5929	974	6164	13270	0	26337	6321	18114	209	13.2	12	5.74	14.2	280	13.2	12	4.29	18.1	56.0	48.6	98.40	94.65	102.96	0.00	64.65	ok	0.07	0.12
C (Was D)	6332	1172	6406	13131	0	27041	6490	18597	321	12.2	12	0.62	33.9	308	12.2	12	0.65	29.0	33.8	37.0	60.92	84.27	146.68	11.26	73.04	ok	0.07	0.1
D (was E)	6036	928	8263	13353	0	28580	6859	19373	207	13	12	4.83	14.4	294	14	13	3.40	19.8	55.5	46.2	105.75	95.24	113.16	0.00	73.18	ok	0.07	0.13
Western Drain (c overflow basin)	37350	0	0	0	0	37350	23531	23531	945	16.2	10.15	6.40	55.0	945	16.2	10.15	6.40	55.0	25.5	25.5	143.00	166.64	550.02	11.07	1000.54	ok	0.07	0

Runoff Coefficients	**Pre-Dev**	**Post-Dev**
Roads	0.24	0.63
Swales/Basins	0.24	1
Res Lots	0.24	0.56
Comm Lots	0.24	0.75
OS	0.24	0.24

City of Swan Handbook of Drainage Design, 2002

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	167
2 min	2	140
3 min	3	127
4 min	4	116
5 min	5	108
10 min	10	79.6
15 min	15	64.1
20 min	20	54.2
25 min	25	47.3
30 min	30	42.2
45 min	45	32.5
1 hr	60	26.9
1.5 hr	90	20.7
2 hr	120	17.2
3 hr	180	13.3
4.5 hr	270	10.3
6 hr	360	8.6
9 hr	540	6.68
12 hr	720	5.57
24 hr	1440	3.53
48 hr	2880	2.17
72 hr	4320	1.62



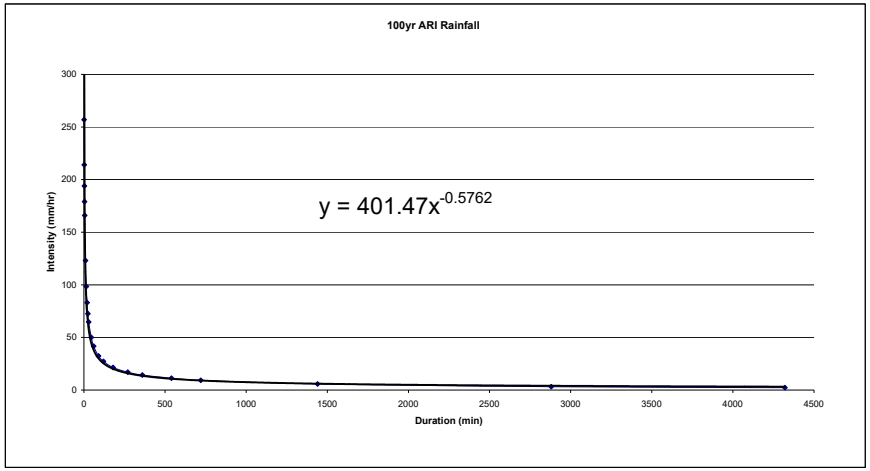
100 YEAR ARI CRITICAL FLOWS - ROADS

CATCHMENT	AREAS (m2)						EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE			FLOW DEPTH	
	Road Reserve (m2)	Swale (m2)	Res Lots (m2)	Comm Lots (m2)	POS (m2)	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mIn)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mIn)	Pre-Dev	Post-Dev	Pre Dev (W Drain pre <= pipe capacity of 143 L/s)	Post Dev (inc Lots @ 16l/s/ha)	Total Flow (m3)	Storage Req (m3)	Total Storage (m3)	Volume Check	Manning's *n*	Height Over Weir (m)
A	13934	3648	2303	103456	2484	125825	36489	111562	624	13	6.5	10.42	31.5	624	13	8	8.01	29.7	55.0	56.9	557.03	436.31	778.12	0.00	168.93	ok	0.07	0.23
B (was C)	5929	974	6164	13270	0	26337	7638	22383	209	13.2	12	5.74	13.9	280	13.2	12	4.29	17.7	88.1	76.5	186.83	165.25	175.99	0.00	64.65	ok	0.07	0.17
C (Was D)	6332	1172	6406	13131	0	27041	7842	22981	321	12.2	12	0.62	33.2	308	12.2	12	0.65	28.4	53.3	58.4	116.15	142.67	243.13	8.40	73.04	ok	0.07	0.14
D (was E)	6036	928	8263	13353	0	28580	8288	23914	207	13	12	4.83	14.1	294	14	13	3.40	19.4	87.2	72.7	200.79	163.09	189.74	0.00	73.18	ok	0.07	0.18
Western Drain (c overflow basin)	37350	0	0	0	0	37350	33615	33615	945	16.2	10.15	6.40	53.1	945	16.2	10.15	6.40	53.1	40.7	40.7	143.00	380.17	1210.78	471.22	1000.54	ok	0.07	0

Runoff Coefficients	**Pre-Dev**	**Post-Dev**	City of Swan Handbook of Drainage Design, 2002
Roads	0.29	0.9	
Swales/Basins	0.29	1	
Res Lots	0.29	0.67	
Comm Lots	0.29	0.9	
OS	0.29	0.29	

Rainfall IFD

Event	Duration (mins)	Intensity (mm/hr)
1 min	1	257
2 min	2	214
3 min	3	194
4 min	4	179
5 min	5	166
10 min	10	123
15 min	15	98.5
20 min	20	83.1
25 min	25	72.5
30 min	30	64.7
45 min	45	50
1 hr	60	41.7
1.5 hr	90	32.4
2 hr	120	27.3
3 hr	180	21.5
4.5 hr	270	17
6 hr	360	14.3
9 hr	540	11.2
12 hr	720	9.33
24 hr	1440	5.72
48 hr	2880	3.27
72 hr	4320	2.33



COMBINED 100 YEAR ARI CRITICAL FLOWS

CATCHMENT	Contributing Segments	AREAS (m2)						EFFECTIVE AREAS (m2)		TIME OF CONCENTRATION PRE DEVELOPMENT					TIME OF CONCENTRATION POST-DEVELOPMENT					CRITICAL STORM INTENSITY (mm/h)		FLOW			STORAGE			FLOW DEPTH	
		Road Reserve	Swale (m2)	Res Lots (m2)	Comm Lots (m2)	POS (m2)	Total	Pre	Post	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope (m/km)	TC (mIn)	Longest Path (m)	RL Top (mAHD)	RL Bottom (mAHD)	Slope	TC (mIn)	Pre-Dev	Post-Dev	Pre Dev (W Drain pre <= pipe capacity of 143 L/s)	Post Dev (inc Lots @ 16l/s/ha)	Total Flow (m3)	Storage Req (m3)	Total Storage (m3)	Volume Check	Mannings *n*	Height Over Weir (m)
A	A	13934	3648	2303	103456	2484	125825	36489	111562	224	9.7	8.00	7.6	12	224	9.7	8.00	7.6	10.8	95.6	101.98	969.17	648.20	419.51	0.00	168.93	ok	0.07	0.28
B	B	5929	974	6164	13270	0	26337	7638	22383	175	11	9.50	8.6	11	175	11	9.50	8.6	9.7	102.2	108.69	216.74	221.60	128.41	0.06	64.65	ok	0.07	0.2
C	C	6332	1172	6406	13131	0	27041	7842	22981	195	13.2	12.00	6.2	13	195	13.2	12.00	6.2	11.5	92.5	98.44	201.55	219.14	150.79	0.97	73.04	ok	0.07	0.18
D	D	6036	928	8263	13353	0	28580	8288	23914	110	12.3	11.80	4.5	8	110	12.3	11.80	4.5	6.8	124.7	132.52	287.02	268.71	110.38	0.00	73.18	ok	0.07	0.24
Western Drain (inc overflow basin)	Bushmead Rd, B, C	49611	2146	12570	26401	0	90728	49095	78979	945	16.2	10.15	6.4	51	945	16.2	10.15	6.4	48.7	41.6	42.77	143.00	618.29	1807.95	1068.36	1073.58	ok	0.07	0

Runoff Coefficients	**Pre-Dev**	**Post-Dev**	City of Swan Handbook of Drainage Design, 2002
Roads	0.29	0.9	
Swales/Basins	0.29	1	
Res Lots	0.29	0.67	
Comm Lots	0.29	0.9	
OS	0.29	0.29	

Overflow Basin Sizing

Storm Event	Depth	Available Depth	Effective Depth	Side Slopes (1:x)	No. Basins	Base Width	Base Length	Top Width (m)	Top Length (m)	Top Area (m2)	Volume	Effective Volume	Water Depth (m)	Inundated Area (m2)	100yr Volume Check
100	1.5	1.5	1.5	3	2	1.5	55	10.5	64	1344	990	917	1.5	1344	ok

Appendix 2 – Traffic Impact Assessment



June 2025

Final

Proposed Local Structure Plan for Lots 39 and 651 Stirling Crescent; Lots 58 and 83 Bushmead Road; and Lot 93 Hazelmere Circus

Prepared For:

Callo Family

Transport Impact Assessment Report



T: +61 8 9274 7076

E: Admin@dvcworld.com

6 Burgess St Midland WA 6056
PO Box 5060 Midland WA 6056
www.dvcworld.com

DOCUMENT ISSUE AUTHORISATION

Issue	Rev	Date	Description	Prepared By	Checked By	Approved By
0	0	9/05/2025	Draft Report	SGY/KL	DNV	DNV
1	0	10/06/2025	Final Report	KL	SGY	DNV

The information contained in this document is solely for the use of the client identified for the purpose for which it has been prepared. It is not to be used by any third party and no responsibility is undertaken to any third party. All photographs remain the copyright of Donald Veal Consultants and are included for illustration only.

Donald Veal Consultants Pty Ltd

TABLE OF CONTENTS

PAGE

1. INTRODUCTION 3
1.1 BACKGROUND 3
1.2 SCOPE OF THIS REPORT 3
2. EXISTING SITE CONDITIONS 4
2.1 LOCATION 4
2.2 CURRENT LAND USES 5
2.3 ADJACENT ROAD NETWORK 8
2.4 EXISTING TRAFFIC VOLUMES 9
2.5 CRASH HISTORY 10
2.6 RAV NETWORK 11
2.7 PLANNED CHANGES TO THE ROAD NETWORK 11
3. PROPOSED STRUCTURE PLAN 15
3.1 STRUCTURE PLAN AREA 15
3.2 PROPOSED REALIGNMENT OF STIRLING CRESCENT (ERIC LUMSDEN DRIVE) 15
3.3 TRIP GENERATION 15
3.4 PROPOSED SITE ACCESS 17
3.5 TRIP DISTRIBUTION 17
3.6 TRIP ASSIGNMENT 17
3.7 IMPACT ON THE EXTERNAL ROAD NETWORK 17
3.8 IMPACT ON THE STRUCTURE PLAN ROAD NETWORK 19
3.9 RAV NETWORK 22
4. SUSTAINABLE TRANSPORT 24
4.1 PEDESTRIANS AND CYCLISTS 24
4.2 PUBLIC TRANSPORT 24
5. SUMMARY AND RECOMMENDATION 26
5.1 SUMMARY 26
5.2 RECOMMENDATION 27
APPENDIX A: SIDRA OUTPUTS 28

1. INTRODUCTION

1.1 BACKGROUND

The Callo family has commissioned Donald Veal Consultants to prepare this Transport Impact Assessment report to support a Local Structure Plan application for the area including Lots 39 and 651 Stirling Crescent; Lots 58 and 83 Bushmead Road; and Lot 93 Hazelmere Circus, within the industrial area of Hazelmere.

1.2 SCOPE OF THIS REPORT

The structure and scope of this Transport Assessment are in accordance with Volume 2 (Planning Schemes, Structure Plans and Activity Centre plans) of the Western Australian Planning Commission's (WAPC) Transport Impact Assessment Guidelines (2016).

2. EXISTING SITE CONDITIONS

2.1 LOCATION

The proposed development structure plan area is located south of the Swan River in Hazelmere, City of Swan and some 3km south of Midland town centre. The relative location of the site to the greater surrounding area is shown in **Figure 2.1** and the local area is shown in **Figure 2.2**.



Figure 2.1: General Locality Plan *Source: MertroMap*



Figure 2.2: Site Location *Source: MetroMap*

2.2 CURRENT LAND USES

The area to the west of the site consists of existing residential development, while the Hazelmere Industrial Area lies to the east. The land currently contains a few residential dwellings, but the majority of the area is vacant. See **Figure 2.3 & Photos 1 - 4**.



Figure 2.3: Existing Land Uses *Source: MetroMap*



Photo 1: Vacant Lot – View from the intersection of Amherst Rd/Stirling Cres



Photo 2: Vacant Lot – View from the intersection of Eric St/Stirling Cres



Photo 3: Existing development (Elite Bee Keeping Supplies) – North of Bushmead Rd



Photo 4: Existing residential house – South of Bushmead Rd

The majority of the subject site is presently zoned 'Urban' in the Metropolitan Region Scheme (MRS) as shown in **Figure 2.4**.

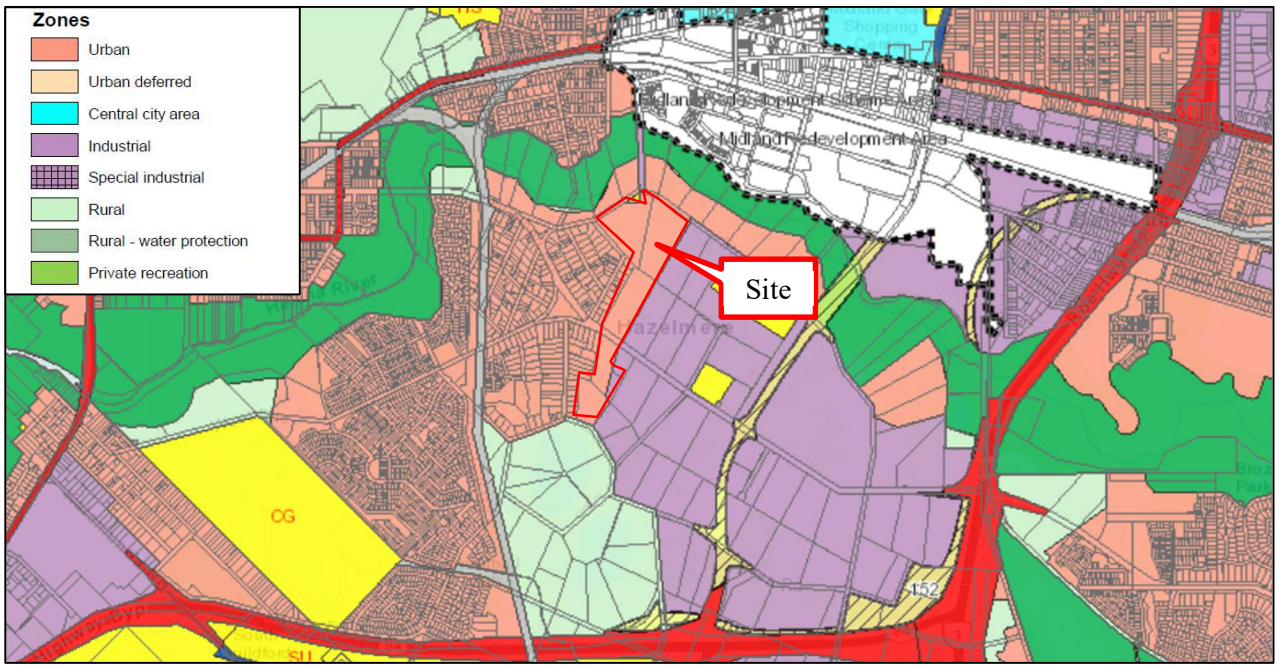


Figure 2.4: Metropolitan Region Scheme ***Source: DPLH***

2.3 ADJACENT ROAD NETWORK

The road network adjacent to the site consists of Stirling Crescent to the north, Hazelmere Circus to the south, Eric Road to the west and Bushmead Road bisecting the site east/west. Other prominent roads in the vicinity adjacent to the site include Lloyd Street, Amherst Road, and Lake Road.

Stirling Crescent intersects a number of roads in Hazelmere including Kalamunda Road, Great Eastern Highway Bypass, Lakes Road, Bushmead Road, Amherst Road, and Lloyd Street.

Stirling Crescent is a single carriageway undivided road, approximately 10m wide between the Great Eastern Highway Bypass and Lloyd Street and 7m wide between Amherst Road dwelling access and Bushmead Road (the western end). The middle section of Stirling Crescent is either narrow residential access or unconstructed.

Stirling Crescent is categorised as a Local Distributor Road between Bushmead Road and Amherst Road (west of Amherst Road), as an Access Road between Amherst Road and Bushmead Road (northern section), and as a Distributor A Road between Great Eastern Highway Bypass and Bushmead Road, as shown in **Figure 2.5**.

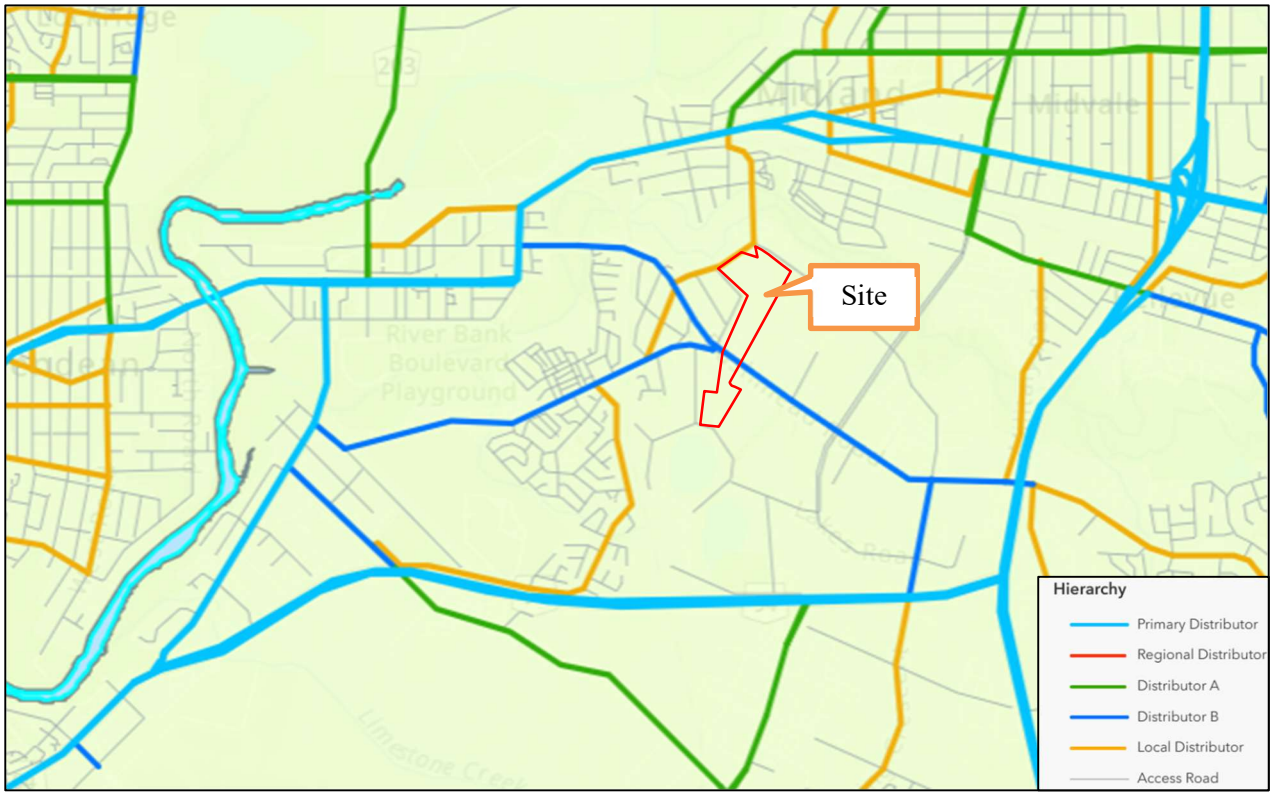


Figure 2.5: Road Hierarchy Map *Source: Crash Map MRWA*

The posted speed limit on Stirling Crescent varies from 60 km/h south of Bushmead Road and 50 km/h on the remaining sections of the road as shown in **Figure 2.6**.

Bushmead Road is a Distributor B Road with a posted limited speed varying from 60 km/h in the industrial zones to 50 km/h in the residential zone. Great Eastern Highway Bypass is a State Road classed as a Primary

Distributor Road with varying posted speed limits from 100 km/h to 70 km/h. Hazelmere Circus and Eric Street are Local Access Roads with speed limits of 50 km/h.

Lloyd Street is categorised as a Distributor A Road in the MRWA Metropolitan Road Hierarchy with a current posted speed limit of 60 km/h. Amherst Road is classified as a Local Distributor Road with a posted speed limit of 50km/h.

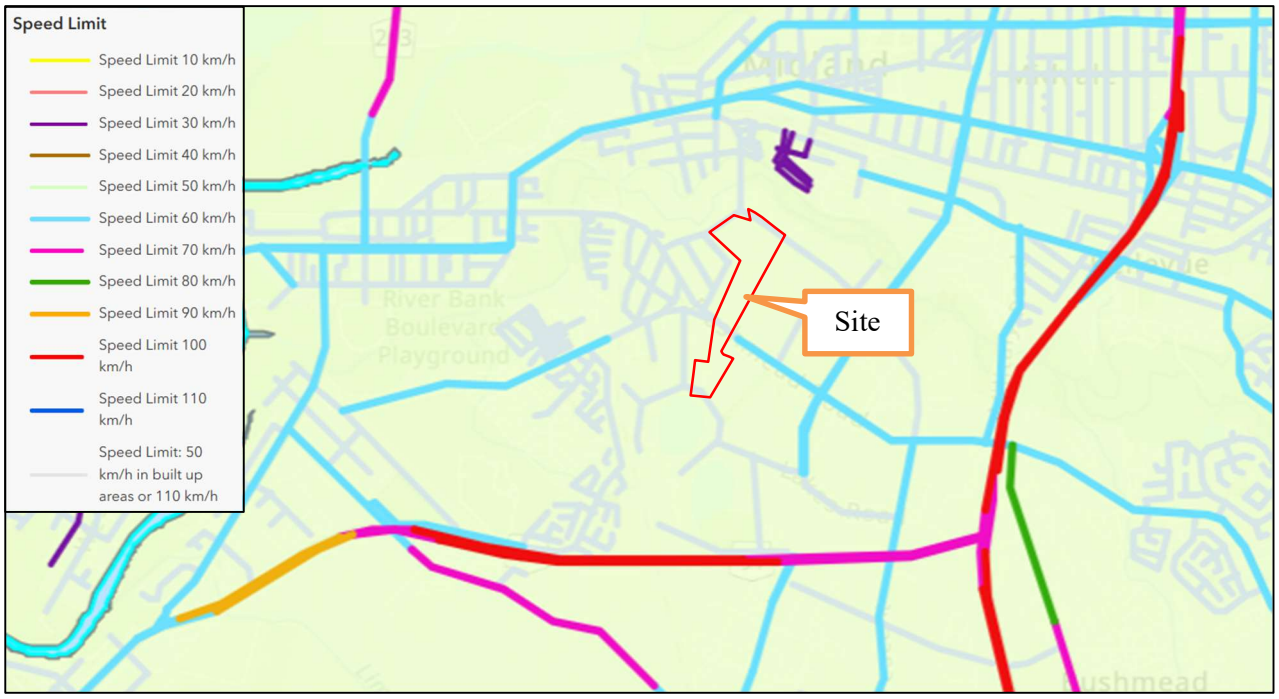


Figure 2.6: Speed Limit Map *Source: MRWA*

2.4 EXISTING TRAFFIC VOLUMES

The latest available traffic counts (2021/22) on West Parade and Bushmead Road were sourced from the MRWA Traffic Map as shown in **Figure 2.7**. These show daily traffic 6,604 vehicles per day (vpd) on Bushmead Road and 4,661 vpd on West Parade.

City of Swan has also provided traffic counts on Amherst Road, Eric Street, Bushmead Rd and Hazelmere Circuit as shown in **Table 2.1**.

Table 2.1: Traffic Counts *Source: Traffic Map & City of Swan*

Road	Location	Date	Daily (vpd)	Heavy Vehicle (%)	AM peak (vph)	PM peak (vph)
Bushmead Rd	West of Janet St	2021/22	6,604	11.2	519	630
West Pde	West of Robertson St	2021/22	4,661	4.8	409	469
Amherst Rd	South of Montreal Rd	2021	8,310	4.8	778	802
Eric St	East of Stirling Cres	2021	987	4.6	84	106
Bushmead Rd	East of Wingate Ave/West Pde	2021	7,308	10	557	724
Hazelmere Cir	East of Mary St	2021	272	14.3	20	25

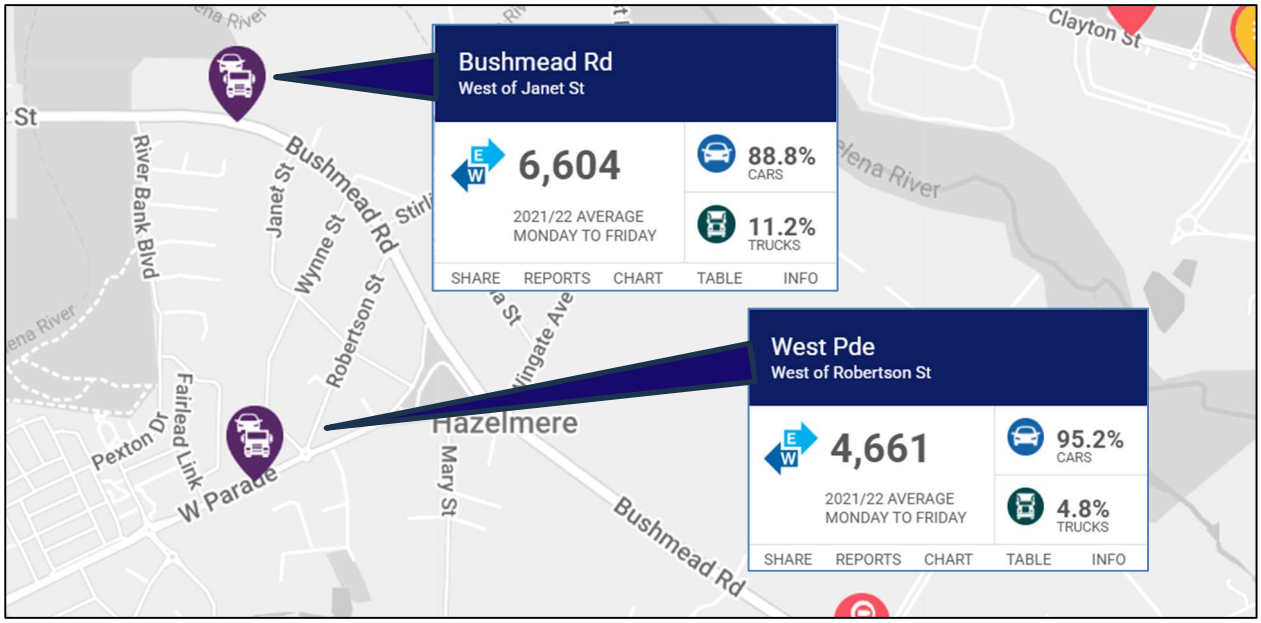


Figure 2.7: Traffic Map Available Traffic Counts

2.5 CRASH HISTORY

Crash data for the roads within and around the LSP area was sourced from the MRWA Crash Map database for the latest five-year reporting period (January 2020 to December 2024). The results showed 11 crashes, primarily at various intersections and is shown graphically in **Figure 2.8**.

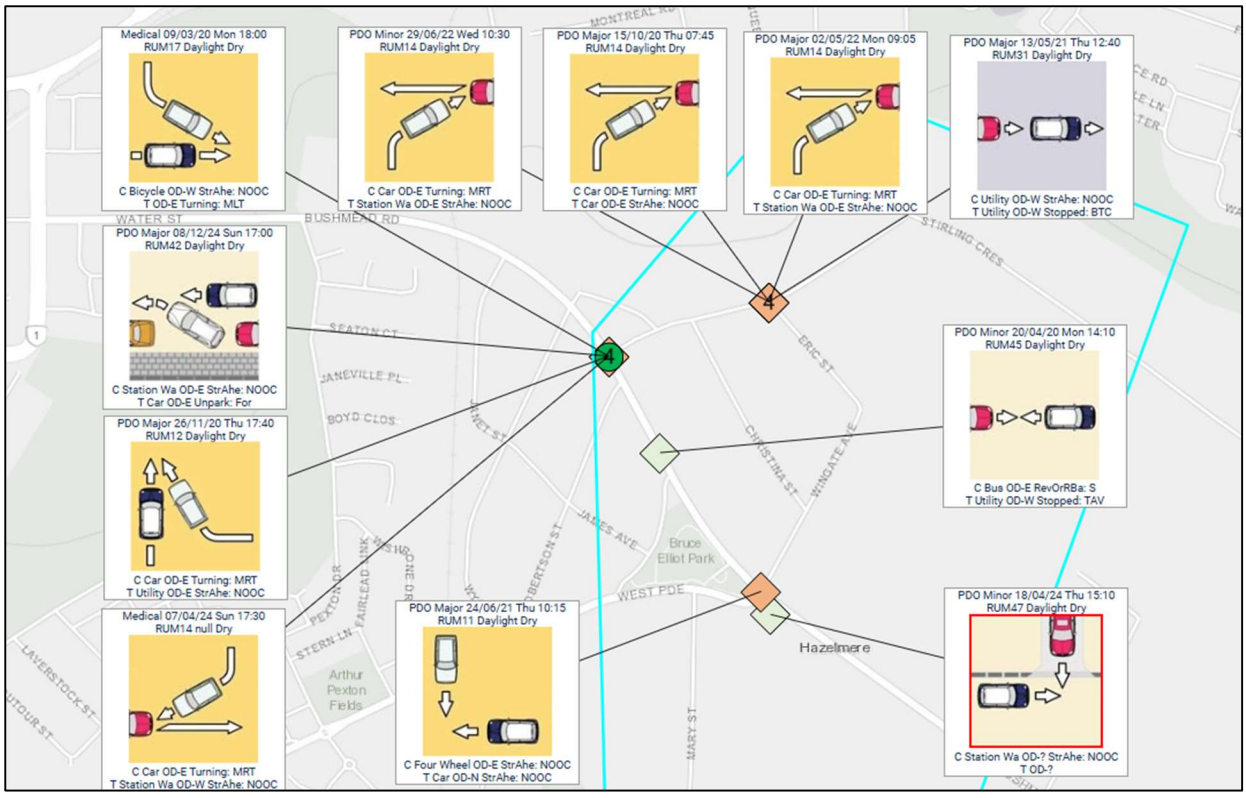


Figure 2.8: Crash History *Source: Crash Map MRWA*

Four of the crashes occurred at the intersection of Stirling Crescent and Bushmead Road (west of the site). One of these involved a parking incident.

A further four occurred at the Eric Street / Stirling Crescent intersection. Three of these involved a vehicle turning right out of Eric Street hitting a through vehicle approaching from the right.

2.6 RAV NETWORK

The MRWA Heavy Vehicle Network Map (see **Figure 2.9**) shows the extent of the RAV network in Hazelmere. Bushmead Road (east of Central Avenue), Stirling Crescent (east of Lloyd Street) and Central Avenue are classified as RAV 7.

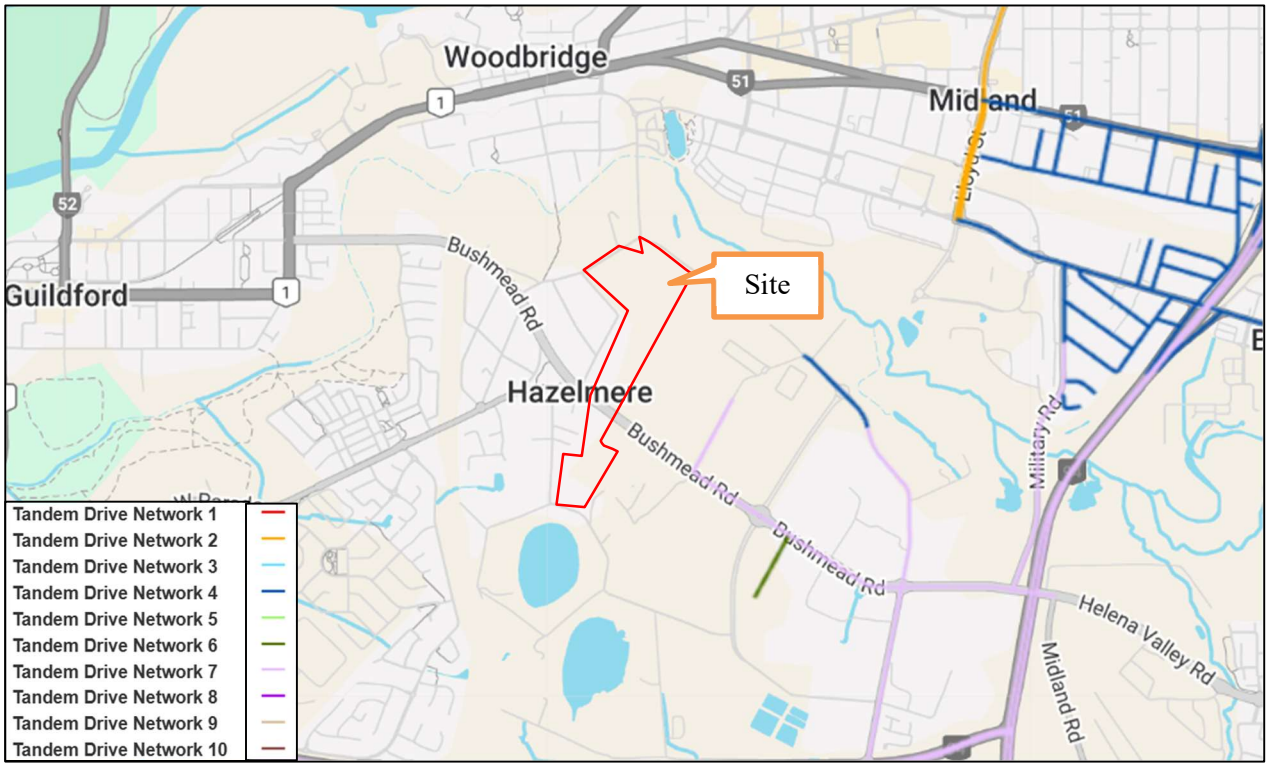


Figure 2.9: RAV Network **Source: MRWA**

A short section of Stirling Crescent either side of the Lloyd Street intersection) is classified as part of the RAV 4 network. Tipper Court is classified as part of the RAV6 network.

Heavy vehicles on Central Avenue are prohibited from turning west towards the non-RAV section of Bushmead Road, which is the residential area.

2.7 PLANNED CHANGES TO THE ROAD NETWORK

The City of Swan has previously supplied a concept diagram of a new road linking Bushmead Road and Stirling Crescent as shown in **Figure 2.10**.



Figure 2.10: Previous Concept Road Network (Source: City of Swan)

Discussions have subsequently been held with the City of Swan at which a modified alignment was agreed in principle. The revised alignment provides a continuous link with the western extension of Stirling Crescent, rather than linking directly into the southern extension of Amherst Road.

The revised alignment, proposed as Eric Lumsden Drive, is shown in **Figure 2.11** and discussed further in **Section 3**: **Proposed Structure Plan**.

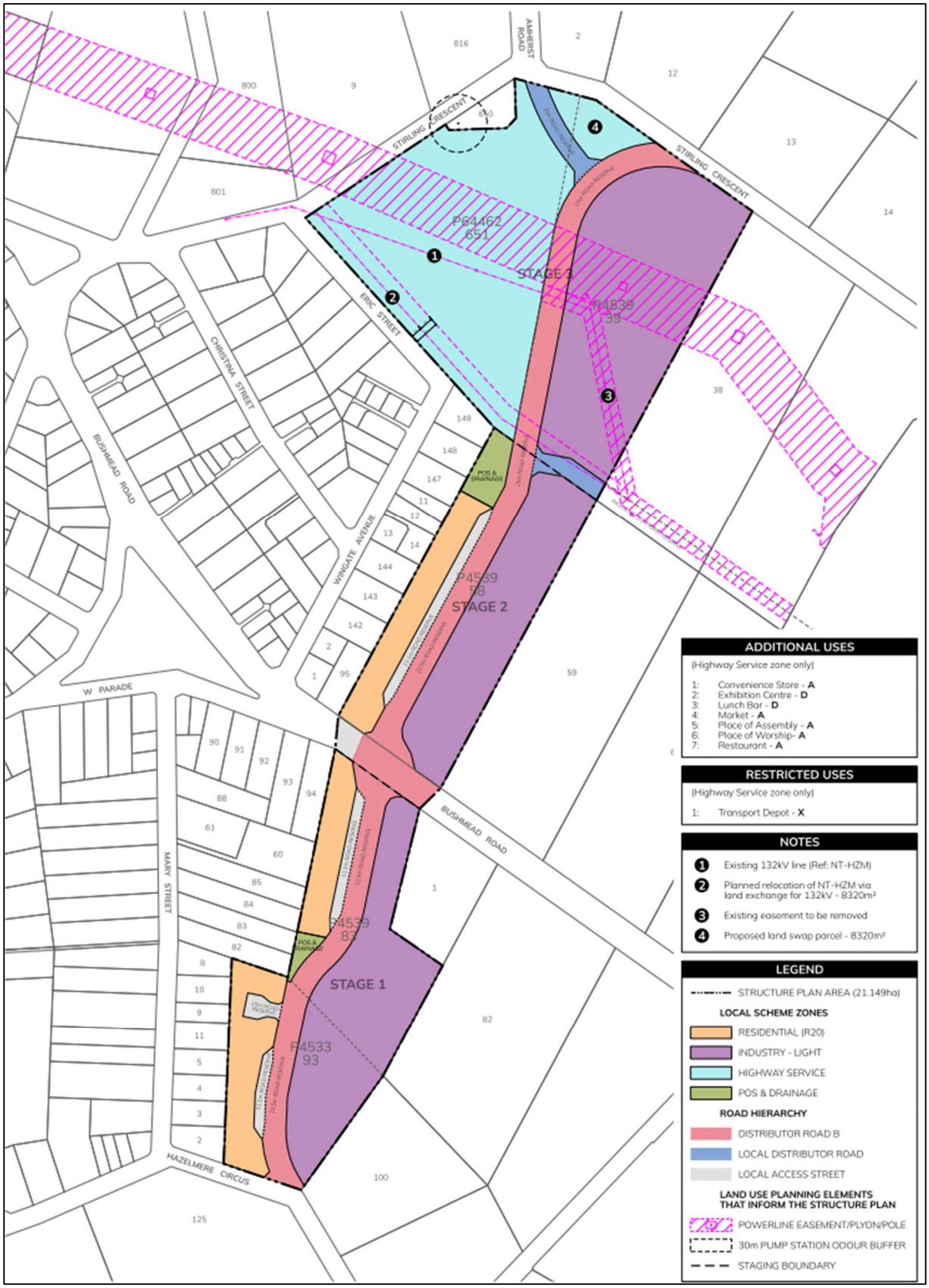


Figure 2.11: Revised alignment *Source: UPRS*

The City of Swan and MRWA's 'Great Eastern Highway Bypass Interchanges Project' is currently on hold, due to issues with the location of the bridge over the Helena River, which is required in order to complete the Lloyd Street extension.

Once completed, the upgrades will have a significant effect on the traffic patterns in this area, and especially the truck movements from the Hazelmere area.

An overall view of the project, showing the planned site of the bridge is shown in **Figure 2.12**.

We understand a feasibility study is being carried out to assess the possibility of relocating the bridge further to the west or if modifications can be made to retain the original alignment. Currently, the project remains on hold.



Figure 2.12: Proposed Helena River bridge has been put on hold ***Source: MRWA***

3. PROPOSED STRUCTURE PLAN

3.1 STRUCTURE PLAN AREA

The structure plan area comprises the following properties (see also **Figure 2.11**):

- Lots 39 and 651 Stirling Crescent;
- Lots 58 and 83 Bushmead Road; and
- Lot 93 Hazelmere Circus.

3.2 PROPOSED REALIGNMENT OF STIRLING CRESCENT (ERIC LUMSDEN DRIVE)

It is proposed that Eric Lumsden Drive is aligned as shown in **Figure 2.11**. Amherst Road would terminate at a T-junction with Eric Lumsden Drive which would continue south to intersect with Bushmead Road and Hazelmere Circus. This alignment provides a discontinuity of both Amherst Road and Hazelmere Circus which will discourage industrial area traffic from entering the nearby residential areas. It also provides a 'ring-road' around the western boundary of the Hazelmere industrial area to further contain industrial traffic.

A roundabout is proposed at the intersection of Bushmead Road and Eric Lumsden Drive. Further south, Hazelmere Circus will also be a T-junction with Eric Lumsden Drive/Lake Road.

Central Avenue is proposed to extend west to intersect with Eric Lumsden Drive.

3.3 TRIP GENERATION

For the purposes of the transport assessment, the Structure Plan area has been divided into 9 traffic zones as shown in **Figure 3.1**. It has been assumed that the Gross Floor Area (GFA) of the proposed commercial land uses (a mix of Light Industrial and Highway Service activity) will be around 25% of the land area. The remaining 75% of each zone is reserved for parking, driveway, landscaping etc. Zones 4, 6 and 8 are proposed as residential areas with the number of lots as shown in the table.

Trip generation rates for the proposed land uses were sourced from *Table 1: Typical Land Use Vehicle Trip Rates* of the *WAPC Transport Impact Assessment Guidelines Volume 2*.

A breakdown of the expected AM and PM Peak Hour trips generated by the proposed land uses is provided in **Table 3.1.** In total, some 430 vehicle trips per hour (vph) will be generated in the AM and PM peak hours and some 2,375 vpd daily.

Table 3.1: Trip Generation

Source	Land Use	Unit	AM Peak Hour trip rate			PM Peak Hour trip rate			Daily Trip Rate		
			In	Out	Total	In	Out	Total	In	Out	Total
WAPC	Residential	Dwellings	0.20	0.60	0.80	0.50	0.30	0.80	4	4	8
WAPC/RTA	Industrial	100m2 GFA	0.80	0.20	1.00	0.20	0.80	1.00	2.5	2.5	5

Zone	Land Use	Quantity	AM Peak Hour Trips			PM Peak Hour Trips			Daily Trips		
			In	Out	Total	In	Out	Total	In	Out	Total
1	Industrial	1,001	8	2	10	2	8	10	25	25	50
2	Industrial	12,533	100	25	125	25	100	125	313	313	627
3	Industrial	9,998	80	20	100	20	80	100	250	250	500
4	Residential	22	4	13	18	11	7	18	88	88	176
5	Industrial	5,526	44	11	55	11	44	55	138	138	276
6	Residential	14	3	8	11	7	4	11	56	56	112
7	Industrial	4,064	33	8	41	8	33	41	102	102	203
8	Residential	19	4	11	15	10	6	15	76	76	152
9	Industrial	2,561	20	5	26	5	20	26	64	64	128
		Total	296	104	401	99	302	401	1,112	1,112	2,224

Note: Ratio Industrial GFA of Lot area is 25%

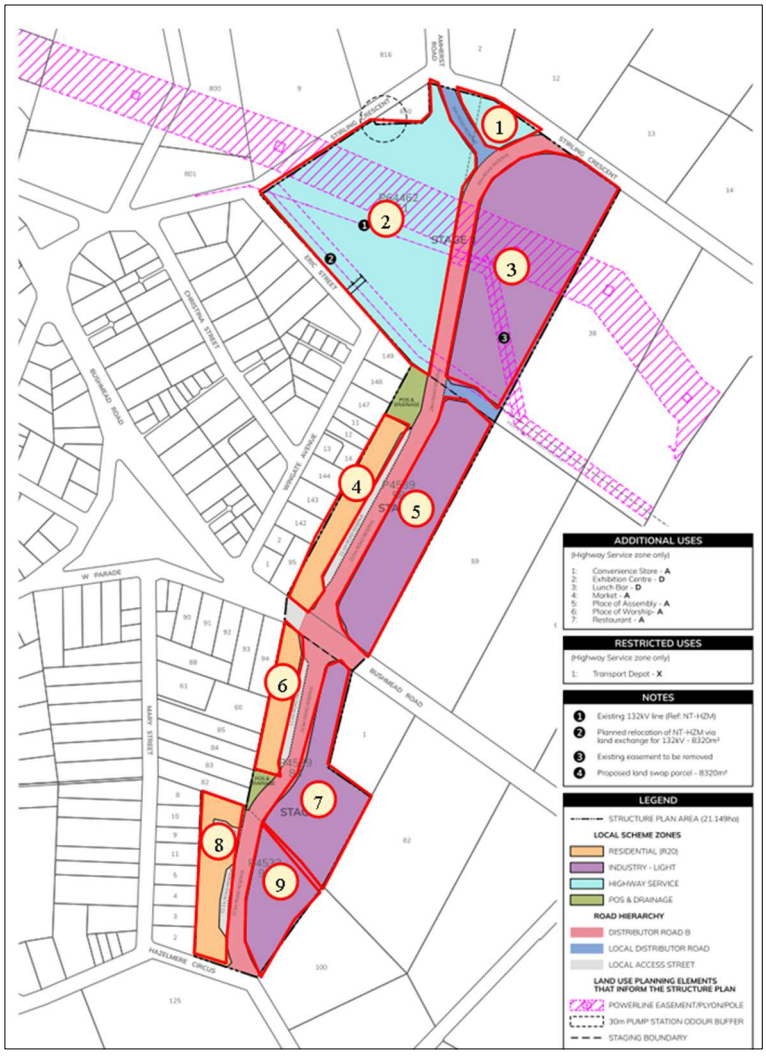


Figure 3.1: Proposed Structure Plan Traffic Zones

3.4 PROPOSED SITE ACCESS

As shown in **Figure 3.1**, each industrial development lot will have direct access to Eric Lumsden Drive. In contrast, residential lots will be served by local residential laneways that link to Eric Lumsden Drive, providing safe and appropriate access tailored to residential use.

3.5 TRIP DISTRIBUTION

Trips generated by the Structure Plan area were distributed to the wider area based on the MRWA ROM24 Model Sub-area Matrices_DAEDS V31_Hazelmere LSP from 2031 to 2041. This shows the following distribution:

- Lloyd Street South – 24%;
- Lloyd Street North – 13%;
- Bushmead Road West - 30%;
- Bushmead Road East – 8%;
- West Parade – 15%; and
- Amherst Road - 10%.

The ROM24 Model is discussed further in the following section.

3.6 TRIP ASSIGNMENT

Based on the trips generated, the assumed trip distribution and proposed access points, the Structure Plan area will introduce approximately 1,700 vpd onto Eric Lumsden Drive north of Bushmead Road and approximately 790 vpd onto the southern portion of Bushmead Road at full development. It is expected that 10-20% (similar to HV% on Bushmead Road) of traffic are heavy vehicles, generated by the proposed industrial development. The PM peak hour turning movements of Structure Plan traffic at the intersection of Eric Lumsden Drive with Bushmead Road were derived from the assignment and used in the SIDRA intersection analysis (see **Section 3.8**).

3.7 IMPACT ON THE EXTERNAL ROAD NETWORK

The proposed road network changes in the Structure Plan and the Lloyd Street extension are likely to impact future traffic movements. Eric Lumsden Drive will provide better network connectivity between the north (Amherst Road) and the south/east (Bushmead Road and Lloyd Street).

Data from the ROM24 model was provided by MRWA for the 2036 forecast year of which an extract is shown in **Figure 3.2**. (Note that the numbers shown in **Figure 3.2** equate to forecast daily volumes divided by 100, hence a number 14 represents 1,400 vpd.)

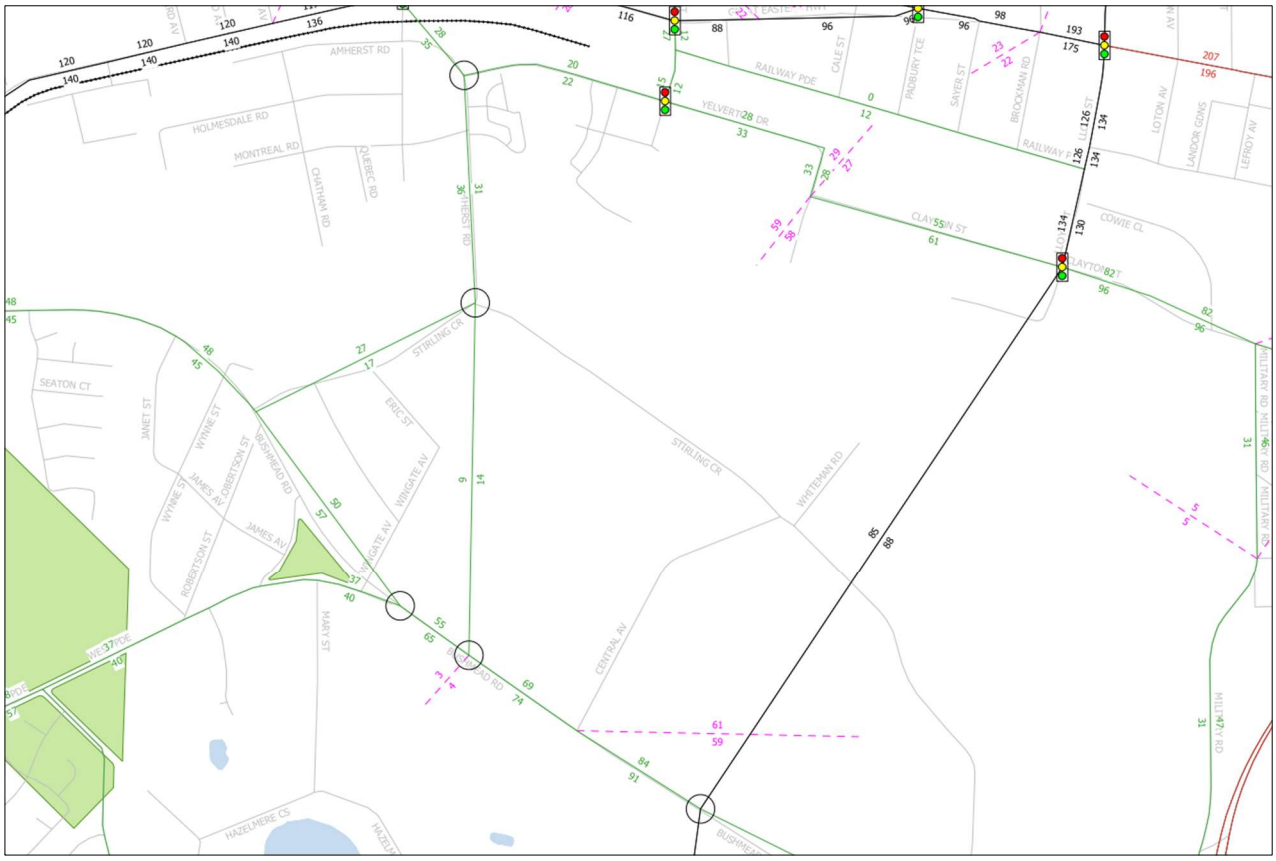


Figure 3.2: Extract from ROM 24 at 2036 ***(Source MRWA)***

DVC considers that the revised alignment of Eric Lumsden Drive (through the Structure Plan area) will provide an attractive east-west link in future and that through-traffic on Eric Street and Wingate Avenue (through the residential areas) will be discouraged. Some of the traffic currently using Eric Street, and Wingate Avenue will in future divert to Bushmead Road and the proposed Eric Lumsden Drive.

The ROM24 model network does not specifically reflect the connection of Stirling Crescent between Amherst Road and Lloyd Street. MRWA advises, "*it isn't included in the current version of our base ROM24 network simply due to the strategic nature of the model, where many "local" connections are not included. Hence, its exclusion shouldn't be taken to be a reflection of the planned connectivity for the road.".* Thus, this section of Stirling Crescent would mainly attract only local traffic, plus some diverted traffic in the area to Lloyd Street extension instead of using Eric Lumsden Drive.

DVC estimates this Stirling Crescent section would absorb approximately 20% from Eric Lumsden Drive traffic based on the forecast traffic from the ROM24 data.

The MRWA ROM24 2041 (see **Figure 3.3**) model forecasts about 10,400vpd on West Parade and 11,000vpd on Bushmead Road (west of Stirling Crescent), while some traffic diverts onto Eric Lumsden Drive. West Parade and Bushmead Road are currently classified as Distributor B roads in the MRWA Road Hierarchy. According to Liveable Neighbourhoods this requires a road reserve of 30m predominantly to manage parking and access to residential properties. Bushmead Road has a road reserve of 30m and West Parade is 20m.

While a single carriageway road will be adequate, attention to the residential access along these roads may be required in the long term if the MRWA forecasts are achieved.

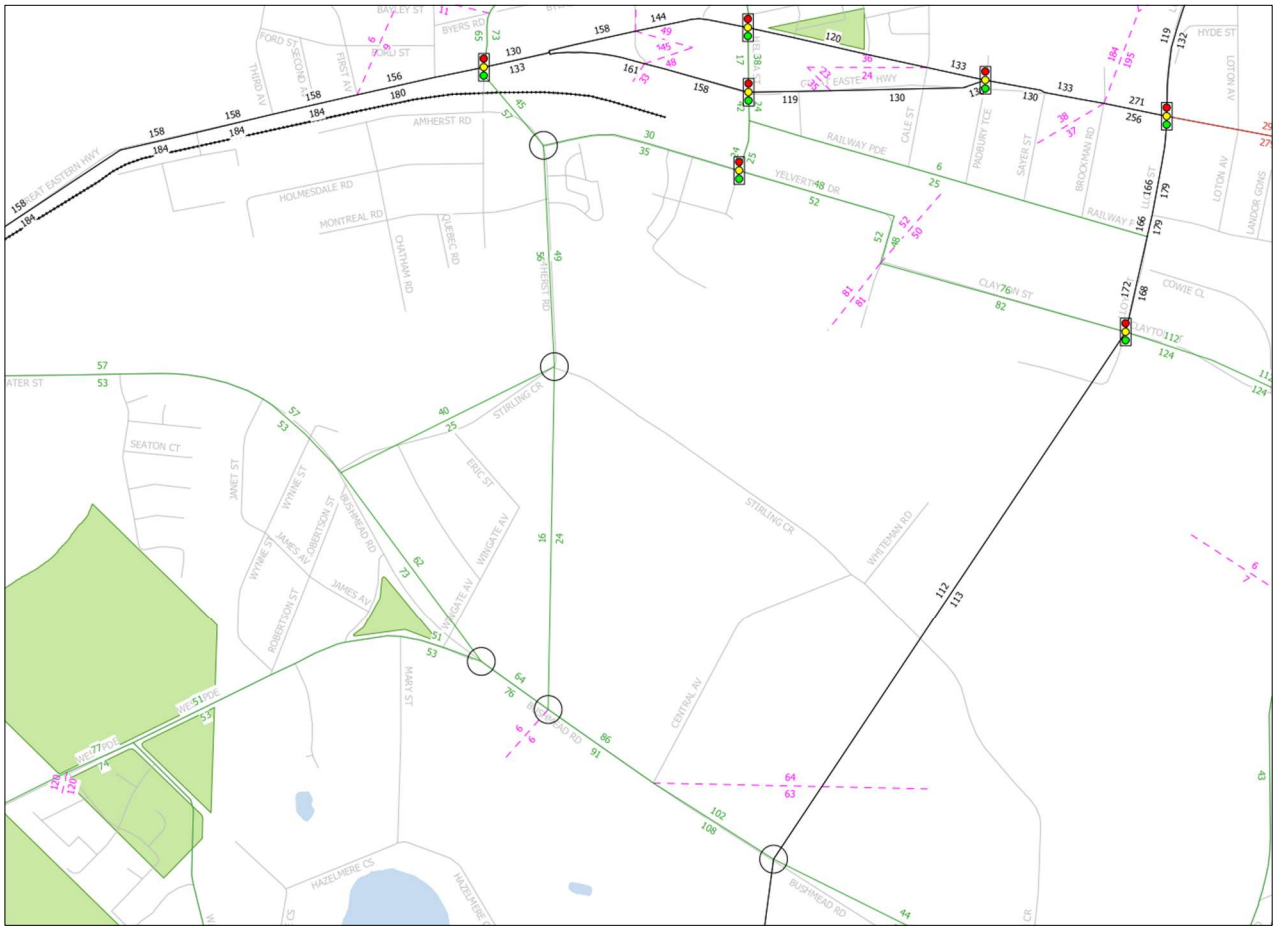


Figure 3.3: Extract from ROM 24 at 2041 *(Source MRWA)*

3.8 IMPACT ON THE STRUCTURE PLAN ROAD NETWORK

3.8.1 Road Reserves

Eric Lumsden Drive will intersect with Amherst Road as a T-junction and with Hazelmere Circus as a T-junction, in both cases with Eric Lumsden Drive as the major road. As per the City of Swan Development Design Specification Geometric Road Design, Table D.1.5 shows that Industrial Subdivisions require road cross-sections as per **Table 3.2**.

Table 3.2: Characteristics of Industrial Subdivision Roads

Industrial Subdivisions					
Road Type	**Industrial Class**	**Carriage Way Width**	**Reserve Width**	**Kerbing**	**Verge Width**
Local	Class 1 & 2 (11)	9m	20m	Semi-mountable	5m
Collector	Class 1 & 2	10m	25m	Semi-mountable	5m

This stipulates a 25m road reserve and a 10m carriageway to accommodate larger vehicles. This would cater for larger vehicles from the main Hazelmere Industrial area using Eric Lumsden Drive and would accommodate the forecast traffic volume of about 3,200vpd by 2041.

Local water management will require Eric Lumsden Drive to be elevated slightly with batters and drainage swales alongside the road. Therefore, a 25m road reserve is proposed i.e., a 10m carriageway with a total of 15m of verge space.

3.8.2 SIDRA Analysis

A SIDRA analysis was undertaken for the intersections of Eric Lumsden Drive with Bushmead Road, and Bushmead Road with West Parade, for the forecast years 2036 (opening year) and 2046 (opening year + 10). Background traffic volumes for 2036 were sourced directly from the ROM24 model, which reflects anticipated changes to the road network and associated traffic redistribution. To project conditions for 2046, a 2% annual growth rate was applied to the 2036 background traffic volumes.

The SIDRA software computes a wide range of operational performance measures from vehicle delay to estimates of emission gases. For this review we have collated the outputs for the four standard measures of assessing the impact on vehicular movement. These comprise Degree of Saturation (DoS), Average Delay, Queue Length and Level of Service (LoS).

Degree of Saturation

Degree of Saturation is a measure of how much physical capacity is being used with reference to the full capability of the particular movement, approach or overall intersection. A DoS of 1.0 therefore equates to full theoretical capacity although in some instances this level is exceeded in practice. SIDRA uses maximum acceptable DoS of 0.90 for signalised intersections for its Design Life analysis, whereas design engineers typically set a maximum DoS threshold of 0.95 for new intersection layouts or modifications.

Average Delay

Average Delay reports the average delay per vehicle in seconds experienced by all vehicles in a particular lane, approach or for the intersection as a whole. For severely congested intersections the average delay begins to climb exponentially.

Queue Length

Queue Length measures the length of approach queues. In this document we have reported queue length in terms of the number of vehicles in the queue at the 95th percentile and also at the 50th percentile. Hence, in the first case the program measures the maximum queue length that will not be exceeded for 95 percent of the time. In the second case it computes the maximum queue that will occur for half of the time. Queue lengths provide a useful indication of the impact of signals on network performance. It also enables the traffic engineer to consider the likely impact of queues blocking back and impacting on upstream intersections and accesses.

Level of Service

Level of Service is a combined appreciation of queuing incidence and delay time incurred, producing an alphanumeric ranking of A through F. A LoS of A indicates an excellent level of service whereby drivers delay is at a minimum and they clear the intersection at each change of signals or soon after arrival with little if any queuing. Values of B through D are acceptable in normal traffic conditions. Whilst values of E and F are typically considered undesirable, within the CBD vehicular and pedestrian numbers are significant with corresponding delays/queues unavoidable and hence, are generally accepted by road users.

The definitions in **Table 3.2** were extracted from the Sidra User Guide and provide a definition for LOS for vehicles based on delay (HCM method).

Table 3.3: Level of Service Definitions for Vehicles (HCM method)

LOS	Delay in seconds (d)		
	Signals	Roundabouts	Stop/Give Way
A	d ≤ 10	d ≤ 10	d ≤ 10
B	10 < d ≤ 20	10 < d ≤ 20	10 < d ≤ 15
C	20 < d ≤ 35	20 < d ≤ 35	15 < d ≤ 25
D	35 < d ≤ 55	35 < d ≤ 55	25 < d ≤ 35
E	55 < d ≤ 80	55 < d ≤ 70	35 < d ≤ 50
F	80 < d	70 < d	50 < d

Source: Sidra V9.1 User Guide Table 5.14.1

The following provides a legend for the abbreviations used in the tables which summarise the SIDRA outputs:

DoS *Degree of Saturation (volume/capacity) 1.0 = Full Capacity; 0.95 = Design Capacity*
LoS *Level of Service (A = Excellent; B, C, and D = Acceptable; E, F = Unacceptable)*
Average Delay *Average Delay per vehicle (seconds)*
Queue 95% *95th percentile back of queue, in metres*
Queue 50% *50th percentile back of queue, in metres*
N, S, E, W *North, South, East, West*

A summary of the SIDRA analysis results is provided in **Table 3.4**. Full SIDRA results are included in **Appendix B**.

The 2036 and 2046 forecast AM and PM peak hour turning movements as input into SIDRA are shown in **Figures 3.4 & 3.5.**

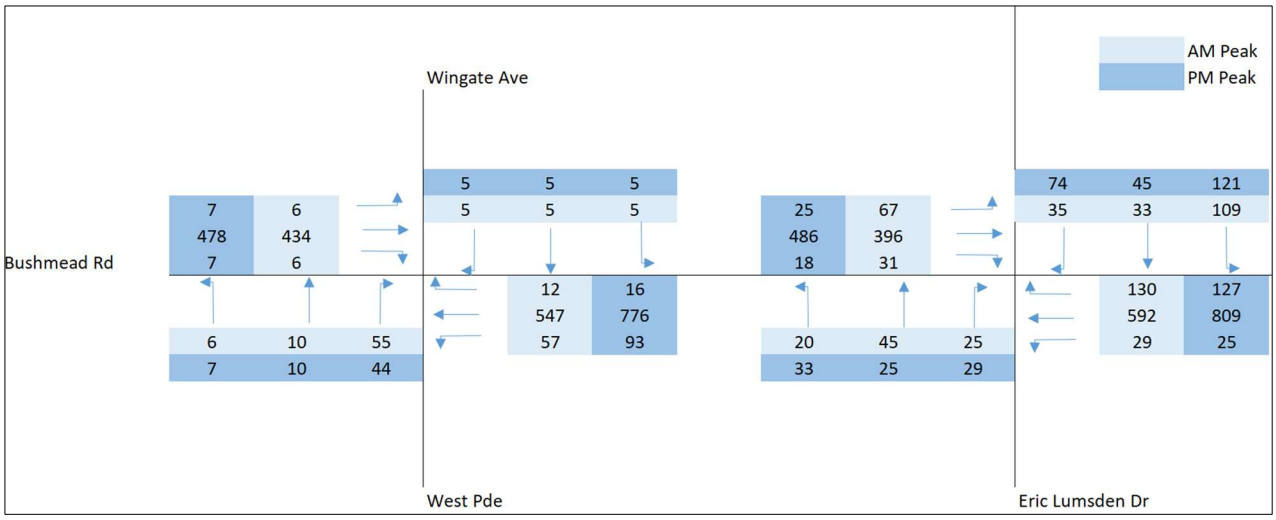


Figure 3.4: Forecast AM & PM Peak Hour Turning Movements - 2036

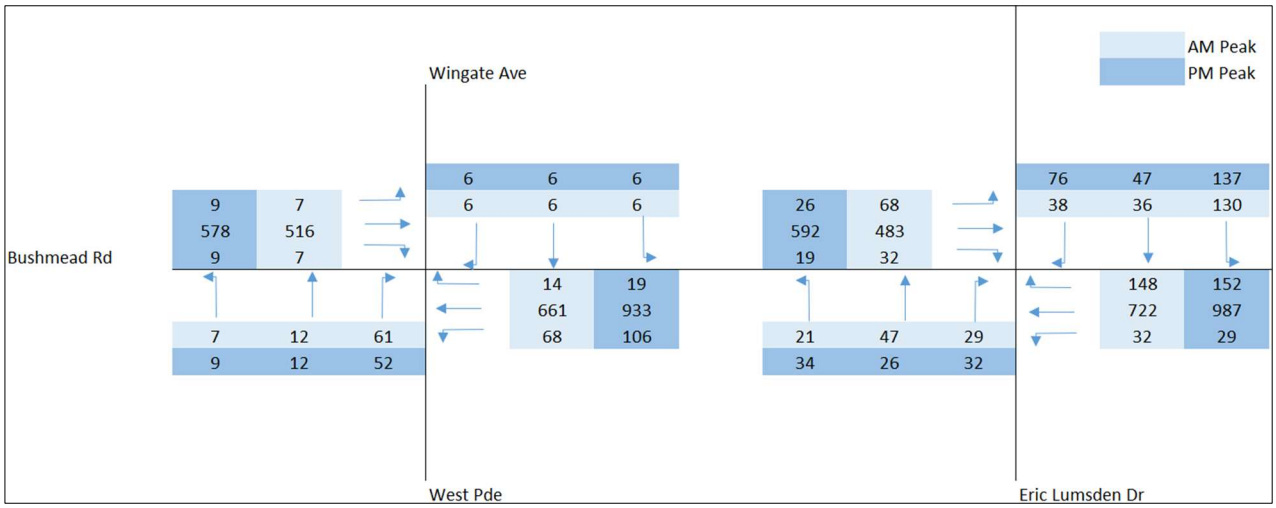


Figure 3.5: Forecast AM & PM Peak Hour Turning Movements – 2046

Table 3.3: SIDRA Modelling Results

Intersection	Year	Peak	DoS	Avg. Delay	Critical Approach LoS
Eric Lumsden Dr /Bushmead Rd	2036	AM	0.542	4.9	B
		PM	0.727	5.4	B
	2046	AM	0.654	5.2	B
		PM	0.887	7.2	C
Bushmead Rd / West Pde	2036	AM	0.428	6.0	B
		PM	0.607	6.3	B
	2046	AM	0.518	6.2	B
		PM	0.731	6.5	B

The intersection of Eric Lumsden Drive and Bushmead Road is proposed as a roundabout, with an adequate central radius to accommodate large heavy vehicles from the industrial area. SIDRA demonstrates that the modelled single lane configuration will have adequate spare capacity in future for all scenarios.

The intersection of Bushmead Road and West Parade was modelled in SIDRA as a single lane roundabout i.e. a similar configuration to its current layout. Again, the SIDRA results indicate that this roundabout will have adequate spare capacity in future.

3.9 RAV NETWORK

As outlined in **Section 2.6**, the RAV network in Hazelmere currently includes Bushmead Road (east of Central Avenue), Stirling Crescent (east of Lloyd Street), and Central Avenue, all classified as RAV 7 routes.

It is anticipated that the RAV 7 network will be extended to encompass Bushmead Road east of Eric Lumsden Drive, as well as Eric Lumsden Drive itself, as part of the Great Eastern Highway Bypass interchange project. This proposed extension would significantly enhance access for heavy vehicles servicing the Hazelmere industrial area, including the subject site.

Importantly, heavy vehicle movements generated by the development should be restricted to access Bushmead Road only and must not utilise Stirling Crescent. This restriction is crucial due to the proximity of the Helena River Steiner School, which is located north of Stirling Crescent (refer to **Photo 5**). The associated school zone begins just west of Amherst Road (see **Photo 6**). Limiting RAV access to Stirling Crescent will help ensure the safety of students crossing the road to and from school.



Photo 5: Helena River Steiner School - North of Stirling Crescent



Photo 6: School Zone – Just West of Amherst Road

4. SUSTAINABLE TRANSPORT

4.1 PEDESTRIANS AND CYCLISTS

In general, industrial estates do not attract any significant level of pedestrian and cycle traffic and the Hazelmere Industrial area is no different. The local bicycle network in the vicinity of the Structure Plan area is shown in **Figure 4.1**. as an extract of the Perth to Midland Bike Route. There is a shared path along Amherst Road which continues west along the current alignment of Stirling Crescent west of Amherst Road.

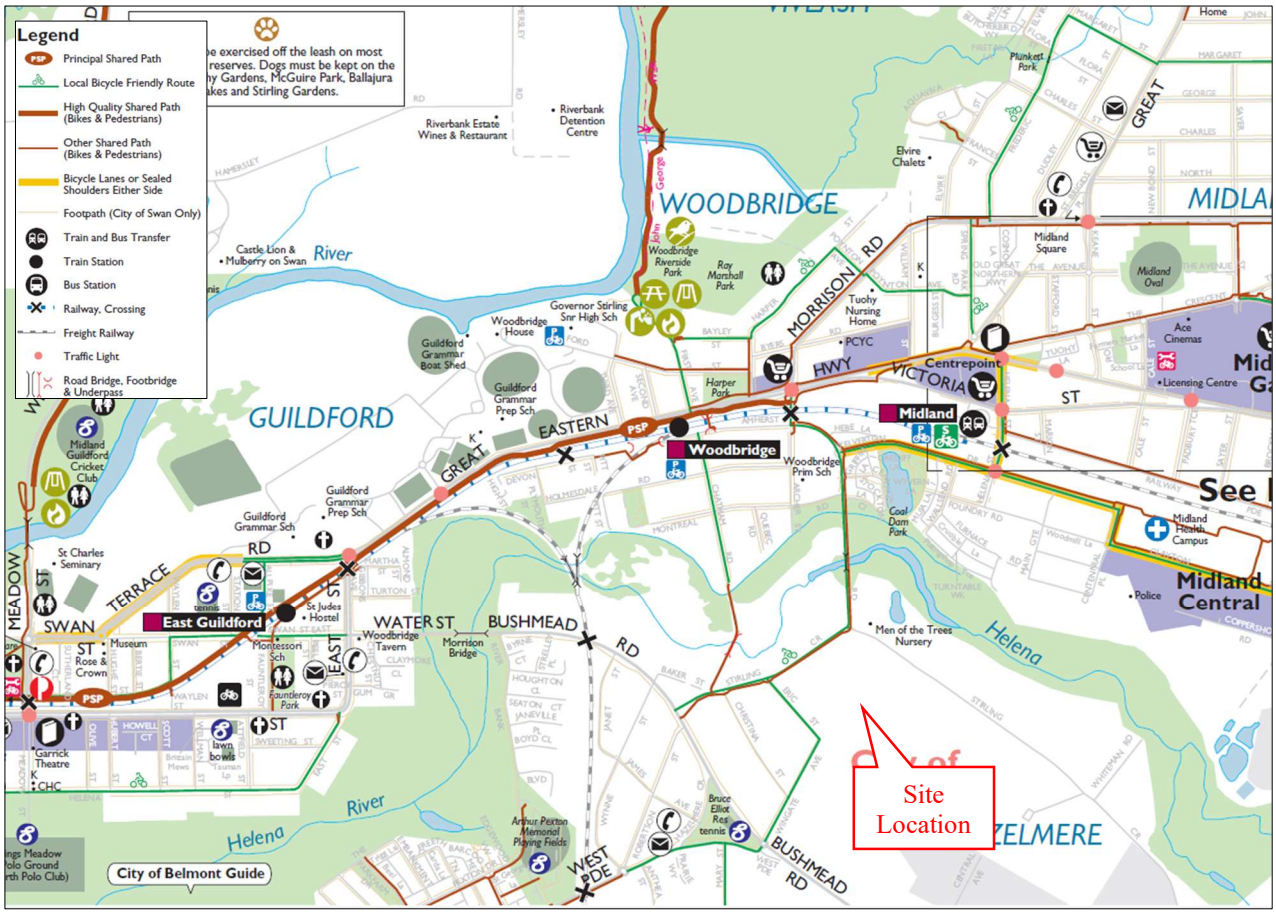


Figure 4.1: Pedestrian and Cyclist Network **(*Source: Your Move*)**

Mary Street, Wingate Street and Eric Street are currently shown as bicycle friendly routes. In future these may become more attractive as traffic diverts to Eric Lumsden Drive through the Structure Plan area.

A wide footpath is recommended along the eastern side of Eric Lumsden Drive and Amherst Road in line with footpath provision along Bushmead Road and Lloyd Street to accommodate pedestrians and less proficient cyclists who may choose to cycle in the area. This will also tie-in with the existing shared path on Amherst Road. On-street cycle lanes are not proposed for Eric Lumsden Drive.

4.2 PUBLIC TRANSPORT

There is currently only one bus route in the vicinity of the Structure Plan area as shown in **Figure 4.2 & Photo 7**.

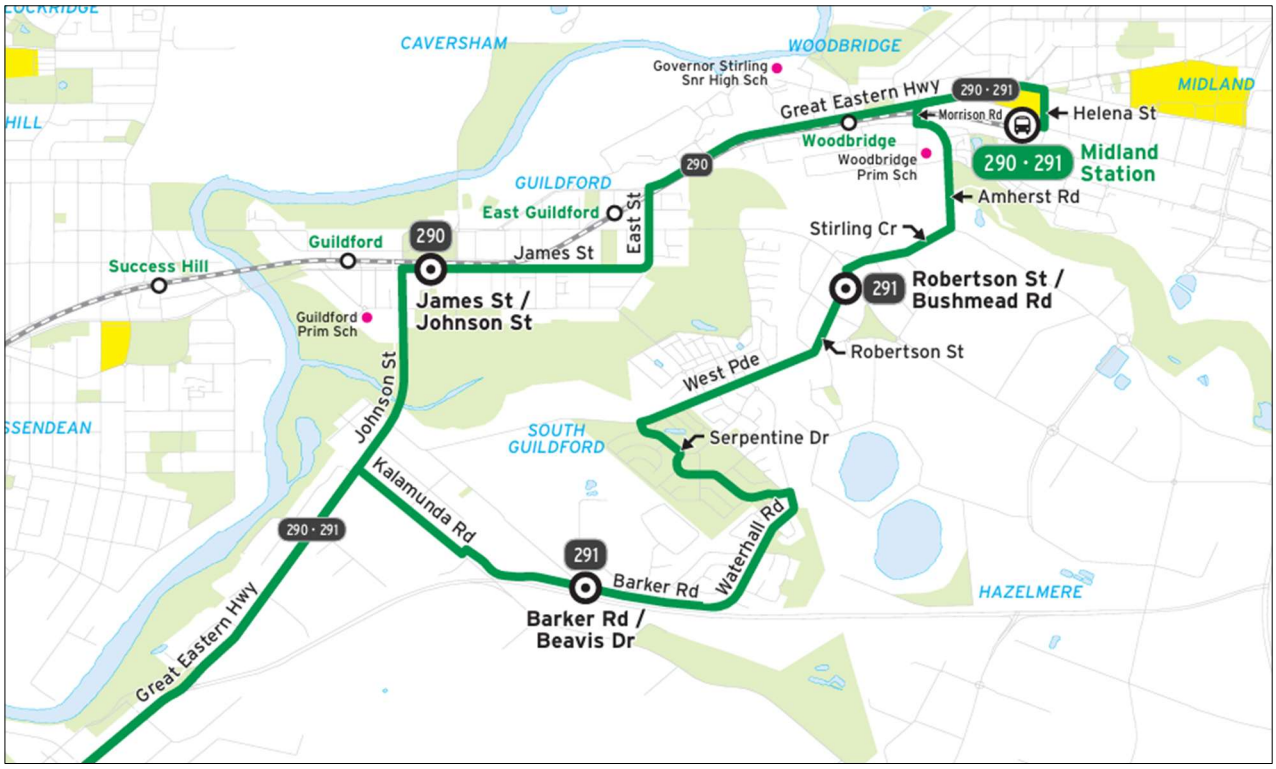


Figure 4.2: Bus Route 291 *Source: TransPerth*

Bus Service No. 291 operates in the residential areas between Midland Station and Redcliffe Station. It runs approximately every 30mins on weekdays and hourly on weekends and Public holidays.

Industrial areas do not generally attract good public transport services due to their low density and hence low patronage. Car parking is also often freely available on-site, further discouraging the use and provision of such services.



Photo 7: Bus Operates along Amherst Rd & Stirling Cres

5. SUMMARY AND RECOMMENDATION

5.1 SUMMARY

The Callo family has commissioned Donald Veal Consultants to prepare this Transport Impact Assessment report to support a Structure Plan for a group of properties along the western edge of the Hazelmere Industrial Area. The Structure Plan area comprises Lots 39 and 651 Stirling Crescent, Lots 58 and 83 Bushmead Road and Lot 93 Hazelmere Circus.

The Structure Plan site has an area of approximately 20.7925Ha (including roads) and is proposed to contain a mix of land uses, including light industrial and residential.

Access to the area is proposed via a realigned Stirling Crescent (proposed to be called Eric Lumsden Drive). Previous concepts for this road have been proposed but the current alignment has had 'in-principle' agreement from the City of Swan. The alignment discourages Hazelmere industrial traffic from entering the surrounding residential areas by providing a ring-road around the western edge of the industrial area. It is expected that the revised alignment will also attract through-traffic currently travelling on nearby residential roads, especially the current alignment of Stirling Crescent west of Amherst Road and Eric Road and Wingate Avenue.

Eric Lumsden Drive will intersect with Amherst Road as a T-junction and with Hazelmere Circus as a T-junction, in both cases with Eric Lumsden Drive as the major road. Eric Lumsden Drive will also intersect with Bushmead Road, proposed as a 4-way single lane roundabout.

Each industrial development lot will have direct access to Eric Lumsden Drive. In contrast, residential lots will be served by local residential laneways that link to Eric Lumsden Drive, providing safe and appropriate access tailored to residential use.

The Structure Plan area in total is expected to generate about 1,700vpd onto Eric Lumsden Drive north of Bushmead Road, and approximately 790vpd south of Bushmead Road. When combined with through-traffic (sourced from the MRWA ROM24 Model for 2041), Eric Lumsden Drive north of Bushmead Road will carry about 3,200vpd. It is expected there will be a corresponding reduction in traffic on the current alignment of Stirling Crescent, Eric Street and Wingate Avenue.

Guided by City of Swan Development Design Specification Geometric Road Design, Table D.1.5, Eric Lumsden Drive is proposed as a 25m wide road reserve with a 10m carriageway. This ties in with the 10m wide carriageway on the western approach to the existing Lloyd Street roundabout intersection. Wide verges are proposed to accommodate an elevated roadway and drainage swales.

RAV 7 network should be extended to encompass Bushmead Road east of Erin Lumsden Drive, as well as Erin Lumsden Drive itself, as part of the Great Eastern Highway Bypass interchange project. Importantly, heavy vehicle movements generated by the development should be restricted to access Bushmead Road only and must not utilise Stirling Crescent. Limiting RAV access to Stirling Crescent will help ensure the safety of students crossing the road to and from school.

The intersection of Eric Lumsden Drive and Bushmead Road is proposed as a single lane roundabout able to accommodate large trucks and the predominant east-west and north-west traffic demand. SIDRA modelling demonstrates that this lane configuration will have ample spare capacity for all scenarios.

It is expected that there will be some reassignment of traffic off Eric Street and Wingate Avenue Road which will decrease volumes through the intersection of Bushmead Road and West Parade. Again, SIDRA modelling demonstrates that the current roundabout-controlled intersection will have adequate spare capacity at full development in 2046.

The increased traffic along Bushmead Road and West Parade, largely due to general growth in the area and not the Structure Plan traffic, can be accommodated by a single lane in each direction. Recommendations in the Liveable Neighbourhoods guidelines suggest that some measures may be needed to manage residential property access along these roads if the 2046 forecast traffic volumes are realised.

The intersection of Eric Lumsden Drive and Hazelmere Circus is also proposed as a T-junction with Hazelmere Circus as the minor leg.

A footpath is proposed along the eastern side of Eric Lumsden Drive to accommodate pedestrians and less proficient cyclists.

5.2 RECOMMENDATION

Based on the above Transport Impact Assessment, DVC supports the proposed Structure Plan.

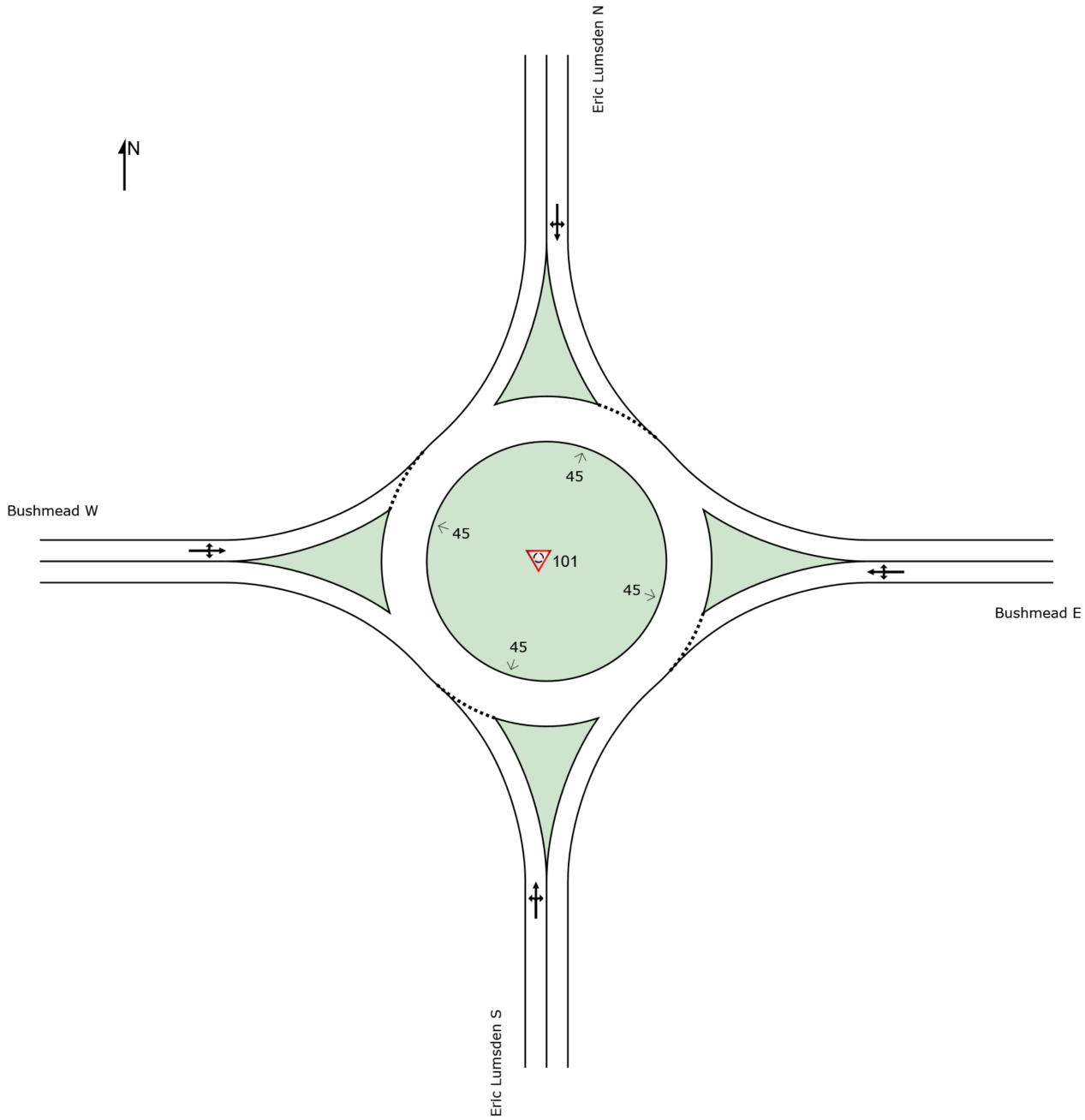
APPENDIX A: SIDRA OUTPUTS

SITE LAYOUT

Site: 101 [Bushmead/Eric Lumsden Dr - AM (Site Folder: 2036)]

New Site
Site Category: (None)
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/Eric Lumsden Dr - AM (Site Folder: 2036)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Eric Lumsden S															
1	L2	All MCs	21	10.0	21	10.0	0.125	7.8	LOS A	0.8	6.3	0.79	0.69	0.79	47.3
2	T1	All MCs	47	10.0	47	10.0	0.125	7.3	LOS A	0.8	6.3	0.79	0.69	0.79	51.7
3	R2	All MCs	26	10.0	26	10.0	0.125	14.5	LOS B	0.8	6.3	0.79	0.69	0.79	50.6
Approach			95	10.0	95	10.0	0.125	9.4	LOS A	0.8	6.3	0.79	0.69	0.79	50.7
East: Bushmead E															
4	L2	All MCs	31	10.0	31	10.0	0.542	3.6	LOS A	4.9	36.9	0.43	0.39	0.43	53.8
5	T1	All MCs	623	10.0	623	10.0	0.542	3.2	LOS A	4.9	36.9	0.43	0.39	0.43	51.1
6	R2	All MCs	137	10.0	137	10.0	0.542	10.3	LOS B	4.9	36.9	0.43	0.39	0.43	53.1
Approach			791	10.0	791	10.0	0.542	4.4	LOS A	4.9	36.9	0.43	0.39	0.43	51.7
North: Eric Lumsden N															
7	L2	All MCs	115	10.0	115	10.0	0.184	5.3	LOS A	1.1	8.6	0.62	0.58	0.62	53.0
8	T1	All MCs	35	10.0	35	10.0	0.184	4.9	LOS A	1.1	8.6	0.62	0.58	0.62	53.4
9	R2	All MCs	37	10.0	37	10.0	0.184	12.0	LOS B	1.1	8.6	0.62	0.58	0.62	36.7
Approach			186	10.0	186	10.0	0.184	6.6	LOS A	1.1	8.6	0.62	0.58	0.62	50.0
West: Bushmead W															
10	L2	All MCs	71	10.0	71	10.0	0.402	4.1	LOS A	2.8	21.1	0.48	0.41	0.48	51.0
11	T1	All MCs	417	10.0	417	10.0	0.402	3.7	LOS A	2.8	21.1	0.48	0.41	0.48	51.7
12	R2	All MCs	33	10.0	33	10.0	0.402	10.8	LOS B	2.8	21.1	0.48	0.41	0.48	50.0
Approach			520	10.0	520	10.0	0.402	4.2	LOS A	2.8	21.1	0.48	0.41	0.48	51.5
All Vehicles			1592	10.0	1592	10.0	0.542	4.9	LOS A	4.9	36.9	0.49	0.44	0.49	51.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/Eric Lumsden Dr - PM (Site Folder: 2036)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Eric Lumsden S															
1	L2	All MCs	35	10.0	35	10.0	0.190	12.1	LOS B	1.5	11.2	0.98	0.79	0.98	43.5
2	T1	All MCs	26	10.0	26	10.0	0.190	11.7	LOS B	1.5	11.2	0.98	0.79	0.98	48.8
3	R2	All MCs	31	10.0	31	10.0	0.190	18.8	LOS B	1.5	11.2	0.98	0.79	0.98	47.8
Approach			92	10.0	92	10.0	0.190	14.2	LOS B	1.5	11.2	0.98	0.79	0.98	46.8
East: Bushmead E															
4	L2	All MCs	26	10.0	26	10.0	0.727	4.3	LOS A	8.8	67.1	0.68	0.44	0.68	52.8
5	T1	All MCs	852	10.0	852	10.0	0.727	3.9	LOS A	8.8	67.1	0.68	0.44	0.68	49.6
6	R2	All MCs	134	10.0	134	10.0	0.727	11.0	LOS B	8.8	67.1	0.68	0.44	0.68	52.0
Approach			1012	10.0	1012	10.0	0.727	4.8	LOS A	8.8	67.1	0.68	0.44	0.68	50.2
North: Eric Lumsden N															
7	L2	All MCs	127	10.0	127	10.0	0.271	6.1	LOS A	1.8	13.7	0.71	0.65	0.71	52.1
8	T1	All MCs	47	10.0	47	10.0	0.271	5.6	LOS A	1.8	13.7	0.71	0.65	0.71	52.5
9	R2	All MCs	78	10.0	78	10.0	0.271	12.8	LOS B	1.8	13.7	0.71	0.65	0.71	36.2
Approach			253	10.0	253	10.0	0.271	8.1	LOS A	1.8	13.7	0.71	0.65	0.71	47.6
West: Bushmead W															
10	L2	All MCs	26	10.0	26	10.0	0.426	4.0	LOS A	3.2	24.1	0.50	0.39	0.50	51.1
11	T1	All MCs	512	10.0	512	10.0	0.426	3.6	LOS A	3.2	24.1	0.50	0.39	0.50	51.7
12	R2	All MCs	19	10.0	19	10.0	0.426	10.7	LOS B	3.2	24.1	0.50	0.39	0.50	50.0
Approach			557	10.0	557	10.0	0.426	3.8	LOS A	3.2	24.1	0.50	0.39	0.50	51.6
All Vehicles			1913	10.0	1913	10.0	0.727	5.4	LOS A	8.8	67.1	0.64	0.47	0.64	49.9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

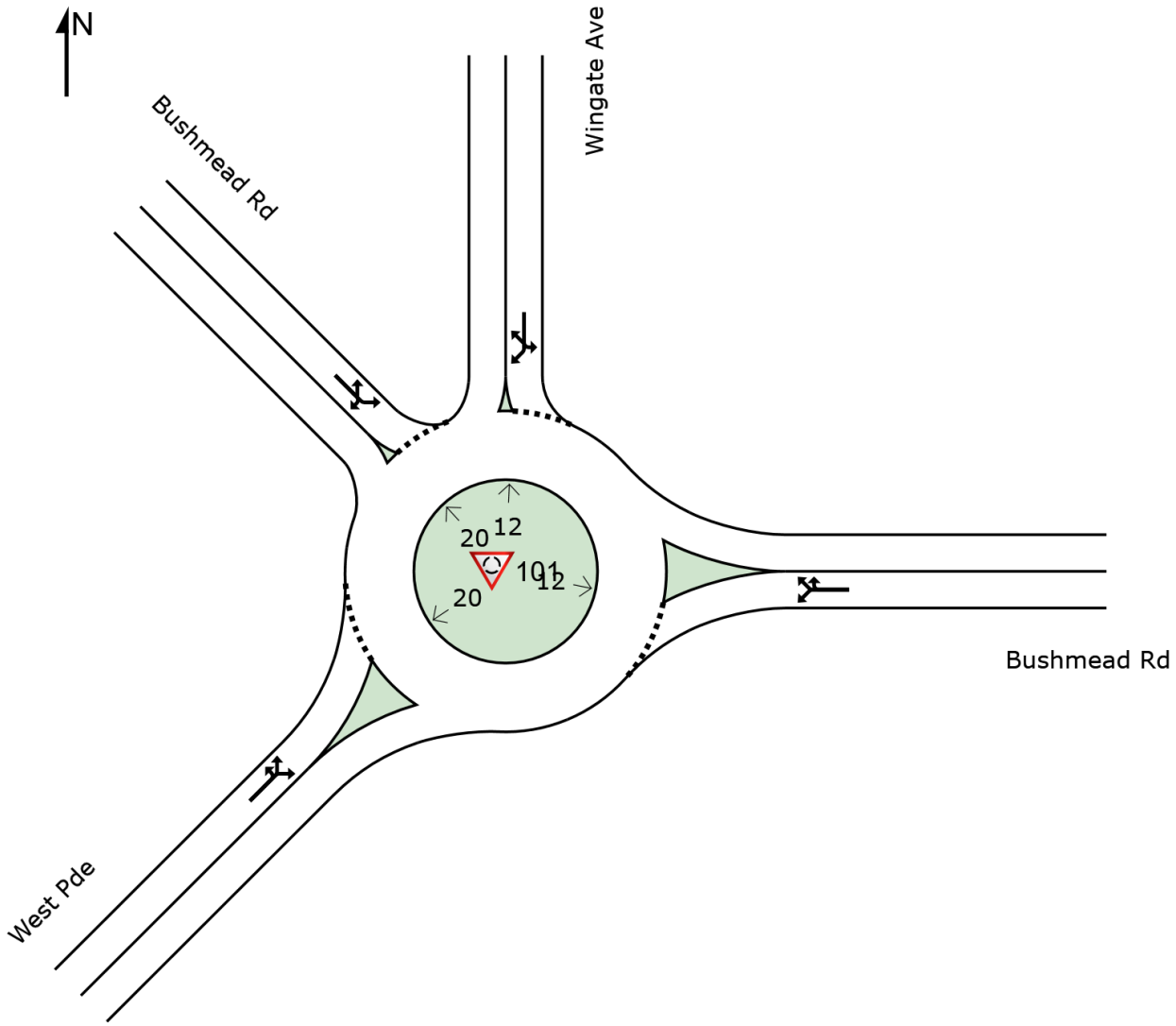
SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

SITE LAYOUT

Site: 101 [Bushmead/West Pde - AM (Site Folder: 2036)]

New Site
Site Category: (None)
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Elliptical shape restrictions apply to this Roundabout.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/West Pde - AM (Site Folder: 2036)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Bushmead Rd															
4a	L1	All MCs	60	10.0	60	10.0	0.428	4.4	LOS A	3.4	25.9	0.14	0.57	0.14	46.2
6a	R1	All MCs	576	10.0	576	10.0	0.428	7.7	LOS A	3.4	25.9	0.14	0.57	0.14	47.0
6	R2	All MCs	13	10.0	13	10.0	0.428	8.7	LOS A	3.4	25.9	0.14	0.57	0.14	42.8
Approach			648	10.0	648	10.0	0.428	7.4	LOS A	3.4	25.9	0.14	0.57	0.14	46.8
North: Wingate Ave															
7	L2	All MCs	5	5.0	5	5.0	0.020	6.4	LOS A	0.1	0.7	0.59	0.65	0.59	44.0
9a	R1	All MCs	5	5.0	5	5.0	0.020	10.3	LOS B	0.1	0.7	0.59	0.65	0.59	47.5
9b	R3	All MCs	5	5.0	5	5.0	0.020	12.3	LOS B	0.1	0.7	0.59	0.65	0.59	48.5
Approach			16	5.0	16	5.0	0.020	9.7	LOS A	0.1	0.7	0.59	0.65	0.59	46.9
NorthWest: Bushmead Rd															
27b	L3	All MCs	6	10.0	6	10.0	0.356	3.8	LOS A	2.6	19.5	0.32	0.39	0.32	46.3
27a	L1	All MCs	457	10.0	457	10.0	0.356	3.4	LOS A	2.6	19.5	0.32	0.39	0.32	45.2
29	R2	All MCs	6	10.0	6	10.0	0.356	7.7	LOS A	2.6	19.5	0.32	0.39	0.32	45.5
Approach			469	10.0	469	10.0	0.356	3.4	LOS A	2.6	19.5	0.32	0.39	0.32	45.2
SouthWest: West Pde															
30	L2	All MCs	6	5.0	6	5.0	0.091	6.4	LOS A	0.5	3.6	0.62	0.68	0.62	43.4
30a	L1	All MCs	11	5.0	11	5.0	0.091	6.1	LOS A	0.5	3.6	0.62	0.68	0.62	43.7
32a	R1	All MCs	58	5.0	58	5.0	0.091	9.9	LOS A	0.5	3.6	0.62	0.68	0.62	39.8
Approach			75	5.0	75	5.0	0.091	9.1	LOS A	0.5	3.6	0.62	0.68	0.62	41.0
All Vehicles			1208	9.6	1208	9.6	0.428	6.0	LOS A	3.4	25.9	0.24	0.51	0.24	45.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/West Pde - PM (Site Folder: 2036)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Bushmead Rd															
4a	L1	All MCs	98	10.0	98	10.0	0.607	4.4	LOS A	6.6	49.9	0.19	0.55	0.19	46.0
6a	R1	All MCs	817	10.0	817	10.0	0.607	7.7	LOS A	6.6	49.9	0.19	0.55	0.19	46.8
6	R2	All MCs	17	10.0	17	10.0	0.607	8.8	LOS A	6.6	49.9	0.19	0.55	0.19	42.7
Approach			932	10.0	932	10.0	0.607	7.4	LOS A	6.6	49.9	0.19	0.55	0.19	46.6
North: Wingate Ave															
7	L2	All MCs	5	5.0	5	5.0	0.020	6.7	LOS A	0.1	0.8	0.61	0.65	0.61	43.7
9a	R1	All MCs	5	5.0	5	5.0	0.020	10.6	LOS B	0.1	0.8	0.61	0.65	0.61	47.3
9b	R3	All MCs	5	5.0	5	5.0	0.020	12.6	LOS B	0.1	0.8	0.61	0.65	0.61	48.4
Approach			16	5.0	16	5.0	0.020	10.0	LOS A	0.1	0.8	0.61	0.65	0.61	46.8
NorthWest: Bushmead Rd															
27b	L3	All MCs	7	10.0	7	10.0	0.386	3.7	LOS A	2.9	22.4	0.32	0.38	0.32	46.3
27a	L1	All MCs	503	10.0	503	10.0	0.386	3.3	LOS A	2.9	22.4	0.32	0.38	0.32	45.2
29	R2	All MCs	7	10.0	7	10.0	0.386	7.7	LOS A	2.9	22.4	0.32	0.38	0.32	45.6
Approach			518	10.0	518	10.0	0.386	3.4	LOS A	2.9	22.4	0.32	0.38	0.32	45.2
SouthWest: West Pde															
30	L2	All MCs	7	5.0	7	5.0	0.099	9.0	LOS A	0.6	4.3	0.76	0.74	0.76	42.1
30a	L1	All MCs	11	5.0	11	5.0	0.099	8.7	LOS A	0.6	4.3	0.76	0.74	0.76	42.3
32a	R1	All MCs	46	5.0	46	5.0	0.099	12.5	LOS B	0.6	4.3	0.76	0.74	0.76	38.0
Approach			64	5.0	64	5.0	0.099	11.5	LOS B	0.6	4.3	0.76	0.74	0.76	39.5
All Vehicles			1529	9.7	1529	9.7	0.607	6.3	LOS A	6.6	49.9	0.26	0.51	0.26	45.8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

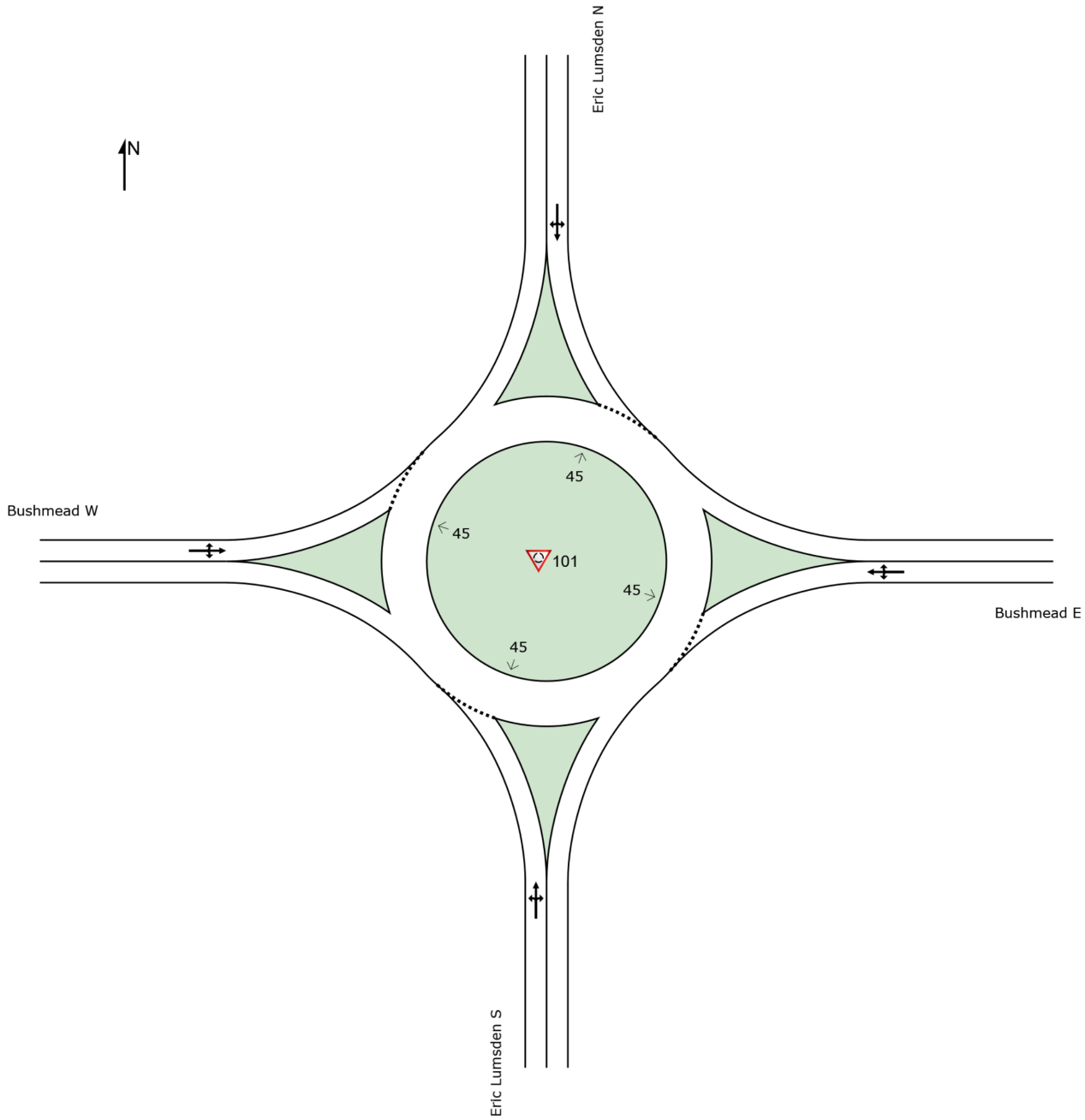
SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

SITE LAYOUT

Site: 101 [Bushmead/Eric Lumsden Dr - AM (Site Folder: 2046)]

New Site
Site Category: (None)
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/Eric Lumsden Dr - AM (Site Folder: 2046)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Eric Lumsden S															
1	L2	All MCs	22	10.0	22	10.0	0.170	10.0	LOS B	1.2	9.5	0.90	0.75	0.90	45.5
2	T1	All MCs	49	10.0	49	10.0	0.170	9.6	LOS A	1.2	9.5	0.90	0.75	0.90	50.3
3	R2	All MCs	31	10.0	31	10.0	0.170	16.7	LOS B	1.2	9.5	0.90	0.75	0.90	49.3
Approach			102	10.0	102	10.0	0.170	11.8	LOS B	1.2	9.5	0.90	0.75	0.90	49.2
East: Bushmead E															
4	L2	All MCs	34	10.0	34	10.0	0.654	3.9	LOS A	7.1	53.9	0.53	0.40	0.53	53.4
5	T1	All MCs	760	10.0	760	10.0	0.654	3.4	LOS A	7.1	53.9	0.53	0.40	0.53	50.5
6	R2	All MCs	156	10.0	156	10.0	0.654	10.6	LOS B	7.1	53.9	0.53	0.40	0.53	52.6
Approach			949	10.0	949	10.0	0.654	4.6	LOS A	7.1	53.9	0.53	0.40	0.53	51.1
North: Eric Lumsden N															
7	L2	All MCs	137	10.0	137	10.0	0.235	6.1	LOS A	1.6	11.9	0.71	0.64	0.71	52.6
8	T1	All MCs	38	10.0	38	10.0	0.235	5.6	LOS A	1.6	11.9	0.71	0.64	0.71	53.0
9	R2	All MCs	40	10.0	40	10.0	0.235	12.8	LOS B	1.6	11.9	0.71	0.64	0.71	36.4
Approach			215	10.0	215	10.0	0.235	7.3	LOS A	1.6	11.9	0.71	0.64	0.71	49.9
West: Bushmead W															
10	L2	All MCs	72	10.0	72	10.0	0.485	4.4	LOS A	3.7	28.1	0.56	0.44	0.56	50.5
11	T1	All MCs	508	10.0	508	10.0	0.485	4.0	LOS A	3.7	28.1	0.56	0.44	0.56	51.1
12	R2	All MCs	34	10.0	34	10.0	0.485	11.1	LOS B	3.7	28.1	0.56	0.44	0.56	49.5
Approach			614	10.0	614	10.0	0.485	4.4	LOS A	3.7	28.1	0.56	0.44	0.56	51.0
All Vehicles			1880	10.0	1880	10.0	0.654	5.2	LOS A	7.1	53.9	0.58	0.46	0.58	50.7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/Eric Lumsden Dr - PM (Site Folder: 2046)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
South: Eric Lumsden S															
1	L2	All MCs	36	10.0	36	10.0	0.376	21.5	LOS C	3.3	25.0	1.00	0.92	1.03	37.2
2	T1	All MCs	27	10.0	27	10.0	0.376	21.0	LOS C	3.3	25.0	1.00	0.92	1.03	43.5
3	R2	All MCs	34	10.0	34	10.0	0.376	28.2	LOS C	3.3	25.0	1.00	0.92	1.03	42.7
Approach			97	10.0	97	10.0	0.376	23.7	LOS C	3.3	25.0	1.00	0.92	1.03	41.3
East: Bushmead E															
4	L2	All MCs	31	10.0	31	10.0	0.887	6.6	LOS A	19.0	144.3	0.98	0.66	1.05	51.2
5	T1	All MCs	1039	10.0	1039	10.0	0.887	6.1	LOS A	19.0	144.3	0.98	0.66	1.05	47.5
6	R2	All MCs	160	10.0	160	10.0	0.887	13.3	LOS B	19.0	144.3	0.98	0.66	1.05	50.5
Approach			1229	10.0	1229	10.0	0.887	7.1	LOS A	19.0	144.3	0.98	0.66	1.05	48.2
North: Eric Lumsden N															
7	L2	All MCs	144	10.0	144	10.0	0.339	7.2	LOS A	2.5	18.7	0.82	0.70	0.82	51.6
8	T1	All MCs	49	10.0	49	10.0	0.339	6.7	LOS A	2.5	18.7	0.82	0.70	0.82	52.0
9	R2	All MCs	80	10.0	80	10.0	0.339	13.9	LOS B	2.5	18.7	0.82	0.70	0.82	35.8
Approach			274	10.0	274	10.0	0.339	9.1	LOS A	2.5	18.7	0.82	0.70	0.82	47.3
West: Bushmead W															
10	L2	All MCs	27	10.0	27	10.0	0.533	4.4	LOS A	4.6	35.3	0.62	0.42	0.62	50.2
11	T1	All MCs	623	10.0	623	10.0	0.533	3.9	LOS A	4.6	35.3	0.62	0.42	0.62	50.8
12	R2	All MCs	20	10.0	20	10.0	0.533	11.1	LOS B	4.6	35.3	0.62	0.42	0.62	49.2
Approach			671	10.0	671	10.0	0.533	4.2	LOS A	4.6	35.3	0.62	0.42	0.62	50.7
All Vehicles			2271	10.0	2271	10.0	0.887	7.2	LOS A	19.0	144.3	0.86	0.61	0.89	48.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

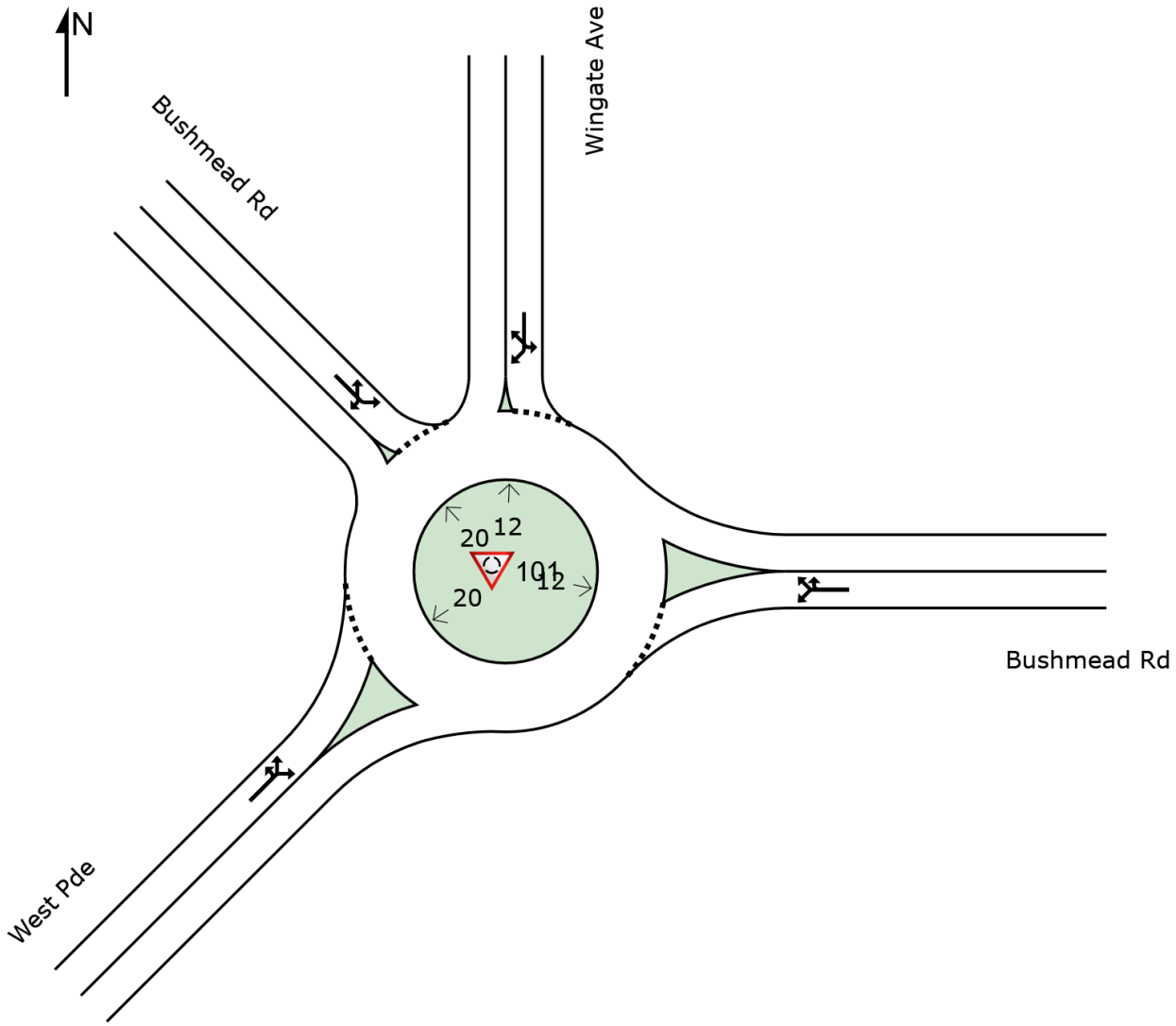
SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

SITE LAYOUT

Site: 101 [Bushmead/West Pde - AM (Site Folder: 2046)]

New Site
Site Category: (None)
Roundabout

Layout pictures are schematic functional drawings reflecting input data. They are not design drawings.



Elliptical shape restrictions apply to this Roundabout.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/West Pde - AM (Site Folder: 2046)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Bushmead Rd															
4a	L1	All MCs	72	10.0	72	10.0	0.518	4.4	LOS A	4.8	36.5	0.18	0.56	0.18	46.0
6a	R1	All MCs	696	10.0	696	10.0	0.518	7.7	LOS A	4.8	36.5	0.18	0.56	0.18	46.8
6	R2	All MCs	15	10.0	15	10.0	0.518	8.8	LOS A	4.8	36.5	0.18	0.56	0.18	42.7
Approach			782	10.0	782	10.0	0.518	7.5	LOS A	4.8	36.5	0.18	0.56	0.18	46.7
North: Wingate Ave															
7	L2	All MCs	6	5.0	6	5.0	0.026	7.2	LOS A	0.1	1.0	0.65	0.68	0.65	43.3
9a	R1	All MCs	6	5.0	6	5.0	0.026	11.1	LOS B	0.1	1.0	0.65	0.68	0.65	46.9
9b	R3	All MCs	6	5.0	6	5.0	0.026	13.1	LOS B	0.1	1.0	0.65	0.68	0.65	48.0
Approach			19	5.0	19	5.0	0.026	10.5	LOS B	0.1	1.0	0.65	0.68	0.65	46.4
NorthWest: Bushmead Rd															
27b	L3	All MCs	7	10.0	7	10.0	0.428	3.9	LOS A	3.4	25.8	0.37	0.40	0.37	46.1
27a	L1	All MCs	543	10.0	543	10.0	0.428	3.5	LOS A	3.4	25.8	0.37	0.40	0.37	44.9
29	R2	All MCs	7	10.0	7	10.0	0.428	7.8	LOS A	3.4	25.8	0.37	0.40	0.37	45.4
Approach			558	10.0	558	10.0	0.428	3.6	LOS A	3.4	25.8	0.37	0.40	0.37	45.0
SouthWest: West Pde															
30	L2	All MCs	7	5.0	7	5.0	0.115	7.7	LOS A	0.7	4.8	0.70	0.71	0.70	42.8
30a	L1	All MCs	13	5.0	13	5.0	0.115	7.3	LOS A	0.7	4.8	0.70	0.71	0.70	43.0
32a	R1	All MCs	64	5.0	64	5.0	0.115	11.1	LOS B	0.7	4.8	0.70	0.71	0.70	38.9
Approach			84	5.0	84	5.0	0.115	10.3	LOS B	0.7	4.8	0.70	0.71	0.70	40.2
All Vehicles			1443	9.6	1443	9.6	0.518	6.2	LOS A	4.8	36.5	0.29	0.51	0.29	45.6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

MOVEMENT SUMMARY

Site: 101 [Bushmead/West Pde - PM (Site Folder: 2046)]

Output produced by SIDRA INTERSECTION Version: 9.1.6.228

New Site
Site Category: (None)
Roundabout

Vehicle Movement Performance

Mov ID	Turn	Mov Class	Demand Flows [Total veh/h	HV] %	Arrival Flows [Total veh/h	HV] %	Deg. Satn v/c	Aver. Delay sec	Level of Service	95% Back Of Queue [Veh. veh	Dist] m	Prop. Que	Eff. Stop Rate	Aver. No. of Cycles	Aver. Speed km/h
East: Bushmead Rd															
4a	L1	All MCs	112	10.0	112	10.0	0.731	4.6	LOS A	10.7	81.2	0.29	0.53	0.29	45.6
6a	R1	All MCs	982	10.0	982	10.0	0.731	7.9	LOS A	10.7	81.2	0.29	0.53	0.29	46.4
6	R2	All MCs	20	10.0	20	10.0	0.731	8.9	LOS A	10.7	81.2	0.29	0.53	0.29	42.4
Approach			1114	10.0	1114	10.0	0.731	7.6	LOS A	10.7	81.2	0.29	0.53	0.29	46.3
North: Wingate Ave															
7	L2	All MCs	6	5.0	6	5.0	0.028	7.7	LOS A	0.2	1.1	0.68	0.69	0.68	42.9
9a	R1	All MCs	6	5.0	6	5.0	0.028	11.6	LOS B	0.2	1.1	0.68	0.69	0.68	46.6
9b	R3	All MCs	6	5.0	6	5.0	0.028	13.6	LOS B	0.2	1.1	0.68	0.69	0.68	47.7
Approach			19	5.0	19	5.0	0.028	11.0	LOS B	0.2	1.1	0.68	0.69	0.68	46.0
NorthWest: Bushmead Rd															
27b	L3	All MCs	9	10.0	9	10.0	0.475	3.9	LOS A	4.1	31.2	0.40	0.40	0.40	46.1
27a	L1	All MCs	608	10.0	608	10.0	0.475	3.5	LOS A	4.1	31.2	0.40	0.40	0.40	44.8
29	R2	All MCs	9	10.0	9	10.0	0.475	7.8	LOS A	4.1	31.2	0.40	0.40	0.40	45.3
Approach			627	10.0	627	10.0	0.475	3.6	LOS A	4.1	31.2	0.40	0.40	0.40	44.9
SouthWest: West Pde															
30	L2	All MCs	9	5.0	9	5.0	0.150	12.1	LOS B	1.0	7.1	0.86	0.79	0.86	40.6
30a	L1	All MCs	13	5.0	13	5.0	0.150	11.8	LOS B	1.0	7.1	0.86	0.79	0.86	40.8
32a	R1	All MCs	55	5.0	55	5.0	0.150	15.6	LOS B	1.0	7.1	0.86	0.79	0.86	35.9
Approach			77	5.0	77	5.0	0.150	14.6	LOS B	1.0	7.1	0.86	0.79	0.86	37.7
All Vehicles			1837	9.7	1837	9.7	0.731	6.5	LOS A	10.7	81.2	0.35	0.50	0.35	45.3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Options tab).
Roundabout LOS Method: SIDRA Roundabout LOS.
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
Roundabout Capacity Model: SIDRA Standard.
Delay Model: SIDRA Standard (Control Delay: Geometric Delay is included).
Queue Model: SIDRA queue estimation methods are used for Back of Queue and Queue at Start of Gap.
Gap-Acceptance Capacity Formula: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Arrival Flows used in performance calculations are adjusted to include any Initial Queued Demand and Upstream Capacity Constraint effects.

SIDRA INTERSECTION 9.1 | Copyright © 2000-2024 Akcelik and Associates Pty Ltd | sidrasolutions.com

Appendix 3 – Bushfire Management Plan

Bushfire Management Plan / Statement addressing the Bushfire Protection Criteria coversheet

Site address: Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere

Site visit: Yes ☒ No ☐

Date of site visit (if applicable): Day 7 Month APR Year 2025

Report author or reviewer: Nathan Peart

WA BPAD accreditation level (please circle):

Not accredited ☐ Level 1 BAL assessor ☐ Level 2 practitioner ☐ Level 3 practitioner ☒

If accredited, please provide the following.

BPAD accreditation number: 38808 Accreditation expiry: Month May Year 2025

Bushfire management plan version number: 1

Bushfire management plan date: Day 16 Month APR Year 2025

If one or more of the following are selected, then these should be automatically referred to DFES.	YES	NO
Strategic planning is required to address SPP 3.7 and the Guidelines	☒	☐
The application is a vulnerable land use	☐	☒

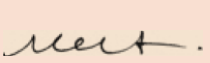
None of the Above ☐

If one or more of the following are selected, and the decision-maker requires input from DFES, then the application can be referred.	YES	NO
The BAL rating has been calculated by a method other than Method 1 as prescribed by AS 3959	☐	☐
An outcomes-based approach has been submitted to demonstrate compliance with the bushfire protection criteria	☐	☐

None of the Above ☒

Note: If a subdivision or development application meets all the acceptable solutions and does not otherwise trigger a referral as listed above, seeking advice from DFES on SPP 3.7 or other matters is at the discretion of the decision-maker.

The information provided within this bushfire management plan to the best of my knowledge is true and correct:

Signature of report author or reviewer  Date 16 April 2025



Bushfire Management Plan

Proposed Structure Plan at: Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere

Client: URPS

Report Number: 24-20819

Assessment Date: 7 April 2025

Report Date: 16 April 2025

Prepared by a BPAD Accredited Practitioner

BUSHFIRE SMART

Document Control

Doc name:	Bushfire Management Plan (DA) - Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere				
Version	Date	Author		Reviewer	
1	16/04/2025	Jess Calcutt	JC	Nathan Peart	NP
	Initial Report Issued				

Disclaimer and Limitation

This report is prepared exclusively for the client and any future landowners of the subject lot. It is not intended for the benefit of any other person and may not be relied upon by any other party. Bushfire Smart accepts no liability or responsibility for any use or reliance upon this report and its supporting materials by third parties.

The mitigation strategies outlined in this report represent prudent minimum standards based on the writer's experience and the standards prescribed by relevant authorities. It is expressly stated that Bushfire Smart and the writer do not guarantee that compliance with these standards or the exercise of prudence by a property owner will prevent damage or destruction of a building or property by bushfire, or the loss of lives in a bushfire. Fire is an extremely unpredictable force of nature, and changing climatic factors, whether predictable or otherwise, can significantly affect the nature of a fire. In a bushfire-prone area, it is not possible to completely guard against bushfire.

Furthermore, the growth, planting, or removal of vegetation; poor maintenance of fire prevention measures; addition of structures not included in this report; or other activities can and will alter the bushfire threat to all properties detailed in the report. The achievement of the level of implementation of fire precautions will depend on the actions of the landowner or occupiers of the land, over which Bushfire Smart has no control.

This report does not negate the need to follow Local government authority requirements for Firebreak and Fuel Hazard Reduction. The client agrees that in submitting this report they approve of and will comply with all requirements detailed.

Insurance Coverage Statement

Bushfire Smart is covered by Professional Indemnity Insurance up to $2,000,000 and Public Liability Insurance valued at $20,000,000. These policies provide comprehensive coverage for bushfire attack level assessments, planning, design, and advisory services, in accordance with the FPA Australia Bushfire Planning and Design Accreditation Scheme for a BPAD-Level 3 practitioner.

Author		
Jess Calcutt	BPAD 65772	
Level 1 Bushfire Planning and Design (BPAD) Accredited Practitioner		
E: BAL@BushfireSmart.com.au	Ph: 9555 9444	

Reviewer		
Nathan Peart	BPAD 38808	
Level 3 Bushfire Planning and Design (BPAD) Accredited Practitioner		
E: BAL@BushfireSmart.com.au	Ph: 9555 9444	

Executive Summary

The proposal is at Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere, with this BMP created to support a **structure plan application** for 74 lots.

The proposal is in an area that has been designated as bushfire prone and must therefore comply with State Planning Policy 3.7 (SPP 3.7). Planning for Bushfire Guidelines (September 2024) has been used to determine the proposals compliance with SPP 3.7.

The proposal is not within an area that has been designated as Native Vegetation by the Department of Primary Industries and Regional Development (DPIRD-005). The entirety of the subject lot(s) lies within the Geomorphic Wetlands: Swan Coastal area identified by the Department of Biodiversity, Conservation and Attractions (DBCA).

The proposal is located within Bush Fire Prone Area 2. Therefore, a Broader Landscape Assessment (BLA) is required.

All residential and commercial lot(s) can achieve a buildable area of BAL—29 or below.

An assessment against the bushfire protection criteria (Appendix Four of the guidelines) is required to be undertaken. The following table summarises the outcome of this assessment.

Table A.1: Summary of assessment against bushfire protection criteria

Element	Acceptable Solution	Compliance Method	Compliance notes.
1: Location	A1.1 Development location	**Acceptable Solution**	The subdivision is within an area classified as Broader Landscape Type A.
2: Siting and Design	A2.1 Siting and design	**Acceptable Solution**	Proposed lot(s) contain a sufficient development site(s) that can achieve a radiant heat impact not exceeding 29 kW/m² (BAL-29).
	A2.2 Asset Protection Zone (APZ)	**Acceptable Solution**	An indicative APZ will be required to allow for a maximum BAL rating of 29, but exact requirements are to be determined at DA stage upon individual application.
	A2.3 Clearing of native vegetation	**Acceptable Solution**	The structure plan avoids the clearing of native vegetation.
3: Vehicular Access	A3.1 Public Roads	**Acceptable Solution**	Public roads to meet the minimum technical requirements in Appendix B.3, Table 10.
	A3.2 Access routes	**Acceptable Solution**	Area 2: Access is provided in at least two different suitable destinations
	A3.3a No through-roads	**Acceptable Solution**	All roads are through-roads.
	A3.3b No through-road requirements	**N/A**	
	A3.4 Emergency access ways	**N/A**	

	A3.5a Perimeter roads	**Acceptable Solution**	Perimeter road has been provided.
	A3.5b Fire service access routes	**N/A**	
	A3.6 Battle axes	**N/A**	
4: Water	A4.1 Water supply for structure plans	**Acceptable Solution**	Hydrants provided via a reticulated water supply to comply with Water Corporation's No. 63 Water Reticulation Standard.
	A4.2 Water supply for subdivision applications	**N/A**	
	A4.3 Water supply for existing habitable building(s)	**N/A**	

Bushfire hazards identified are:

The subject lots are embedded within a mixed urban and industrial setting but are notably positioned adjacent to a continuous riparian vegetation corridor extending along the waterway to the north (stretching southeast and southwest).

This corridor comprises a dense, forested structure with fuel continuity and minimal breaks in canopy, representing a significant source of bushfire hazard. To the northwest, land use transitions into a mosaic of rural-residential and agricultural holdings characterised by unmanaged grasslands, scattered trees, and vegetated boundaries, contributing to fine fuel connectivity, ember generation and grassfire/landscape fire potential.

While the surrounding industrial areas to the east and southeast introduce fragmentation, the site's exposure to adjoining unmanaged vegetation and its proximity to connected forested corridors (in the south and north) indicate a moderate to elevated bushfire risk.

Action Required:

Compliance with this BMP, and therefore SPP 3.7, will require action before, during and after development. The items requiring implementation include:

- Prior to the lodgement of a subdivision application, Council will require a detailed assessment of site-specific vegetation, layout, and compliance with bushfire protection criteria before approving final subdivision or development plans in bushfire-prone areas.
- All developers must submit a detailed assessment against State Planning Policy 3.7 to support any proposed development within the bushfire-prone area.
- Subdivision plan to show Public Open Space (POS) to be maintained to APZ standards.

The entire report should be read in conjunction with the guidelines to ensure all requirements are understood.

Table of Contents

1 PROPOSAL AND SITE DETAILS 8

1.1 PROPOSAL DETAILS 8

2 ENVIRONMENTAL CONSIDERATIONS 11

2.1 NATIVE VEGETATION – MODIFICATION AND CLEARING 12

2.2 REVEGETATION/LANDSCAPE PLAN 12

3 BROADER LANDSCAPE ASSESSMENT 13

3.1 BROADER LANDSCAPE ASSESSMENT (BLA) 13

4 BUSHFIRE ASSESSMENT 18

4.1 SITE ASSESSMENT 18

4.1 VEGETATION CLASSIFICATION 21

5 BUSHFIRE HAZARD ISSUES 31

6 ASSESSMENT AGAINST THE BUSHFIRE PROTECTION CRITERIA FIVE – STRUCTURE PLANS AND SUBDIVISIONS 32

ELEMENT 1: LOCATION 32

ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT 32

ELEMENT 3: VEHICULAR ACCESS 33

ELEMENT 4: WATER 36

7 IMPLEMENTATION 37

7.1 IMPLEMENTATION AND ONGOING MAINTENANCE RESPONSIBILITIES 37

7.2 ACKNOWLEDGEMENT - PROPONENT 37

8 GENERAL REFERENCES 38

9 ONLINE REFERENCES 38

10 ACKNOWLEDGEMENT OF COUNTRY 38

11 APPENDICES 39

APPENDIX A: SPATIAL REPRESENTATION OF ROADS AND WATER LINES (NEXT PAGE) 39

APPENDIX B: APZ TECHNICAL REQUIREMENTS 41

APPENDIX C: WATER TANK TECHNICAL REQUIREMENTS 42

APPENDIX D: LOT NUMBERING FOR INTERNAL REFERENCE 44

Table of Figures

Figure: 1 Lot Proposal Plan 8
Figure: 2 Plan With Use Legend 9
Figure: 3 Location 10
Figure: 4 Map of Bushfire Prone Area for Subject Site 10
Figure: 5 Map of Native Vegetation Extents for Subject Site 12
Figure: 6 BLA - Desktop Vegetation Assessment 14
Figure: 7 Assessment of Hazard Aspects by Intercardinal Quadrants 15
Figure: 8 Predominant Vegetation Pattern Assessment 16
Figure: 9 Identified Access Routes 17
Figure: 10 Vegetation Classification 19
Figure: 11 BAL Contours (Indicative – Attainable Post Development) 20
Figure: 12 Spatial representation of Compliance 40

1 Proposal and Site Details

1.1 Proposal Details

The proposal is at Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere. The land totals 21.149 ha and is to be subdivided into 74 lots ranging from 5.085 ha to 312 m². These include lots designated as Residential (R20), Light Industry, POS & Drainage, and Highway Service.

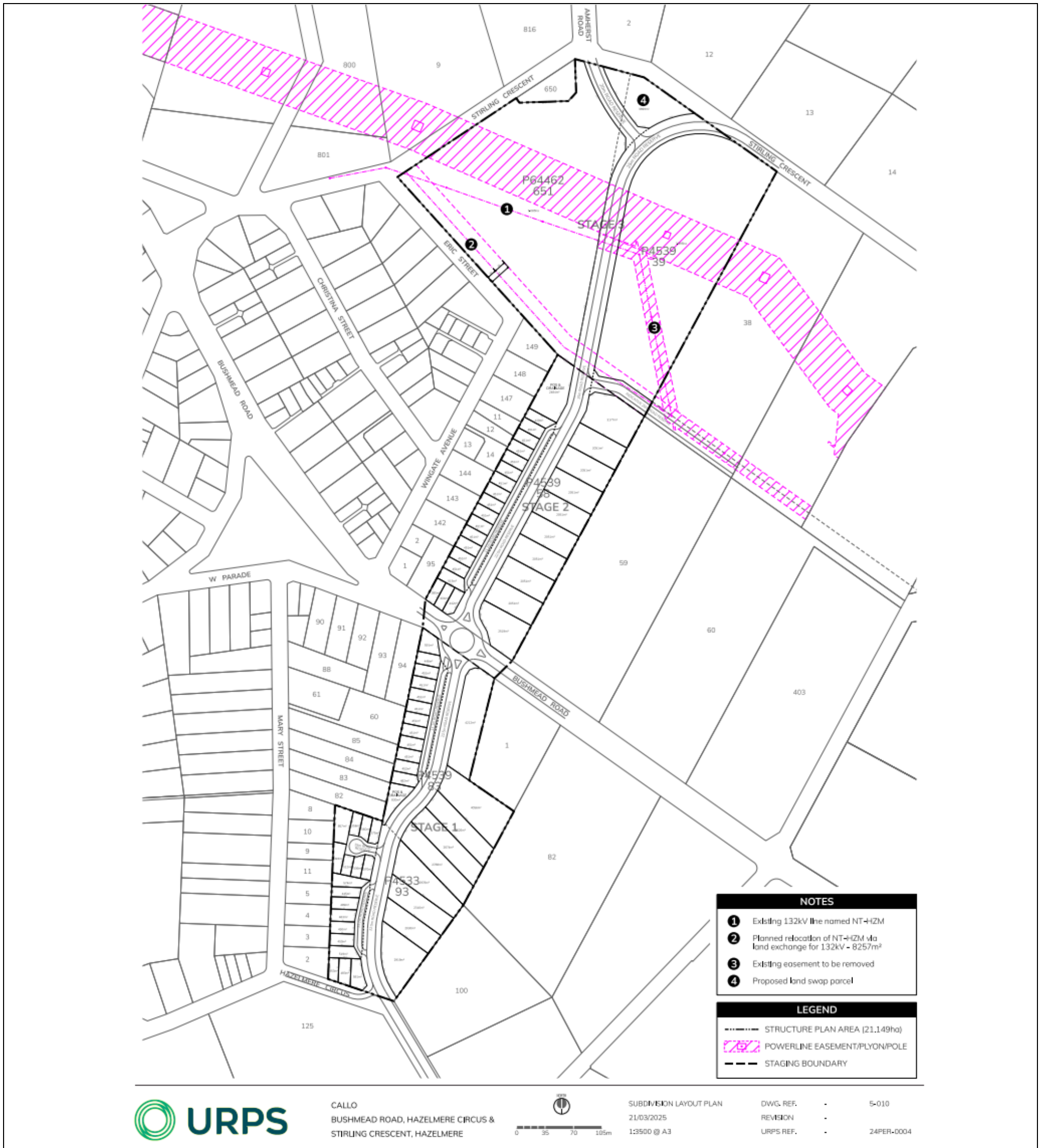


Figure: 1 *Lot Proposal Plan*

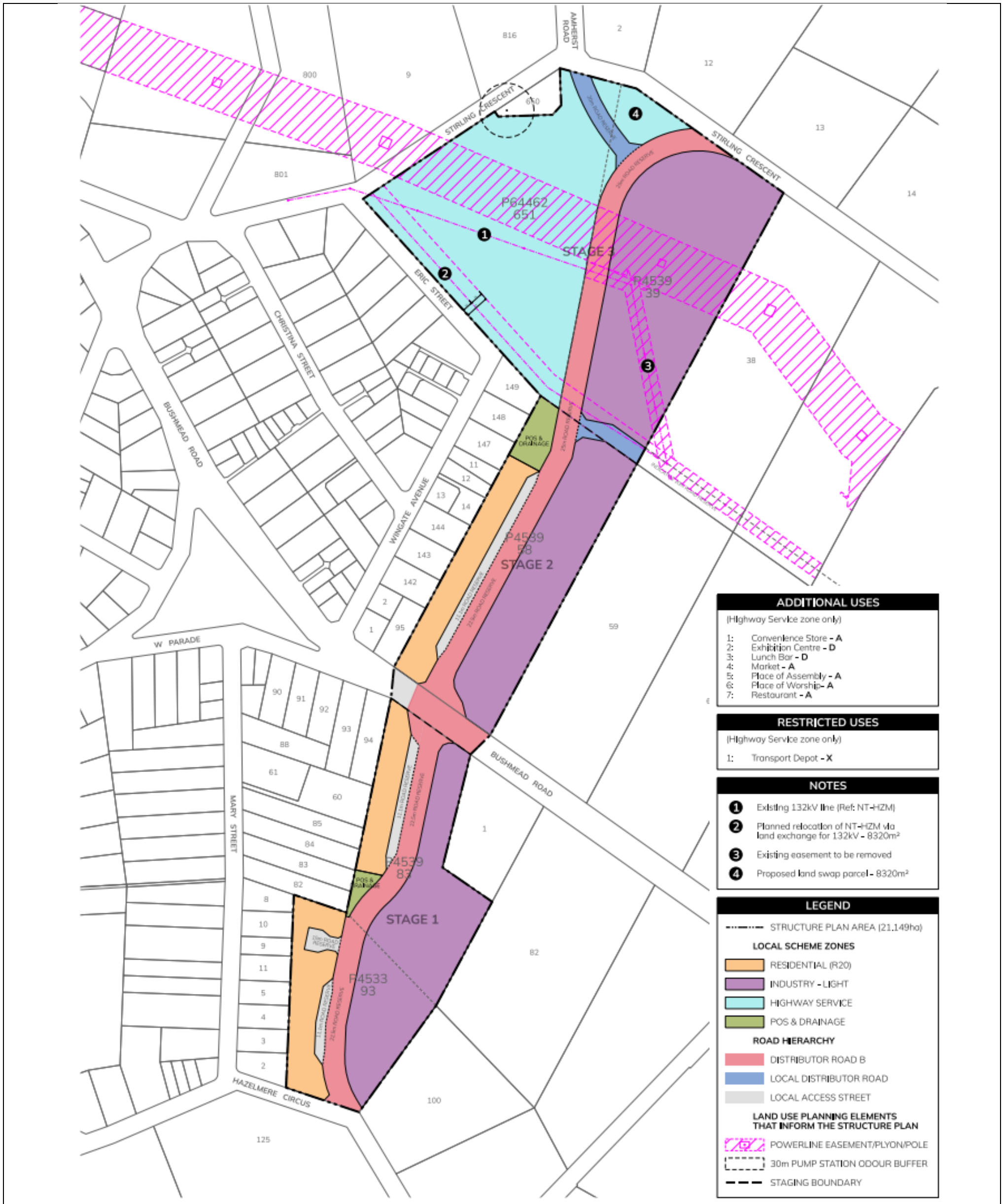


Figure: 2 *Plan With Use Legend*



Figure: 3 *Location*



Figure: 4 *Map of Bushfire Prone Area for Subject Site*

2 Environmental Considerations

SPP3.7 objective 5.4 prioritises the retention of native vegetation for biodiversity conservation, environmental protection and landscape amenity. To identify environmental, biodiversity and conservation values of the subject site, the site has been examined against the following databases as shown in Table 1.

Table 1: Assessment against environmental considerations

Object	Database	Identified	Details
Geomorphic Wetlands: Swan Coastal Plain / Augusta to Walpole	DBCA-019 / DBCA-017	Yes	Site identified within area – further action required. 
Ramsar sites (Wetland areas designated under the Ramsar Convention)	DBCA-010	No	Site not identified within database.
Threatened and Priority Flora	DBCA-036	No	Site not identified within database.
Threatened and Priority Fauna	DBCA-037	No	Site not identified within database.
Threatened Ecological Communities	DBCA-038	No	Site not identified within database.
Bush Forever Areas - 2000	DPLH-019	No	Site not identified within database.
Clearing Regulations – Environmentally Sensitive Areas	DWER-046	No	Site not identified within database.
SWAN Bioplan Regionally Significant Natural Areas 2010	DWER-070	No	Site not identified within database.
Local government biodiversity/planning	-	No	-

The entirety of the subject lot(s) lies within the Geomorphic Wetlands: Swan Coastal area identified by the Department of Biodiversity, Conservation and Attractions (DBCA).

The applicant will need to seek clarification from the appropriate authorities, which may include the preparation of reports from suitably qualified consultants, to ensure any clearing is appropriate for the area.

2.1 Native vegetation – modification and clearing

The site has been checked against the Native Vegetation mapping conducted by the Department of Primary Industries and Regional Development (DPIRD-005). This database does not show native vegetation on the site, as seen in the image below.

An asset protection zone for future development, as required in this BMP, will not require the removal of native vegetation.



Figure: 5 *Map of Native Vegetation Extents for Subject Site*

2.2 Revegetation/landscape plan

No detailed landscaping or revegetation plans relating to this proposal have been provided. However, a portion of the subdivision (2 lots of 2484 m2 and 830 m2 respectively) have been drafted as a Public Open Space & Drainage.

Any future landscaping for the site should comply with the APZ requirements of this report.

3 Broader Landscape Assessment

3.1 Broader Landscape Assessment (BLA)

The structure plan is located in Area 2, requiring a BLA. Vegetation patterns, road networks, and urban proximity have been assessed, with the figures shown below and the points collated in Table 2 below:

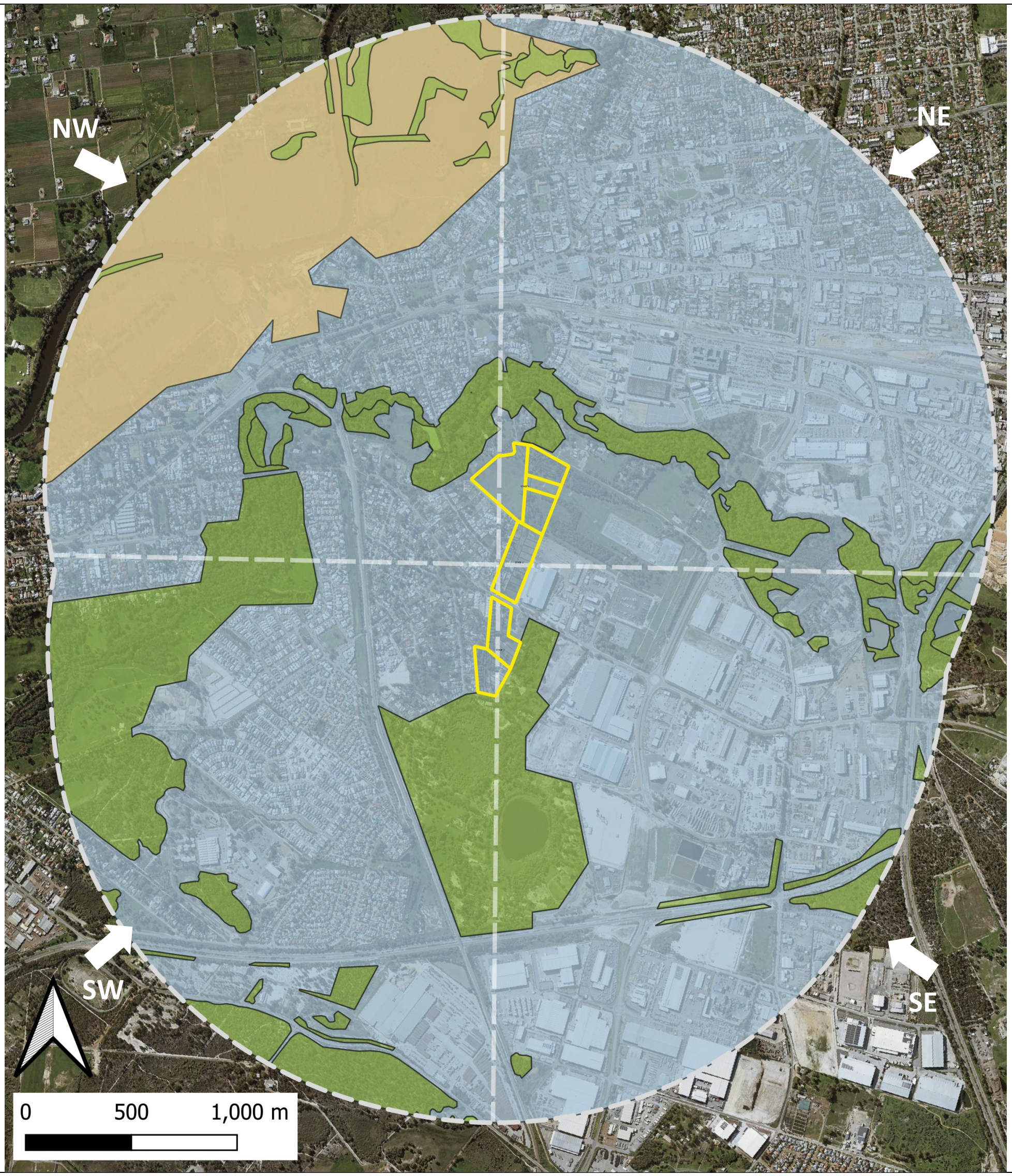
Criteria	5 points	2 points	1 point	Points for Proposal
Proximity of the proposal to a suitable destination is:	>10km	1-10km	<1km	1
The road pattern from the planning proposal to a suitable destination is:	Complex and indirect (cul-de-sacs, and/or multiple intersections)	Mixed road patterns	Simple and/or direct (limited intersections)	1
The predominant vegetation pattern is:	Large tracts of vegetation (contiguous vegetation)	A mosaic pattern of vegetation (e.g. vegetation within rural living precincts)	Cleared vegetation (e.g. clearing for residential zoned urban lots)	5
Exposure of the planning proposal to an identified external bushfire hazard (excluding Class G Grassland) is from:	Three or four aspects	Two aspects	From nil or one aspect only	2
Total Points				**9**
Broader Landscape Type Determined			Broader landscape type A (BLT A)	



The figure displays a desktop vegetation assessment using up-to-date aerial imagery, distinguishing between various vegetation classifications within the Bushfire Landscape Assessment (BLA) area. Low-threat and non-vegetated areas are outlined, alongside plots of unmanaged grassland (Class G Grassland) and other types of classified vegetation grouped together. Special attention is given to areas designated for revegetation or identified for conservation, biodiversity, or environmental protection. The figure also identifies undeveloped land with approved plans proposing a post-development BAL rating of BAL-LOW as future non-vegetated areas. Any coastlines or water bodies within or adjacent to the BLA area are marked as non-vegetated, as they act as natural barriers to fire spread.

Figure: 6 *BLA - Desktop Vegetation Assessment*

Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere	**Legend**				
The aerial imagery used was the best available at the time of review; however, it may no longer reflect the most current conditions.	Subject Land	2km area assessment	Low Threat vegetation	Unmanaged Grassland	All Other classified vegetation



The figure illustrates the Bushfire Landscape Assessment (BLA) area, divided into four intercardinal quadrants—Northeast, Southeast, Northwest, and Southwest. Each quadrant is assessed for bushfire hazards external to the proposed development, focusing on potential landscape-scale impacts on life, property, and infrastructure. The diagram highlights classified vegetation extents within each quadrant, allowing for a comprehensive evaluation of hazard intensity relative to the aspects of the terrain.

Figure: 7 *Assessment of Hazard Aspects by Intercardinal Quadrants*

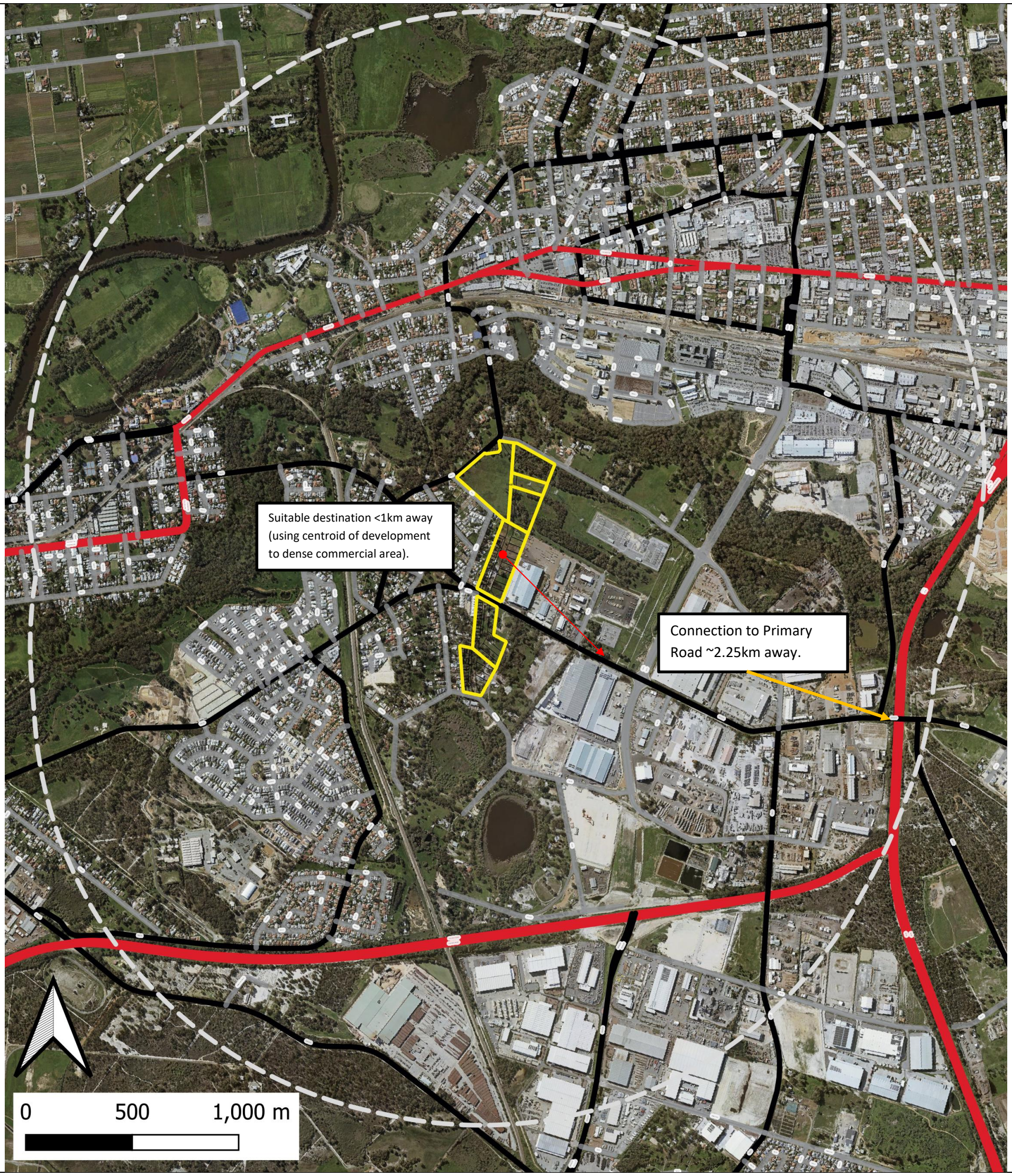
Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere	**Legend**				
The aerial imagery used was the best available at the time of review; however, it may no longer reflect the most current conditions.	Subject Land	2km area assessment	Low Threat vegetation	Unmanaged Grassland	All Other classified vegetation



The figure shows the main vegetation patterns identified in the Bushfire Landscape Assessment (BLA) area. It highlights cleared vegetation, which includes residential and urban areas with low bushfire risk due to limited fuel. The mosaic pattern displays patches of Class G Grassland mixed with rural living areas, indicating varied fire behaviour. Lastly, the figure features large tracts of classified vegetation found in reserves or national parks, which present a higher risk for long fire runs and landscape-scale bushfires. Overall, the figure illustrates how different vegetation types affect bushfire hazards in the broader area.

Figure: 8 *Predominant Vegetation Pattern Assessment*

Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere	**Legend**				
The aerial imagery used was the best available at the time of review; however, it may no longer reflect the most current conditions.	Subject Land	2km area assessment	Cleared Vegetation	Mosaic Pattern	Large Tracts of classified vegetation



The figure provides a detailed assessment of the road network and vehicular access to designated destinations. It maps both existing and proposed routes, classifying them by road hierarchy and accessibility standard (sealed or unsealed) and indicating topographical influences. Spatial differentiation highlights areas with direct, extended-view access (e.g., grid or modified grid layouts) versus complex road patterns, including curved roads or cul-de-sacs. Vegetation impediments are annotated along each route, noting characteristics affecting reliability where known.

Figure: 9 *Identified Access Routes*

Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere	**Legend**					
The aerial imagery used was the best available at the time of review; however, it may no longer reflect the most current conditions.	Subject Land	2km area assessment	Primary Regional Road	Other Regional Road	Local Road	Access Road

4 Bushfire Assessment

4.1 Site Assessment

The assessment of this site/development was undertaken by a BPAD Accredited Practitioner for the purpose of determining the Bushfire Attack Level in accordance with AS 3959-2018 Simplified Procedure (Method 1).



Figure: 10 *Vegetation Classification*

Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere	Legend											
The aerial imagery used was the best available at the time of review; however, it may no longer reflect the most current conditions.	Proposed Lot Boundary	Subject Land	150m area assessment	100m area assessment	Photo point	A Forest	B Woodland	C Shrubland	D Scrub	G Grassland	Excluded	Other

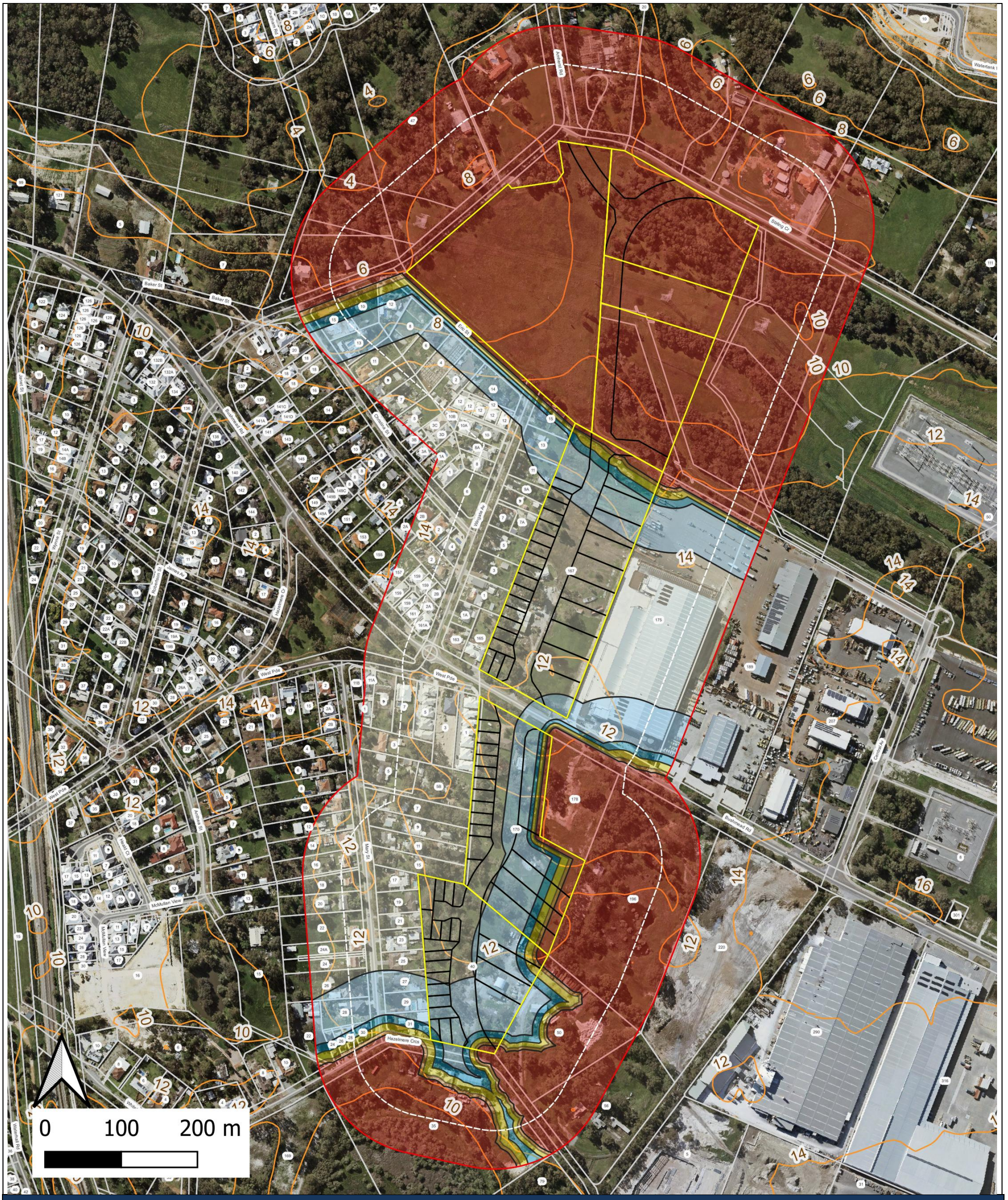


Figure: 11 *BAL Contours (Indicative – Attainable Post Development)*

Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere	**Legend**										
The aerial imagery used was the best available at the time of review; however, it may no longer reflect the most current conditions.	Proposed Lot Boundary	Subject Land	150m area assessment	100m area assessment	BAL FZ	BAL 40	BAL 29	BAL 19	BAL 12.5	BAL Low	Comments

4.1 Vegetation Classification

All vegetation within 150m of the site / proposed development was classified in accordance with Clause 2.2.3 of AS 3959-2018. Each distinguishable vegetation plot with the potential to determine the Bushfire Attack Level is identified below.

Table 2: BAL Analysis

Plot:	1	**Effective Slope (°):**	Flat/Upslope	**Separation Distance (m):**	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class A Forest - Open forest A-03		
Description / Justification for Classification:					
To the south of the project lies an inactive portion of a commercial lot, featuring unmanaged grasses reaching ~40 cm in height. This area is bordered by multi-height vegetation structures, including *Eucalyptus* species up to ~18 m, with scattered lower trees, shrubs, and scrub throughout. Aerial imagery indicates a short, steep depression in the terrain that likely terminates in a low-lying wetland zone.					
					
Photo ID: 1				**Photo ID: 2**	

Plot:	2	Effective Slope (°):	Flat/Upslope	Separation Distance (m):	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class A Forest - Open forest A-03		

Description / Justification for Classification:

Permanently non-vegetated spaces include public roads, driveways, cul-de-sacs, gravel parking bays, and surrounding residential/commercial developments in the area, as well as hardscaped verge areas devoid of vegetation. Low-threat vegetation includes private managed gardens with visible irrigation and high moisture content, cropped verge grasses maintained at <100mm, and isolated trees or shrubs lacking understorey.



Photo ID: 3



Photo ID: 4

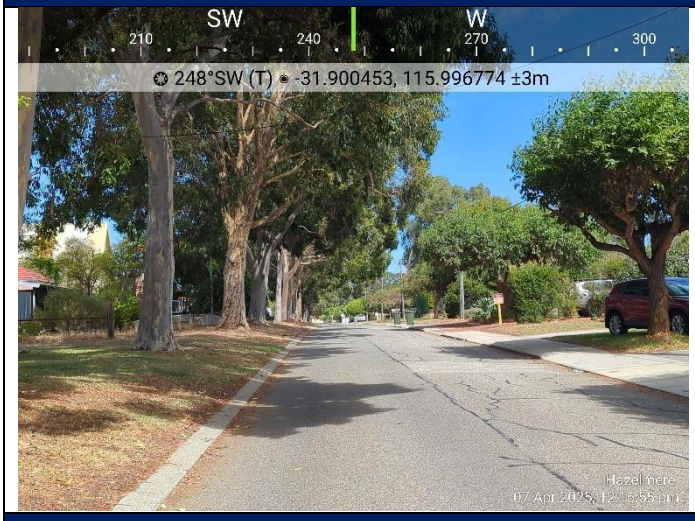


Photo ID: 5

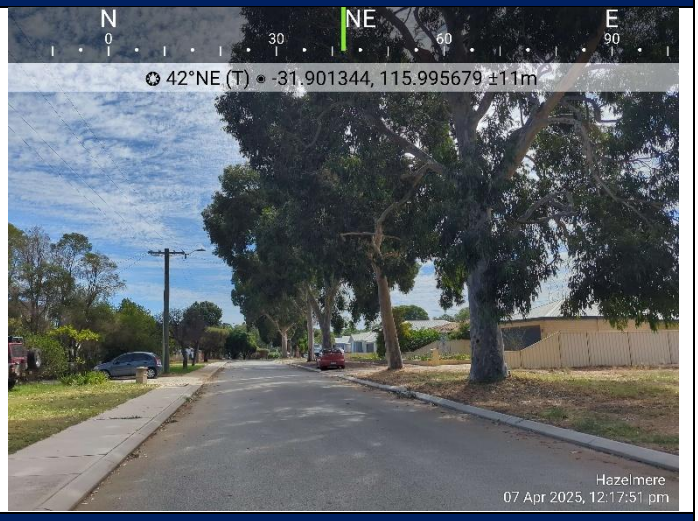


Photo ID: 6

Plot 2 Continued.



Photo ID: 7

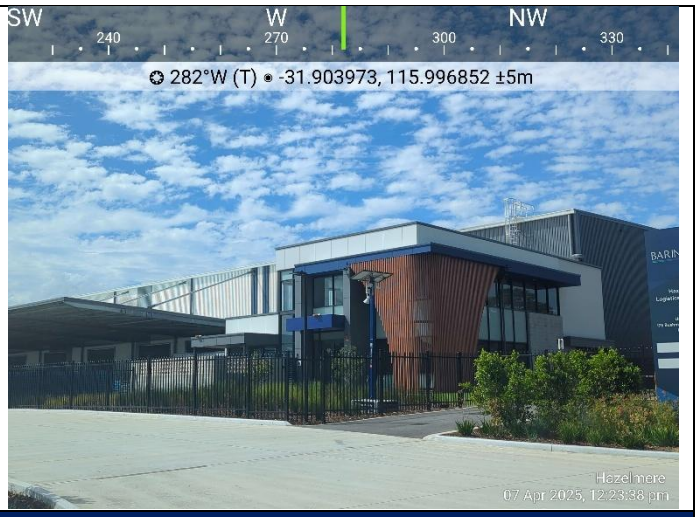


Photo ID: 8

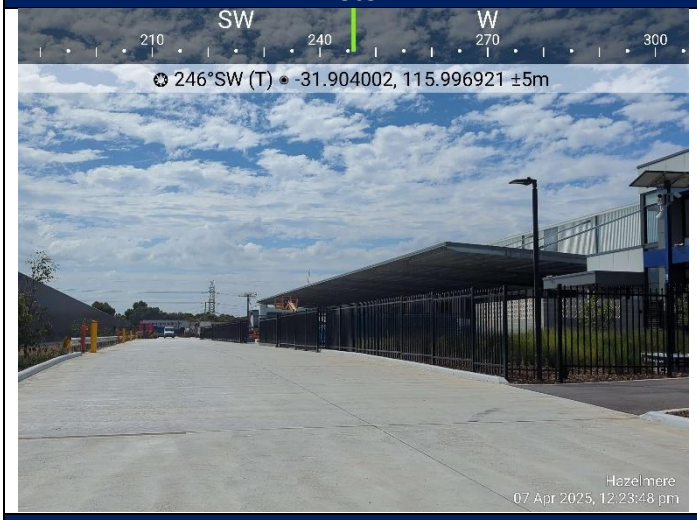


Photo ID: 9



Photo ID: 10

Plot:	3	Effective Slope (°):	Flat/Upslope	Separation Distance (m):	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class B Woodland - Open woodland B-06		
Description / Justification for Classification:					
Wooded area to the east of Stage 1 contains trees approximately 16 m in height with foliage cover between 10–30% and lacks shrub or scrub. Managed grasses are present below, contributing to open understorey.					

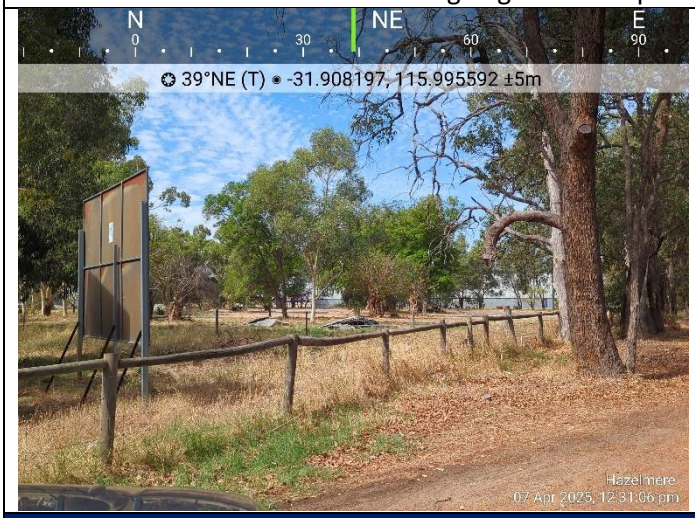


Photo ID: 11

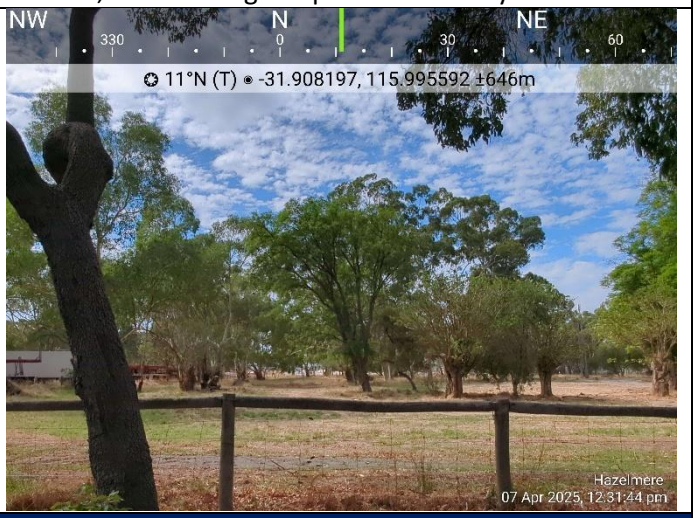


Photo ID: 12

Plot:	4	Effective Slope (°):	Flat/Upslope	Separation Distance (m):	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class A Forest - Open forest A-03		
Description / Justification for Classification:					
West of Plot 3, tree coverage becomes denser with foliage cover exceeding 30%. Unmanaged grasses are present below. Background of Photo ID 14 shows this forested area from the south looking northward.					



Photo ID: 13



Photo ID: 14

Plot:	5a/b	Effective Slope (°):	N/A	Separation Distance (m):	N/A
Vegetation Classification or Exclusion Clause:			Excludable - 2.2.3.2 (e/f) Non-Vegetated Areas & Low Threat Vegetation		

Description / Justification for Classification:

Photo ID 15 shows the commercial-use area of #35 Hazelmere Circus, a low-fuel working area used for trucks and equipment. While some edge grasses are present, they are insufficient in quantity to contribute to increased bushfire attack severity. The foreground of Photo ID 14 depicts the low threat and non-vegetated space of the commercial lot at #50, with the forest described in Plot 4 visible in the background.



Photo ID: 15



Photo ID: 14

Plot:	6	Effective Slope (°):	Flat/Upslope	Separation Distance (m):	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class G Grassland – Open tussock G-23		

Description / Justification for Classification:

East of Plot 4 is a grassland area with prior management evident, though currently unmanaged. Scruffy grasses border the subject area, and while edge trees are present, the broader area remains open grassland.



Photo ID: 16

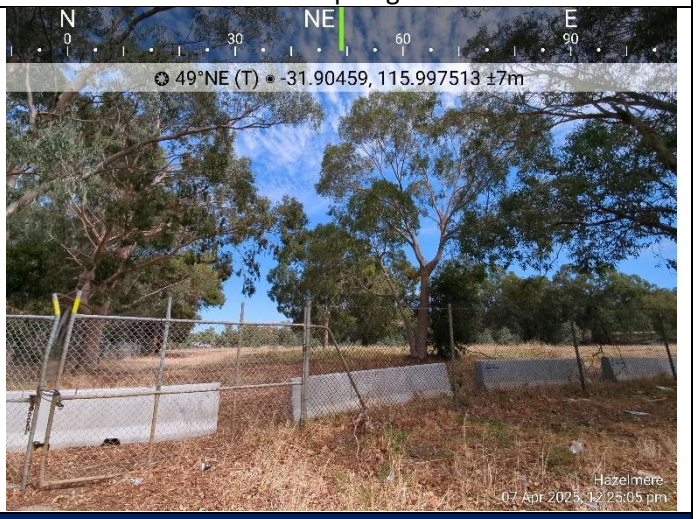


Photo ID: 17

Plot:	7	Effective Slope (°):	N/A	Separation Distance (m):	N/A
Vegetation Classification or Exclusion Clause:			Excludable - 2.2.3.2(f) Low Threat Vegetation		
Description / Justification for Classification:					
Public Open Space (POS) contains a well-maintained greenspace. Grasses are cropped to <100 mm, with crown-lifted trees set within thick woodchip mulch.					

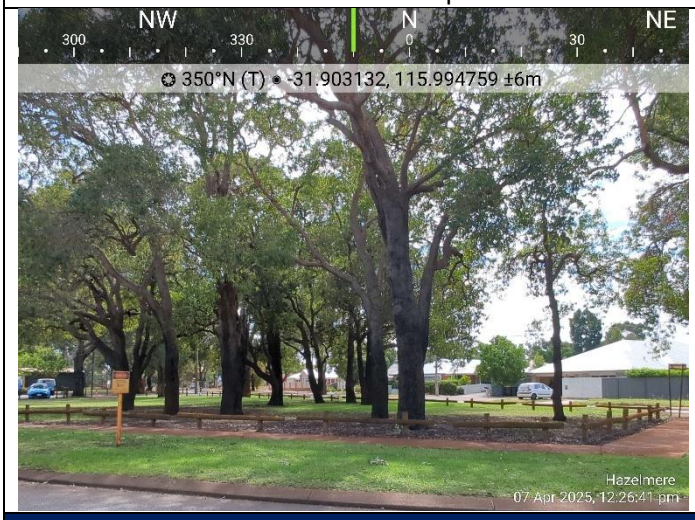


Photo ID: 18

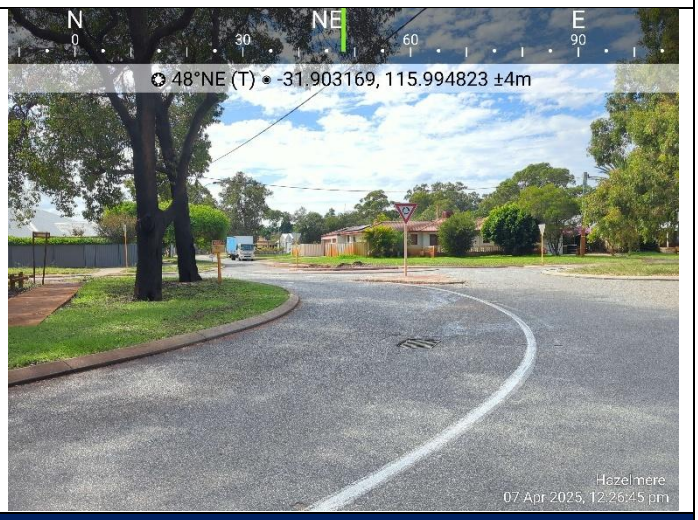


Photo ID: 19

Plot:	8a/b/c	Effective Slope (°):	Flat/Upslope	Separation Distance (m):	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class A Forest - Open forest A-03		
Description / Justification for Classification:					
Remnant forest persists across easements in the Stage 3 area of the project. Vegetation is mixed species dominated by *Eucalyptus* spp., reaching up to 20 m in height. Foliage cover significantly exceeds 30%.					

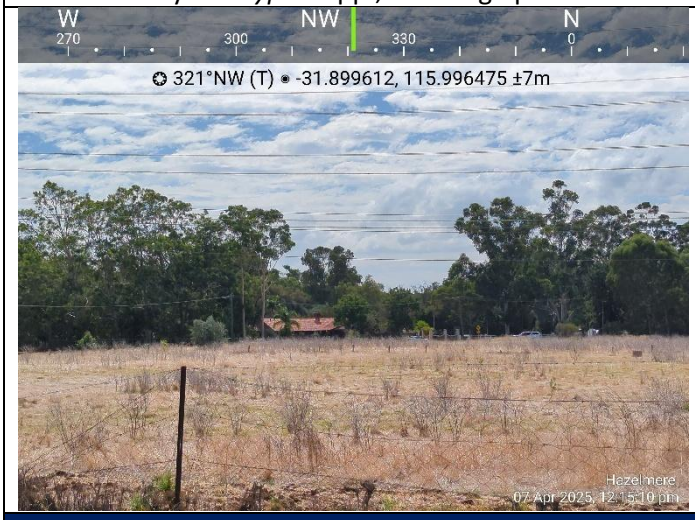


Photo ID: 20

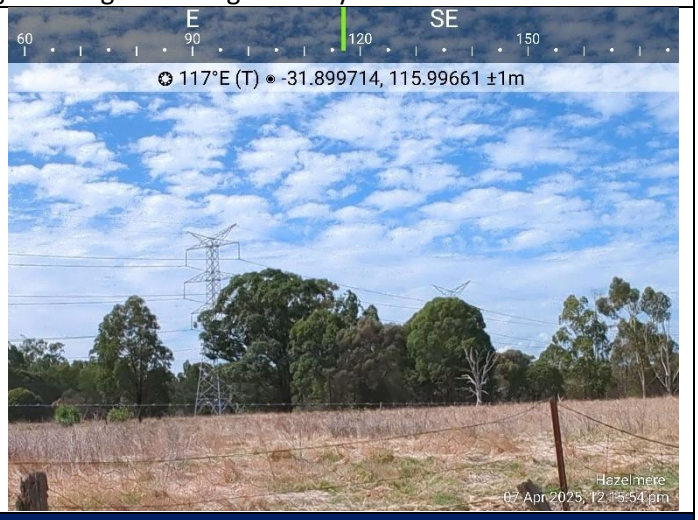


Photo ID: 21

Plot:	9	Effective Slope (°):	Flat/Upslope	Separation Distance (m):	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class G Grassland – Tussock grassland G-22		
Description / Justification for Classification:					
The same imagery as above shows extensive partially managed grassland situated between forest patches along easements and beneath power pylon lines. While contour data indicates a slope, this was not apparent during the site inspection.					

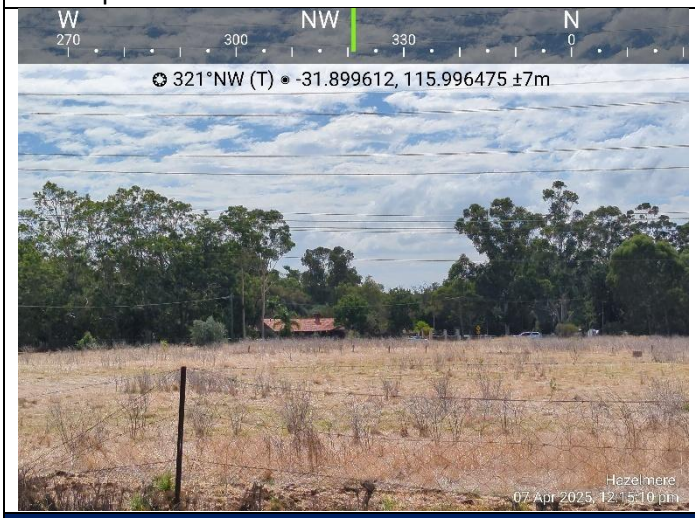


Photo ID: 20



Photo ID 21

Plot:	10	Effective Slope (°):	>0-5°	Separation Distance (m):	Varies – See Table
Vegetation Classification or Exclusion Clause:			Class A Forest - Open forest A-03		
Description / Justification for Classification:					
North of Stage 3, a mixed-species forest structure features *Eucalyptus* spp. and ornamental trees. Access to vegetation beyond the roadside was restricted due to private residential lots, but aerial imagery indicates a contiguous vegetation structure surrounding the existing residential developments. Trees reach up to 25 m in height with vertical fuel continuity throughout.					



Photo ID: 22



Photo ID: 23

Plot:	11a/b	Effective Slope (°):	N/A	Separation Distance (m):	N/A
Vegetation Classification or Exclusion Clause:			Excludable - 2.2.3.2(f) Low Threat Vegetation		
Description / Justification for Classification:					
The proposed Public Open Space (POS) areas are not yet established but are assessed as part of the landscape vegetation. Per client feedback, these areas will be landscaped, likely with turf, and possibly retaining one or two established trees. The northern POS is expected to primarily feature turfed recreational space with a secondary drainage function. The southern POS will mostly serve as a drainage area, though it is anticipated to have a turfed arrangement as well. This assumption will be retained until the detailed subdivision and landscaping stages.					

The Fire Danger Index (FDI) – 80-and table 2.4.3 AS3959-2018 applied.

Potential Bushfire Impacts

The potential bushfire impact to the site / proposed development from each of the identified vegetation plots are identified below.

Table 3.1: BAL Analysis

Plot	Vegetation Classification	Effective Slope
1	Class A - Forest	Flat/Upslope
2	Excludable - 2.2.3.2 (e/f) Non-Vegetated Areas & Low Threat Vegetation	N/A
3	Class A - Forest	Flat/Upslope
4	Class A - Forest	Flat/Upslope
5	Excludable – Clause 2.2.3.2(e)	N/A
6	Class G Grassland	Flat/Upslope
7	Excludable – Clause 2.2.3.2(f)	N/A
8a/b/c	Class A - Forest	Flat/Upslope
9	Class G Grassland	Flat/Upslope
10	Class A - Forest	>0-5°
11a/b	Excludable – Clause 2.2.3.2(f)	N/A

Table 3.3: BAL Analysis showing Determined and Indicative BAL with APZ requirements

Plans received did not have tentative Lot numbering available and have therefore been broken down into C = Commercial and R = Residential numbers for reference purposes. Not all lots have been numbered, only those require modified offsets.
See Appendix D for Map with Labelled Lots per below.

Lot (s)	Vegetation Plot	Vegetation Classification	Effective Slope	Separation (m)	Highest (Determined) BAL Contour	APZ / Offset Required	Indicative BAL Contour
C1	3	Class B Woodland	Flat/Upslope	4.7	BAL – FZ	9.3 m from E Boundary	BAL – 29
C2	4	Class A - Forest	Flat/Upslope	46.5	BAL – 12.5	-	BAL – 12.5
C3	4	Class A - Forest	Flat/Upslope	19.8	BAL – 40	1.2 m from E Boundary	BAL – 29
C4	4	Class A - Forest	Flat/Upslope	0	BAL – FZ	21 m from E Boundary	BAL – 29
C5-C7	4	Class A - Forest	Flat/Upslope	0	BAL – FZ	21 m from E Boundary	BAL – 29
C8	4	Class A - Forest	Flat/Upslope	0	BAL – FZ	21 m from E Boundary	BAL – 29
C8	6	Class G Grassland	Flat/Upslope	0	BAL – FZ	8 m from N Boundary	BAL – 29
C9	6	Class G Grassland	Flat/Upslope	0	BAL – FZ	8 m from N Boundary	BAL – 29
C10	6	Class G Grassland	Flat/Upslope	30	BAL – 12.5	-	BAL – 12.5
C11	8c	Class A - Forest	Flat/Upslope	76.6	BAL – 12.5	-	BAL – 12.5
C12	8c	Class A - Forest	Flat/Upslope	46	BAL – 12.5	-	BAL – 12.5
C13	8c	Class A - Forest	Flat/Upslope	0	BAL – FZ	21 m from N Boundary	BAL – 29
C13	9	Class G Grassland	Flat/Upslope	0	BAL – FZ	8 m from N Boundary	BAL – 29
R1	1	Class A - Forest	Flat/Upslope	30.7	BAL – 29	-	BAL – 29

R2	1	Class A - Forest	Flat/Upslope	40.8	BAL – 19	-	BAL – 19
R3	3	Class B Woodland	Flat/Upslope	26.2	BAL – 19	-	BAL – 19
R4	1	Class A - Forest	Flat/Upslope	49.1	BAL – 12.5	-	BAL – 12.5
R5	1	Class A - Forest	Flat/Upslope	62.1	BAL – 12.5	-	BAL – 12.5
R6	1	Class A - Forest	Flat/Upslope	75.7	BAL – 12.5	-	BAL – 12.5
R7	1	Class A - Forest	Flat/Upslope	90	BAL – 12.5	-	BAL – 12.5
R8	8c	Class A - Forest	Flat/Upslope	94.2	BAL – 12.5	-	BAL – 12.5
R9	8c	Class A - Forest	Flat/Upslope	78	BAL – 12.5	-	BAL – 12.5

In its predevelopment state, all residential lots proposed are located within an area with a radiant heat impact not exceeding 29 kW/m² (BAL-29), therefore no offsets or additional APZ required.

For commercial lots, all contain a buildable area that does not exceed 29 kW/m² (BAL-29). APZs and suitable boundary offsets will be required to ensure future developments are within this area at the time of individual DA.

5 Bushfire Hazard Issues

The subject lots are embedded within a mixed urban and industrial setting but are notably positioned adjacent to a continuous riparian vegetation corridor extending along the waterway to the north (stretching southeast and southwest).

This corridor comprises a dense, forested structure with fuel continuity and minimal breaks in canopy, representing a significant source of bushfire hazard. To the northwest, land use transitions into a mosaic of rural-residential and agricultural holdings characterised by unmanaged grasslands, scattered trees, and vegetated boundaries, contributing to fine fuel connectivity, ember generation and grassfire/landscape fire potential.

While the surrounding industrial areas to the east and southeast introduce fragmentation, the site's exposure to adjoining unmanaged vegetation and its proximity to connected forested corridors (in the south and north) indicate a moderate to elevated bushfire risk.

6 Assessment against the Bushfire Protection Criteria Five – Structure plans and Subdivisions

An assessment against the bushfire protection criteria is required to be undertaken for any strategic planning proposal or subdivision that has or will, on completion, have a bushfire hazard level above 'Low' or a BAL rating above BAL LOW. The following section outlines the steps required to ensure this proposal meets the necessary compliance standards

Element 1: Location

The proposal is within Area 2 and has been identified as Broader Landscape A (BLT A) within the Broader Landscape Assessment conducted within this report. Therefore, the proposal meets the acceptable solution of Element 1.

Element 2: Siting and design of development

A.2.1a: Siting and design

Each proposed building lot contains a sufficient development site(s) that can achieve a radiant heat impact not exceeding 29 kW/m² (BAL-29).

A2.2 Asset Protection Zone (APZ)

All lots are to be maintained to APZ standards, including all grass being maintained at less than 100mm tall, by the developer until sale and then by new owners following that. All landscaping within lots and verges to be managed as per Table 9 of the guidelines, extract shown in Appendix B.

Element 2.2 will be satisfied using an indicative Asset Protection Zone (APZ) which will allow a radiant heat impact not exceeding 29 kW/m² (BAL-29). See Table 3.3. for details.

A2.3 Clearing of native vegetation

The structure plan does not require the clearing of native vegetation. Per 2.1 of this report, the subject lots do not fall within the native vegetation extent.

Element 3: Vehicular Access

A3.1 Public Roads

The minimum requirements under this acceptable solution are applicable to all proposed and existing public roads.

While all existing public roads are assumed to meet the minimum technical requirements, all new roads must meet the minimum technical requirements of Appendix B.3, Table 10 (shown below).

Table 10: Vehicular access technical requirements

	1		2		3		4		5	
TECHNICAL REQUIREMENTS	**PERIMETER ROADS**		**PUBLIC ROADS**		**EMERGENCY ACCESS WAY[3]**		**FIRE SERVICE ACCESS ROUTE[3]**		**BATTLE-AXE & PRIVATE DRIVEWAYS[1]**	
MAP OF BUSH FIRE PRONE AREAS DESIGNATION	**Area 2**	**Area 1**	**Area 2**	**Area 1**	**Area 2**	**Area 1**	**Area 2**	**Area 1**	**Area 2**	**Area 1**
Minimum horizontal clearance (metres)	12	8	See note 5		10	6	10	6	6	
Minimum vertical clearance (metres)	4.5									
Minimum weight capacity (tonnes)	15									
Maximum grade unsealed road[2]	See note 5		See note 5		1:10 (10% or 6°)					
Maximum grade sealed road[2,4]					1:7 (14.3% or 8°)					
Maximum average grade sealed road					1:10 (10% or 6°)					
Minimum inner radius of road curves (metres)					8.5					

Notes:

[1] Driveways and battle-axe legs to comply with the Residential Design Codes and Development Control Policy 2.2 Residential Subdivision where not required to comply with the widths in this Appendix or the Guidelines.

[2] Dips must have no more than a 1 in 8 (12.5% - 7.1 degrees) entry and exit angle.

[3] To have crossfalls between 3 per cent and 6 per cent.

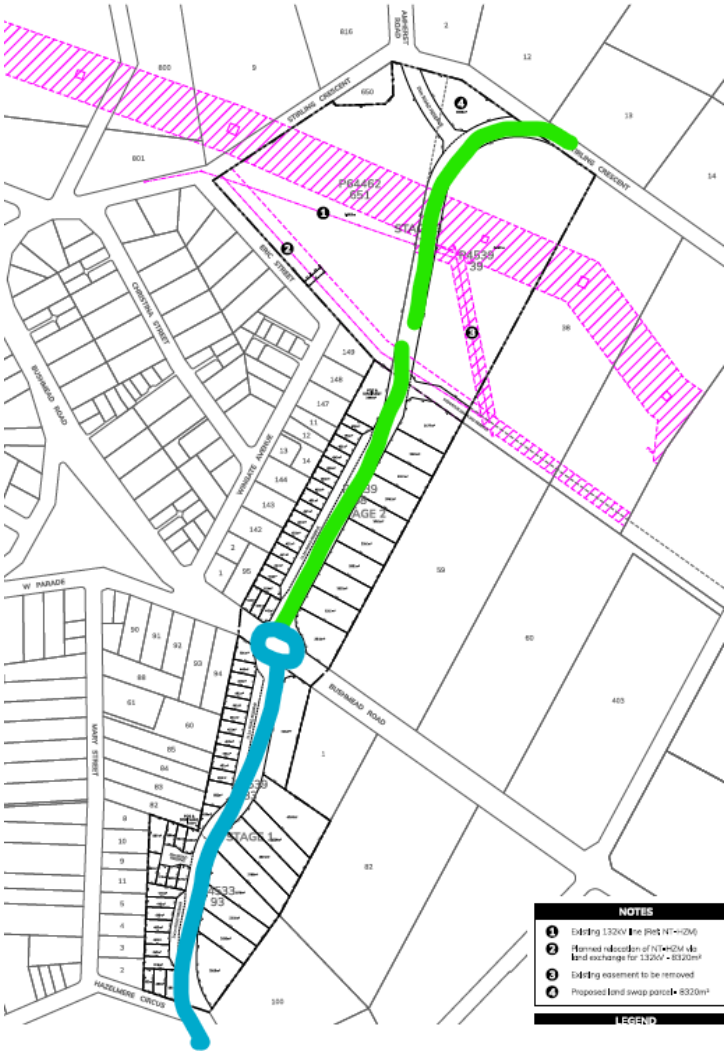
[4] For sealed roads only the maximum grade of no more than 1 in 5 (20 per cent) (11.3 degrees) for no more than 50 metres is permissible, except for short constrictions to 3.5 metres for no more than 30 metres in length where an obstruction cannot be reasonably avoided or removed.

[5] As outlined in the Institute of **Public Works Engineering Australasia (IPWEA) subdivision guidelines, Liveable Neighbourhoods, Austroads Standards** Main Roads standard, supplement, policy or guideline and/or any applicable or relevant local government standard or policy.

A3.2 Access routes

The structure plan will be implemented in three stages, with agreements in place to ensure that the roads are constructed during either Stage 1 or Stage 2. All stages fall within an area classified as 'Area 2,' and public road access is provided from two different directions to at least two suitable destinations, with an all-weather, two-way surface.

It is understood that the primary distributor road, which serves as the main spine, will be constructed by the City of Swan before any development on the lots commences. The City has allocated funding for this road and it is expected that the road will be completed in one stage (Stirling Street to Hazelmere Circus), or at most, in two stages (as indicated by the green and blue notations in image below).



Assuming this to be the case, the following access will be provided:

Stage 1 -

- North to Bushmead Road, leading west to urban areas or east to industrial developments.
- South to Hazelmere Circus, leading southeast to Lakes Road or southwest to Whitehall Road.

Depending on fire location, either route may be preferable.

Stage 2 –

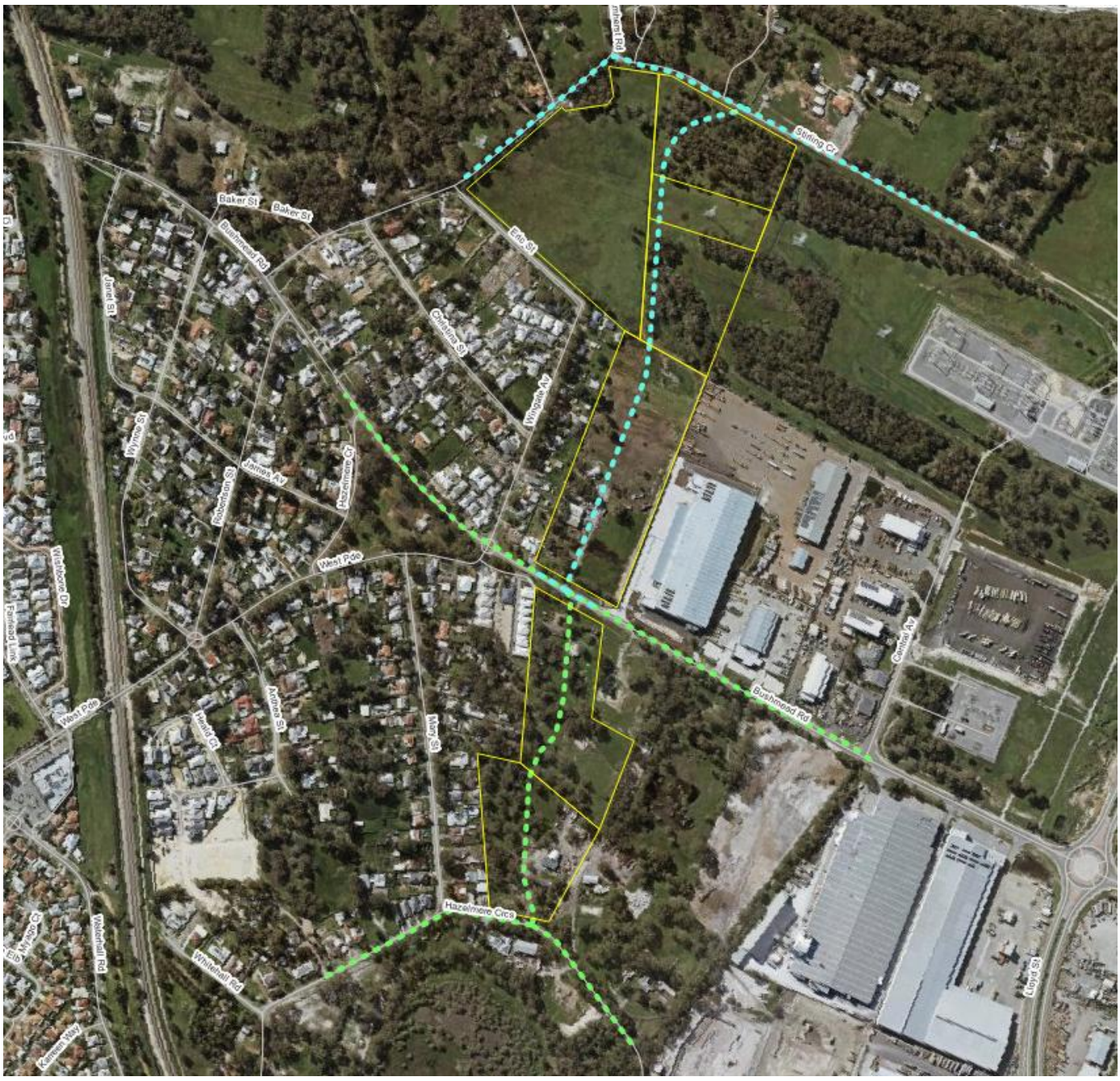
- South to Bushmead Road, leading west to urban areas or east to industrial developments.
- North to Stirling Crescent.

Egress via Bushmead Road would be preferential as Stirling Crescent runs through easement reserves and into rural/lifestyle blocks that are more likely to carry a fire. Whereas Bushmead leads to and through urban areas that have a lower risk.

Stage 3 – (Not intended for Residential or Commercial purposes but has access)

- South to Bushmead Road, leading west to urban areas or east to industrial developments.
- North to Stirling Crescent.

Egress via Bushmead may be most preferable per above.



Green = Stage 1, Blue = Stage 2 (if not completed as part of Stage 1)

A3.3a No-through-roads

The subdivision is within an area classified as 'Area 2' and must comply. Two-way access will be established upon completion of Stage 1 or, at worst, during Stage 2. Therefore, all roads will be through roads.

A3.3b No-through-road requirements – Not Applicable

A3.4 Emergency access way – Not Applicable

A3.5a Perimeter roads

A perimeter road is to meet the requirements contained in Appendix B.3, Table 10, Column 1.

A3.5b Fire service access route – Not Applicable

A3.6 Battle-Axe Legs – Not Applicable

Element 4: Water

A4.1 Water supply for structure plans

There is a reticulated water supply for firefighting that may be provided at the subdivision and/or development application stage, in accordance with the specifications of the relevant water supply authority or the requirements in Appendix B.4: Water Supply dedicated for bushfire firefighting.

A4.2 Provision of water for firefighting purposes – Not Applicable

A4.3 Water supply for existing habitable building(s) – Not Applicable

7 Implementation

7.1 Implementation and Ongoing Maintenance Responsibilities

The following tables set out the responsibilities of the developer(s), landowner(s) and local government for the initial implementation and ongoing maintenance associated with this proposal.

	Management Action	Timing
	Proponent/Developer	
1	Council will require a detailed assessment of site-specific vegetation, layouts, and compliance with bushfire protection criteria before approving final subdivision or development plans in bushfire-prone areas.	Prior to the lodgement of subdivision application
2	All developers of the proposed areas must present a detailed assessment against State Planning Policy 3.7 to support any development within the Bushfire Prone Area.	Prior to the lodgement of subdivision application

7.1.1 The following items, as numbered in the above table, are subject to a Clearance Certificate issued by the Bushfire Consultant:

None required.

7.2 Acknowledgement - Proponent

The proponent acknowledges the responsibilities as listed above and the requirement to ensure that should the land transfer to a new owner, that the new owner is aware of the BMP and their ongoing responsibility.

8 General References

Office of Bushfire Risk Management (OBRM). (2020). *Bushfire risk management (BRM) plan guidelines*. Retrieved October 2020.

Standards Australia. (2024). *AS 3959-2018 construction of buildings in bushfire-prone areas*. Sydney.

WA Department of Planning. (2016). *Visual guide for bushfire risk assessment in Western Australia*.

Water Corporation. (2018). *Design standard DS 63: Water reticulation standard design and construction requirements for water reticulation systems up to DN250 (Version 3, Revision 14)*. Water Corporation.

Western Australian Planning Commission. (2024). *State planning policy 3.7 Bushfire*. State of Western Australia.

Western Australian Planning Commission. (2024). *Planning for bushfire guidelines*. State of Western Australia.

9 Online references

Landgate. (2024). Map Viewer Plus. Government of Western Australia. Retrieved from https://map-viewer-plus.app.landgate.wa.gov.au/index.html

Office of Bushfire Risk Management (OBRM). (2024). Map of Bush Fire Prone Areas. Retrieved from https://maps.slip.wa.gov.au/landgate/bushfireprone/

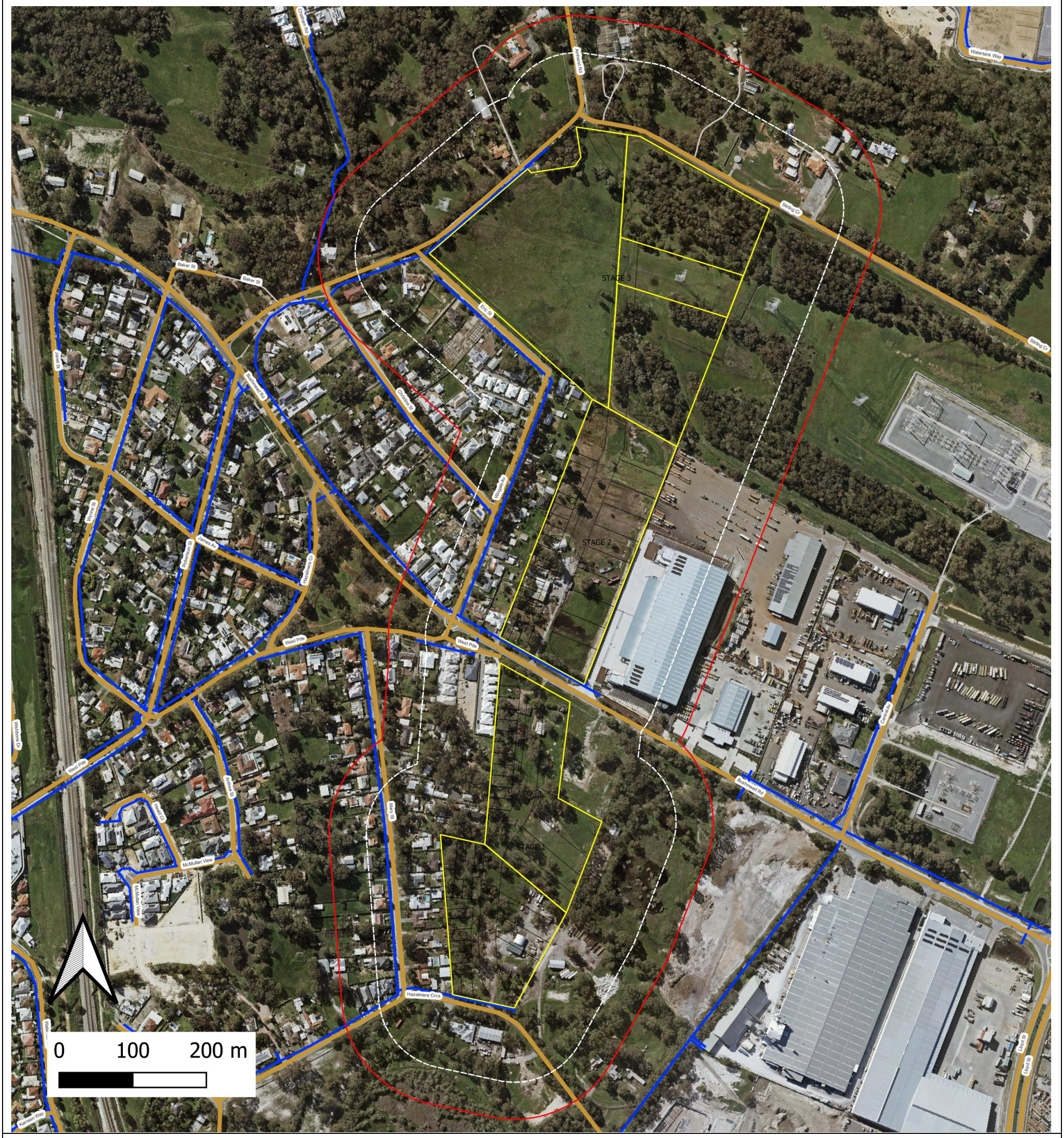
WA Local Government Association (WALGA). Environmental Planning Tool. Retrieved from https://pbp.walga.asn.au/Tools/EnvironmentalPlanningTool.html

10 Acknowledgement of Country

We acknowledge the traditional custodians of the land on which we operate, the Noongar people. We pay our respects to their elders, past, present, and emerging, and recognise their enduring connection to the land and environment. As we conduct our bushfire management and reporting, we honour their legacy and their stewardship of our natural landscapes.

11 Appendices

Appendix A: Spatial Representation of Roads and Water Lines (Next Page)



The assessment focuses on the current accessibility of water lines for future firefighting supply and evaluates the existing road access networks. Additionally, proposed access routes have been indicated to ensure they support effective operations.

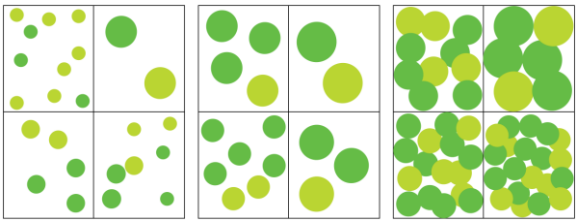
Figure: 12 *Spatial representation of Compliance*

Lot 651, Lot 39 Stirling Crescent, Lot 93 (#40) Hazelmere Crescent, Lot 83 (#170) & 58 (#167) Bushmead Road, Hazelmere	**Legend**			
The aerial imagery used was the best available at the time of review; however, it may no longer reflect the most current conditions.	Subject Land	150 m Buffer	Road Access	Mains Water

08 9555 9444
BAL@bushfiresmart.com.au
Address: 71 Allnutt Street, Mandurah, 6210
Postal: PO Box 4160, Mandurah North, WA, 6210

Appendix B: APZ technical requirements

The APZ is to be managed as per the extract from *Table 9: Asset Protection Zone (APZ) technical requirements* (WAPC 2024).

Object	Requirement
Fences within the APZ	Should be constructed from non-combustible materials (for example, iron, brick, limestone, metal post and wire, or bushfire-resisting timber referenced in Appendix F of AS 3959).
Fine fuel load (combustible, dead vegetation matter less than 6 mm in thickness)	• Should be managed and removed on a regular basis to be maintained as low threat vegetation • Should be maintained at less than two tonnes per hectare (on average) • Mulches should be non-combustible such as stone, gravel, shells, rock or crushed mineral earth or wood mulch more than five millimetres in thickness.
Trees* (more than 6 metres in height)	• Trunks at maturity should be a minimum distance of six metres from all elevations of the building • Branches at maturity should not touch or overhang a building or powerline • Lower branches and loose bark should be removed to a height of two metres above the ground and/or surface vegetation. • Canopy cover within the APZ should be less than 15 per cent of the total APZ area • Tree canopies at maturity should be at least 5 m apart to avoid forming a continuous canopy. Stands of existing mature trees with interlocking canopies may be treated as an individual canopy provided the total canopy cover within the APZ does not exceed 15 per cent and is not connected to the tree canopy outside the APZ. **Tree canopy cover – ranging from 15 to 70 per cent at maturity**  15% 30% 70%
Shrub* and scrub* (0.5 metres to 6 m in height). Shrub and scrub more than 6 m in height are to be treated as trees.	• Should not be located under trees or within three metres of buildings. • Should not be planted in clumps more than 5 square metres in area. • Clumps should be separated from each other and any exposed window or door by at least 10 metres.
Ground covers* (<0.5 m in height. Ground covers more than 0.5 metres in height are to be treated as shrub)	• Can be planted under trees but must be maintained to remove dead plant material, as prescribed in 'Fine fuel load' above. • Can be located within two metres of a structure, but three metres from windows or doors if more than 100 millimetres in height.
Grass	• Grass should be maintained at a height of 100 mm or less, at all times. • Wherever possible, perennial grasses should be used and well-hydrated with regular application of wetting agents and efficient irrigation
Defendable space	Within three metres of each wall or supporting post of a habitable building, the area is kept free from vegetation, but can include ground covers, grass and non-combustible mulches as prescribed above.
LP Gas Cylinders	• Should be located on the side of a building furthest from the likely direction of a bushfire or on the side of a building where surrounding classified vegetation is upslope, at least one metre from vulnerable parts of a building. • The pressure relief valve should point away from the house. • No flammable material within six metres from the front of the valve. • Must sit on a firm, level and non-combustible base and be secured to a solid structure.

Appendix C: Water tank technical requirements

Water tank technical requirements (extract from guidelines):

B.4.1 CONSTRUCTION AND DESIGN

An above-ground tank and associated stand should be constructed of non-combustible material.
Below-ground tanks should have a 200 millimetres diameter access hole to allow tankers or emergency services vehicles to refill direct from the tank, with the outlet location clearly marked on the surface.
Above and below ground tanks may need to comply with AS/NZS 3500.1:2018.
An inspection opening may double as the access hole provided that the inspection opening meets the requirements of AS/NZS 3500.1:2018.
Where an outlet for an emergency services vehicle is provided, then an unobstructed, hardened ground surface is to be supplied within four metres of any water supply.

B.4.1.1 Pipes and fittings

All above-ground, exposed water supply pipes and fittings should be metal. Fittings should be located away from the source of bushfire hazard and be in accordance with the applicable section below, unless otherwise specified by the local government.

B.4.1.2 Fittings for above-ground water tanks:

• Commercial land uses: 125 millimetres Storz fitting; or
• Strategic water tanks: 50 millimetres or 100 millimetres (where applicable and adapters are available) male camlock coupling with full flow valve; or
• Standalone water tanks: 50 millimetres male camlock coupling with full flow valve; or
• Combined water tanks: 50 millimetres male camlock coupling with full flow valve or a domestic fitting, being a standard household tap that enables an occupant to access the water supply with domestic hoses.

B.4.1.3 Remote outlets

In certain circumstances, it may be beneficial to have the outlet located away from the water supply. In instances in which a remote outlet is to be used, the applicant should consult the local government and DFES on their proposal.



Figure 39 of the Planning for Bushfire Guidelines (Nov 2024): A good and bad example of landscaping around a water tank

B.4.2 USE OF WATER SUPPLY

The combination of drinking water and water for firefighting purposes is not recommended, as stagnant water may alter the quality of the drinking water and the emergency services, by law, may not be able to take water from the water supply to suppress a bushfire.

Combining drinking water and water for firefighting purposes is contrary to provisions within clause 4.2.3 of AS/NZS 3500.1:2021.

B.4.3 INDEPENDENT WATER AND POWER SUPPLY

Bushfires can directly impact a water service provider's equipment or pipes. As such, a reticulated water supply may not be reliable due to a reduction in water pressure or loss of supply.

Where development is in an area shown as Area 2 on the Map of Bush Fire Prone Areas and/or where the local government area has known issues with water supply or pressure, it is recommended that the landowner consider providing a water tank in accordance with Table 11, *Water supply dedicated for bushfire firefighting purposes*.

In non-reticulated water supply areas, it is recommended that any pumping equipment be powered by means other than the electricity network. The pumping equipment could be a diesel- or petrol-powered pump, or an electric pump if there is an onsite generator or backup power supply independent of the electricity network grid.

It is recommended that combustion pumps should be a minimum five hp or three kW diesel- or petrol-powered pump and should be shielded against bushfire attack.

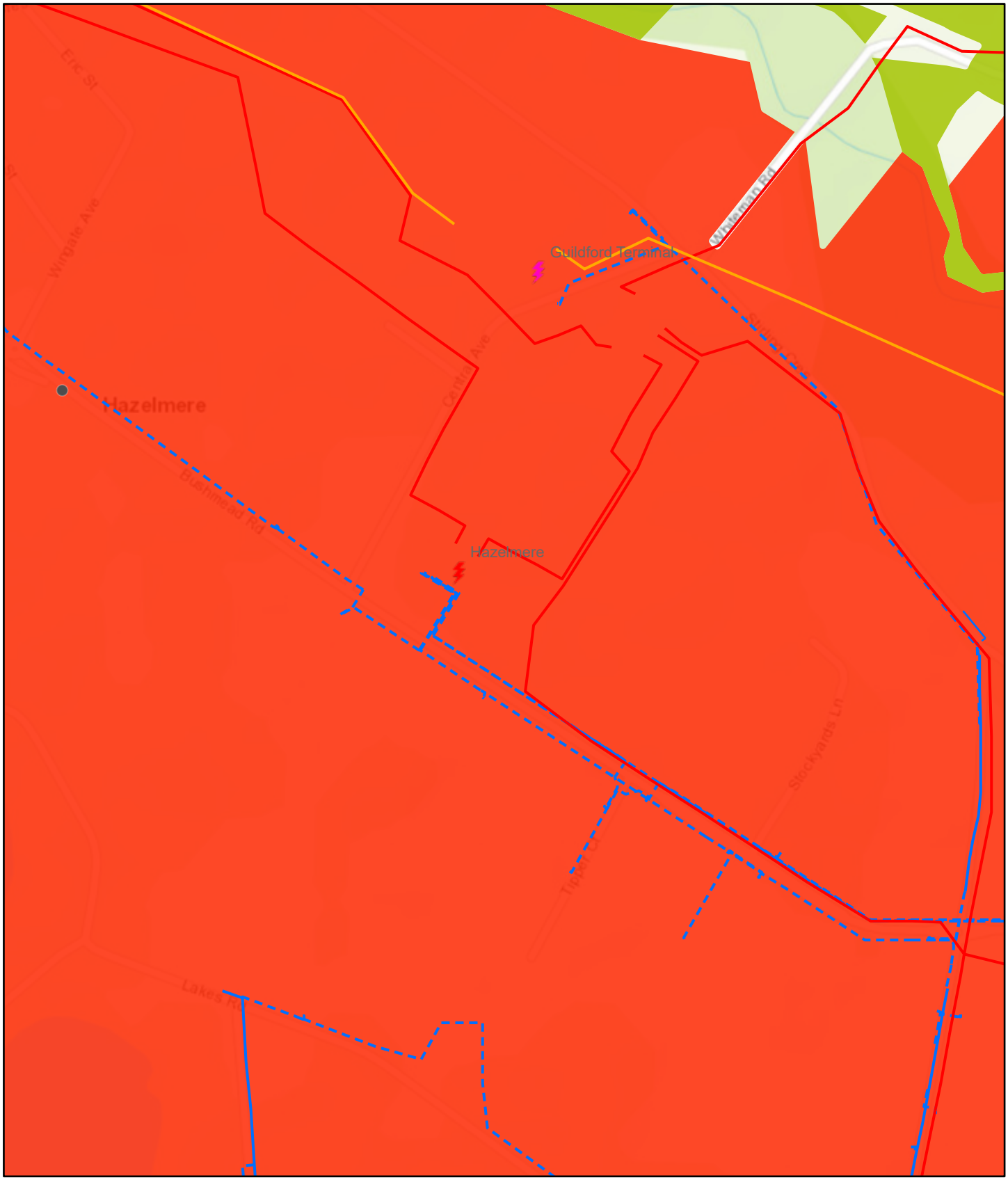
Where an electric pump is used, a backup power supply independent of the electricity network grid should be provided. A 3.7 kW/12k W/h sized battery (14.8 kW/h reserved solely for bushfire will power a 3.7 kW system for four hours) with blackout protection or a generator should be provided.

Appendix D: Lot Numbering for Internal Reference



Appendix 4 – Western Power Capacity Plan

Network Capacity Mapping Tool



6/16/2025, 4:45:15 PM

1:9,028

0 0.05 0.1 0.2 mi

0 0.1 0.2 0.4 km

NCMT Existing Substations/Terminals/Power Stations (WP-049)

- Existing Western Power Substation
- Current Western Power Terminal/Power Station

NCMT High Voltage Overhead Transmission Lines (WP-051)

- 132 KV
- 330 KV

NCMT High Voltage Distribution Lines (WP-052)

- Overhead Single Phase
- Overhead Three Phase
- Underground Single Phase
- Underground Three Phase

NCMT Forecast Remaining Capacity 2025 (WP-055)

- 20 to 25 MVA
- Less than 5 MVA

Esri, HERE, Garmin, USGS, METI/NASA

Plans printed from the Network Capacity Mapping Tool (NCMT) are indicative

© Western Power 2016

Legend

Services > Power > Ground level > **Transformers**

- Electrical Transformer

Services > Power > Overhead > **Transmission**

- HV Pole - Wood
- HV Pole/Tower - Steel
- HV Transmission

Services > Power > Ground level > **Enclosures**

- Electrical Enclosure

Services > Power > **Substations**

- SubStation

Services > Power > Overhead > **Distribution**

- Overhead Distribution Powerline

Services > Power > Overhead > **Other**

- Other Overhead Line

Services > Power > **Restriction Zones**

- Restriction Zone

Property > **Easements/Interests**

- Easement/Interest Coverage
- Easement/Interest Boundary

Services > Power > Underground > **Other**

- Other Underground Cable

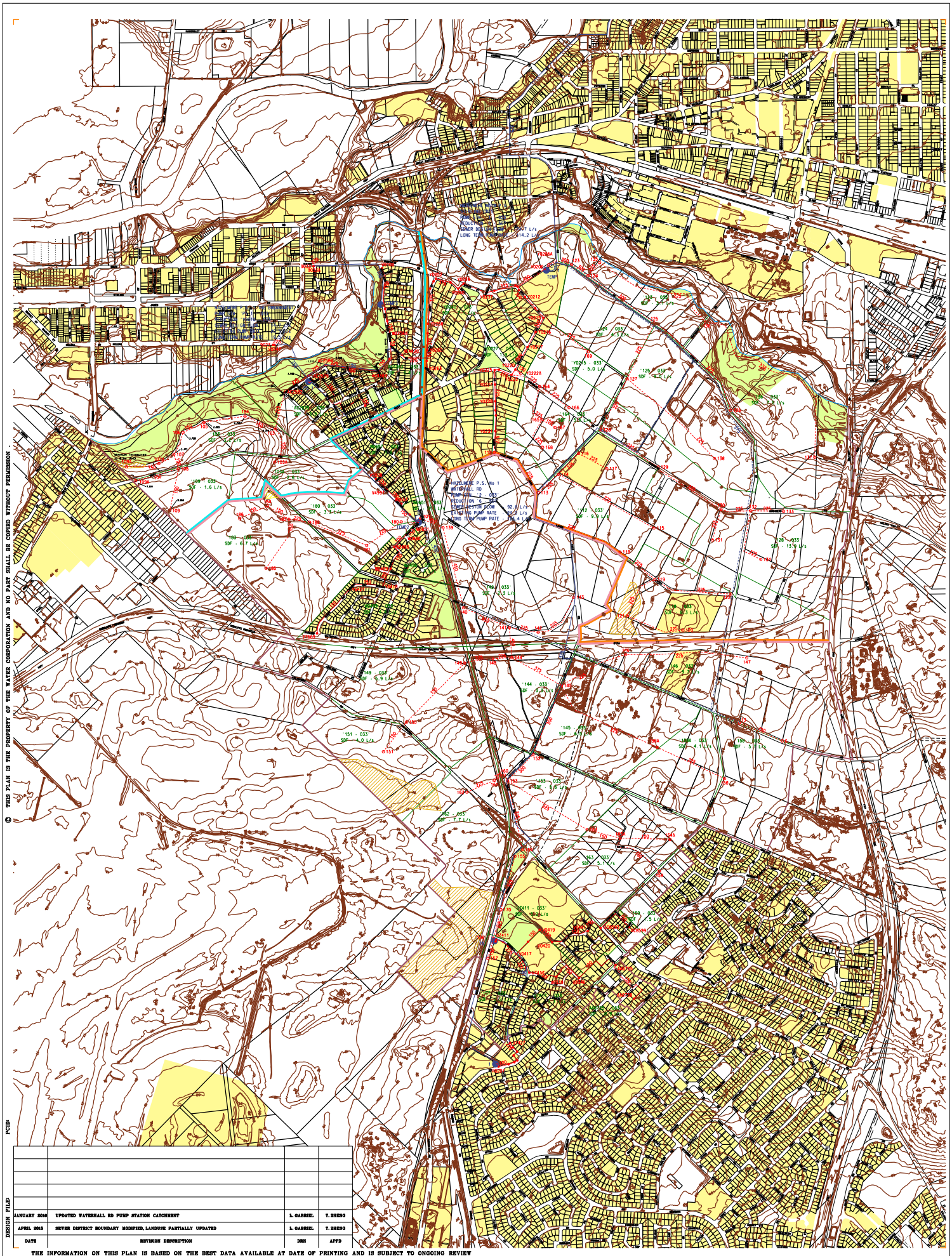
Services > Power > Underground > **Distribution**

- Underground Distribution Cable

Base > **MetroMap**

27 May 2025
5 March 2025

Appendix 5 – Water Corporation Sewer Concept Plan



© THIS PLAN IS THE PROPERTY OF THE WATER CORPORATION AND NO PART SHALL BE COPIED WITHOUT PERMISSION .

PCID:

DESIGN FILE:

DATE	REVISION DESCRIPTION	DRN	APPD
JANUARY 2016	UPDATED WATERHALL RD PUMP STATION CATCHMENT	L. GABRIEL	Y. SHENG
APRIL 2015	SEWER DISTRICT BOUNDARY MODIFIED, LANDUSE PARTIALLY UPDATED	L. GABRIEL	Y. SHENG

THE INFORMATION ON THIS PLAN IS BASED ON THE BEST DATA AVAILABLE AT DATE OF PRINTING AND IS SUBJECT TO ONGOING REVIEW AND AMENDMENT. NO RESPONSIBILITY IS ACCEPTED BY THE WATER CORPORATION FOR ACCURACY OF DATA SUPPLIED BY EXTERNAL AGENCIES.

LEGEND

- EXISTING PUMPING STATION
- EXISTING PRESSURE MAIN
- EXISTING GRAVITY SEWER
- PROPOSED PUMPING STATION
- PROPOSED PRESSURE MAIN
- PROPOSED GRAVITY SEWER
- PARKS AND PUBLIC OPEN SPACE
- EXISTING SEWERED AREAS
- SEWERED BY PRIVATE PS
- NODE CATCHMENT
- PS AND SEWER CATCHMENTS
- SEWER DISTRICT CATCHMENT
- WWTP CATCHMENT

NOTATION

SEWER DESIGN FLOW - 1.5 x AVERAGE DAILY FLOW RATE
PUMP RATE - LONG TERM PUMP RATE OR EXISTING PUMP RATE IF LARGER

SHEET INDEX

WATER CORPORATION

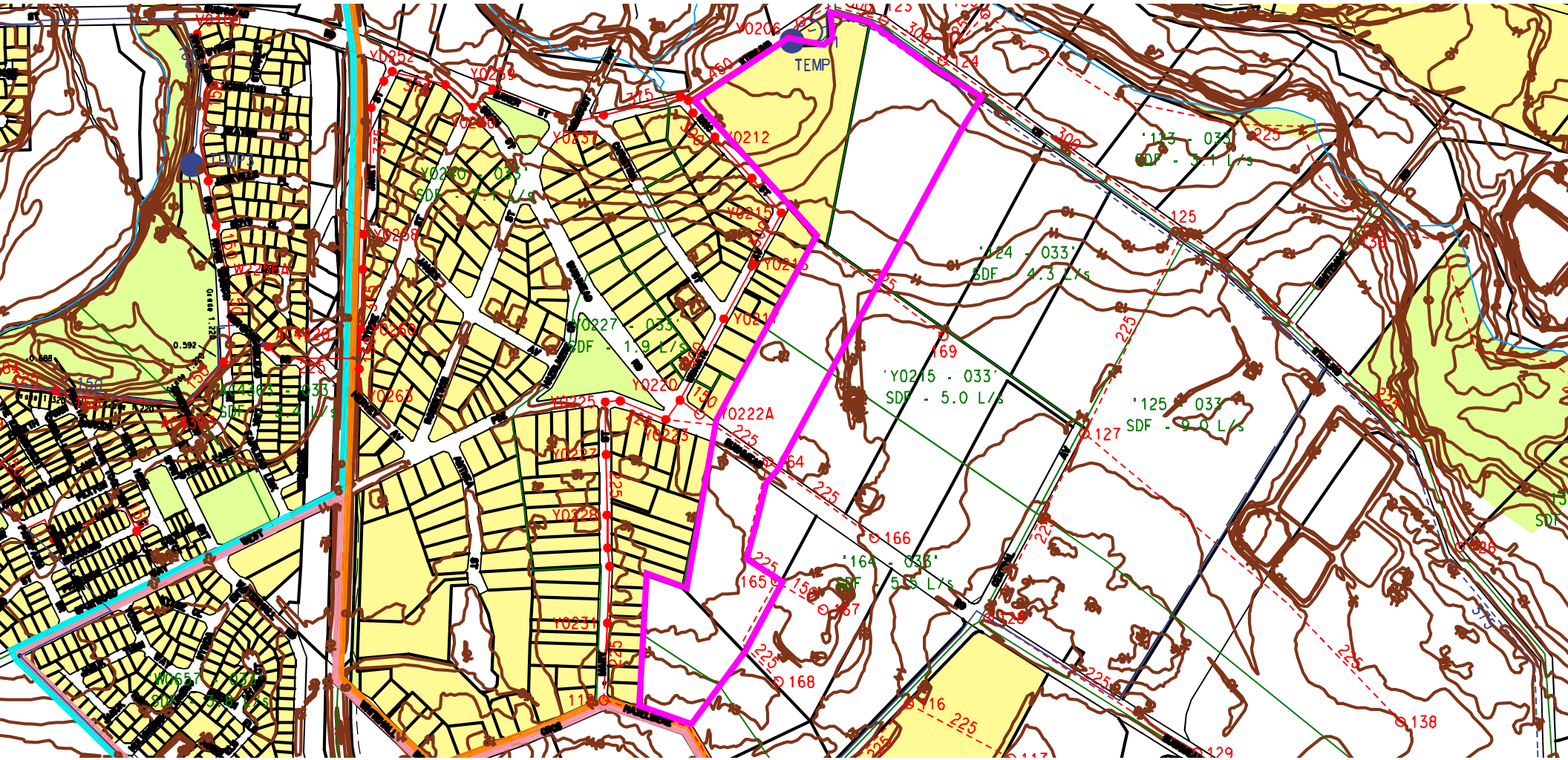
ISSUED WITH THE AUTHORITY OF THE MANAGER INFRASTRUCTURE PLANNING BRANCH
629 NEWCASTLE STREET, LEEDERVILLE 6007 WESTERN AUSTRALIA.
TELEPHONE (08) 9420 2420, FAX (08) 9420 3179

WASTEWATER SCHEME PLANNING SERIES

HAZELMERE SD033
CONCEPTUAL PLANNING
LONG TERM SCHEME

PLANNING BY	COMPILED BY	ACCEPTED BY
IPB Planners	C. LEGERSTEE	I. SCOTT
SCALE	VERSION	IPB HOUSE FILE NO.
1:10 000	6 MAY 1998	P509 - A1

Document Set ID: 9939972
Version: 2, Version Date: 19/10/2021


TEMP
'124 - 033'
SDF - 4.3 L/s
'Y0215 - 033'
SDF - 5.0 L/s
'125 - 033'
SDF - 9.0 L/s
'164 - 033'
SDF - 5.5 L/s
'Y0227 - 033'
SDF - 1.9 L/s
Y0212
Y0222A
Y0206
Y0252
Y0234
Y0237
Y0215
Y0220
Y0225
Y0223
Y0217
Y0229
Y0231
Y0263
Y0260
Y0268
W0657
W0656
W0655
W0654
W0653
W0652
W0651
W0650
W0649
W0648
W0647
W0646
W0645
W0644
W0643
W0642
W0641
W0640
W0639
W0638
W0637
W0636
W0635
W0634
W0633
W0632
W0631
W0630
W0629
W0628
W0627
W0626
W0625
W0624
W0623
W0622
W0621
W0620
W0619
W0618
W0617
W0616
W0615
W0614
W0613
W0612
W0611
W0610
W0609
W0608
W0607
W0606
W0605
W0604
W0603
W0602
W0601
W0600
W0599
W0598
W0597
W0596
W0595
W0594
W0593
W0592
W0591
W0590
W0589
W0588
W0587
W0586
W0585
W0584
W0583
W0582
W0581
W0580
W0579
W0578
W0577
W0576
W0575
W0574
W0573
W0572
W0571
W0570
W0569
W0568
W0567
W0566
W0565
W0564
W0563
W0562
W0561
W0560
W0559
W0558
W0557
W0556
W0555
W0554
W0553
W0552
W0551
W0550
W0549
W0548
W0547
W0546
W0545
W0544
W0543
W0542
W0541
W0540
W0539
W0538
W0537
W0536
W0535
W0534
W0533
W0532
W0531
W0530
W0529
W0528
W0527
W0526
W0525
W0524
W0523
W0522
W0521
W0520
W0519
W0518
W0517
W0516
W0515
W0514
W0513
W0512
W0511
W0510
W0509
W0508
W0507
W0506
W0505
W0504
W0503
W0502
W0501
W0500
W0499
W0498
W0497
W0496
W0495
W0494
W0493
W0492
W0491
W0490
W0489
W0488
W0487
W0486
W0485
W0484
W0483
W0482
W0481
W0480
W0479
W0478
W0477
W0476
W0475
W0474
W0473
W0472
W0471
W0470
W0469
W0468
W0467
W0466
W0465
W0464
W0463
W0462
W0461
W0460
W0459
W0458
W0457
W0456
W0455
W0454
W0453
W0452
W0451
W0450
W0449
W0448
W0447
W0446
W0445
W0444
W0443
W0442
W0441
W0440
W0439
W0438
W0437
W0436
W0435
W0434
W0433
W0432
W0431
W0430
W0429
W0428
W0427
W0426
W0425
W0424
W0423
W0422
W0421
W0420
W0419
W0418
W0417
W0416
W0415
W0414
W0413
W0412
W0411
W0410
W0409
W0408
W0407
W0406
W0405
W0404
W0403
W0402
W0401
W0400
W0399
W0398
W0397
W0396
W0395
W0394
W0393
W0392
W0391
W0390
W0389
W0388
W0387
W0386
W0385
W0384
W0383
W0382
W0381
W0380
W0379
W0378
W0377
W0376
W0375
W0374
W0373
W0372
W0371
W0370
W0369
W0368
W0367
W0366
W0365
W0364
W0363
W0362
W0361
W0360
W0359
W0358
W0357
W0356
W0355
W0354
W0353
W0352
W0351
W0350
W0349
W0348
W0347
W0346
W0345
W0344
W0343
W0342
W0341
W0340
W0339
W0338
W0337
W0336
W0335
W0334
W0333
W0332
W0331
W0330
W0329
W0328
W0327
W0326
W0325
W0324
W0323
W0322
W0321
W0320
W0319
W0318
W0317
W0316
W0315
W0314
W0313
W0312
W0311
W0310
W0309
W0308
W0307
W0306
W0305
W0304
W0303
W0302
W0301
W0300
W0299
W0298
W0297
W0296
W0295
W0294
W0293
W0292
W0291
W0290
W0289
W0288
W0287
W0286
W0285
W0284
W0283
W0282
W0281
W0280
W0279
W0278
W0277
W0276
W0275
W0274
W0273
W0272
W0271
W0270
W0269
W0268
W0267
W0266
W0265
W0264
W0263
W0262
W0261
W0260
W0259
W0258
W0257
W0256
W0255
W0254
W0253
W0252
W0251
W0250
W0249
W0248
W0247
W0246
W0245
W0244
W0243
W0242
W0241
W0240
W0239
W0238
W0237
W0236
W0235
W0234
W0233
W0232
W0231
W0230
W0229
W0228
W0227
W0226
W0225
W0224
W0223
W0222
W0221
W0220
W0219
W0218
W0217
W0216
W0215
W0214
W0213
W0212
W0211
W0210
W0209
W0208
W0207
W0206
W0205
W0204
W0203
W0202
W0201
W0200
W0199
W0198
W0197
W0196
W0195
W0194
W0193
W0192
W0191
W0190
W0189
W0188
W0187
W0186
W0185
W0184
W0183
W0182
W0181
W0180
W0179
W0178
W0177
W0176
W0175
W0174
W0173
W0172
W0171
W0170
W0169
W0168
W0167
W0166
W0165
W0164
W0163
W0162
W0161
W0160
W0159
W0158
W0157
W0156
W0155
W0154
W0153
W0152
W0151
W0150
W0149
W0148
W0147
W0146
W0145
W0144
W0143
W0142
W0141
W0140
W0139
W0138
W0137
W0136
W0135
W0134
W0133
W0132
W0131
W0130
W0129
W0128
W0127
W0126
W0125
W0124
W0123
W0122
W0121
W0120
W0119
W0118
W0117
W0116
W0115
W0114
W0113
W0112
W0111
W0110
W0109
W0108
W0107
W0106
W0105
W0104
W0103
W0102
W0101
W0100
W0099
W0098
W0097
W0096
W0095
W0094
W0093
W0092
W0091
W0090
W0089
W0088
W0087
W0086
W0085
W0084
W0083
W0082
W0081
W0080
W0079
W0078
W0077
W0076
W0075
W0074
W0073
W0072
W0071
W0070
W0069
W0068
W0067
W0066
W0065
W0064
W0063
W0062
W0061
W0060
W0059
W0058
W0057
W0056
W0055
W0054
W0053
W0052
W0051
W0050
W0049
W0048
W0047
W0046
W0045
W0044
W0043
W0042
W0041
W0040
W0039
W0038
W0037
W0036
W0035
W0034
W0033
W0032
W0031
W0030
W0029
W0028
W0027
W0026
W0025
W0024
W0023
W0022
W0021
W0020
W0019
W0018
W0017
W0016
W0015
W0014
W0013
W0012
W0011
W0010
W0009
W0008
W0007
W0006
W0005
W0004
W0003
W0002
W0001

Legend

Services > Water > **Fire Hydrants**

Fire Hydrant

Services > Sewer > **Gravity**

Sewer Manhole

Sewer Pipe

Property > **Easements/Interests**

Easement/Interest Coverage

Easement/Interest Boundary

Services > Water > **Water Meters**

Water Meter

Services > Water > **Water Valves**

Water Valve

Services > Water > **Pipes**

Water Pipe

Services > Water > Abandoned > **Pipes**

Water Pipe Abandoned

Services > Sewer > **Pressure**

Sewer Pressure Main

Services > Sewer > Abandoned > **Pressure**

Sewer Pressure Main Abandoned

Base > **MetroMap**

27 May 2025

Appendix 6 – Retail Needs Assessment

pracsys.

URPS

Needs Assessment

Lot 651 (Zoned Special Use 16), Stirling Crescent, Hazelmere

MAY 2025

Document Control				
Document Version	**Description**	**Prepared By**	**Approved By**	**Date Approved**
v 1.0	Draft	Steven Godecke	Dawson D-Huning	29/04/2021
v 2.0	Draft – Updated	Steven Godecke	Dawson D-Huning	17/05/2021
v 3.0	Final – Updated	Ben Fahrner	Dawson D-Huning	14/05/2021

Disclaimer

This report has been prepared for **URPS**. The information contained in this document has been prepared with care by the authors and includes information from apparently reliable secondary data sources which the authors have relied on for completeness and accuracy. However, the authors do not guarantee the information, nor is it intended to form part of any contract. Accordingly, all interested parties should make their own inquiries to verify the information and it is the responsibility of interested parties to satisfy themselves in all respects.

This document is only for the use of the party to whom it is addressed, and the authors disclaim any responsibility to any third party acting upon or using the whole or part of its contents.

CONTENTS

1 Introduction 4

2 Context 5

2.1 Site Context 5

2.2 Proposed Development 5

3 Socio-Demographic Analysis 9

3.1 Potential Customer Base Profile 9

3.2 Income Profile 11

3.3 Retail Expenditure Profile 11

4 Floorspace Needs Analysis 13

4.1 Retail Supply and Demand 14

4.2 Retail Gap Analysis 18

5 Retail Potential Analysis 22

5.1 Estimated Shop/Retail Potential 22

5.2 Estimated Other Retail Potential 23

5.3 Retail Potential Analysis Summary 23

6 Conclusion 24

7 Appendix I: Gravity Modelling Methodology 25

7.1 Drivers of Retail Floorspace Supply and Demand 26

8 Appendix II: Required Floorspace Productivity 28

1 INTRODUCTION

This report investigates the suitability and need for retail and commercial land uses at Lot 651 Stirling Crescent, Hazelmere to inform the Hazelmere Circus SU16 local structure planning process being undertaken. The site is part of land zoned "Special Use 16" (SU16) and is envisioned to be primarily suitable as industrial buffer land, with supporting retail, showroom shops and commercial uses to service workers and the local population. This Needs Assessment (RNA) will identify the amount and types of retail and commercial floorspace uses likely to be viable at the development. This has been done by assessing the demand for and provision of retail and commercial floorspace in the surrounding area, in consideration of the State Planning Policy 4.2: Activity Centres (SPP 4.2.).

Floorspace Gap Analysis has been undertaken to identify prospective land uses at Lot 651 on SU16. Prospective land uses have been identified by Western Australian Standard Land Use Classification (WASLUC) code. Floorspace Gap Analysis involves comparing floorspace per person estimates in the primary catchment around the proposed site to a combination of comparable Local Government Areas (LGA). Land uses identified in this report are not guaranteed to be incorporated into the development, however, they demonstrate uses currently underprovided in the identified trade area with specific gaps calculated based on a primary catchment around the proposed site. After undertaking the Floorspace Gap Analysis, the retail potential for the site has been verified using Retail Gravity Modelling. Retail Gravity Modelling has been undertaken for the identified trade area around the proposed site. The trade area used in Retail Gravity Modelling extends beyond the primary catchment and analysis is undertaken for 2026, including approved but yet to be completed developments in the trade area to provide a conservative assessment.

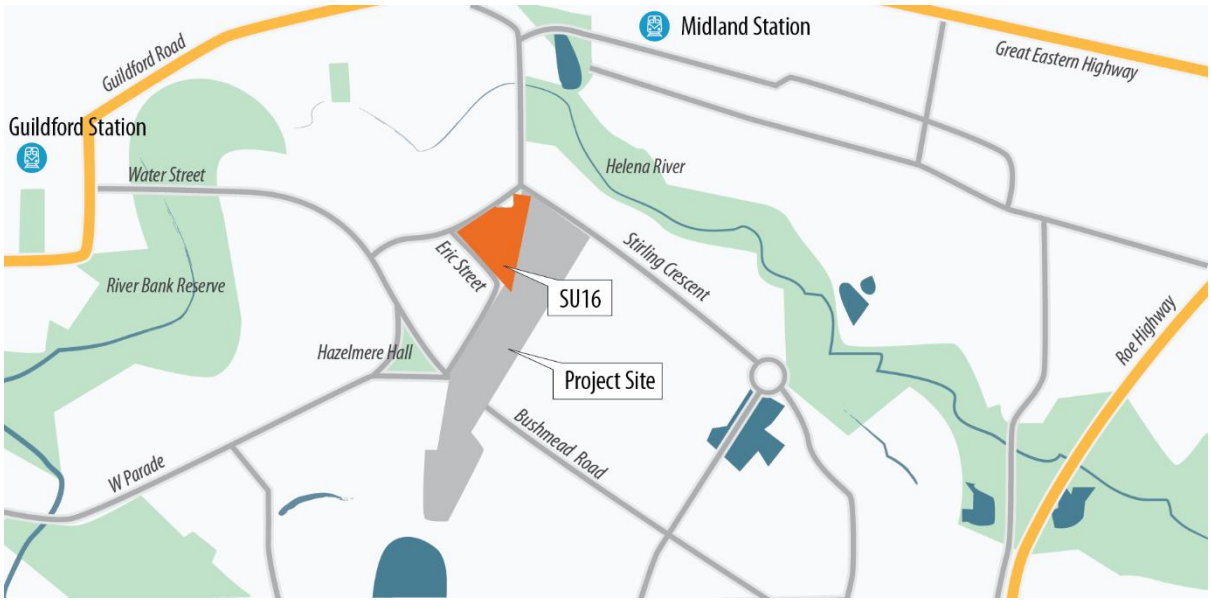
It should be noted that proposed land uses at Lot 651 on SU16 are not intending to compete with land uses currently located at the Midland Workshop land and will attract a lower order of tenant. Additionally, a portion of the retail and commercial floorspace for Lot 651 on SU16 will be Industry – Service, used primarily as a retail shopfront for goods produced at the industrial section of the development or for a depot to receive goods to be serviced.

2 CONTEXT

2.1 Site Context

The proposed site is located at Lot 651, Stirling Crescent, in the City of Swan Local Government Area (LGA) and is part of SU16. This Site is south of the Swan River in Hazelmere and is approximately 3km south of the Midland Town Centre. The area is serviced by major road networks, including Great Eastern Hwy to the West and Roe Hwy to the East (Figure 1).

Figure 1. Proposed Site Context



Source: Pracsys 2021

Lot 651 is 5.3 hectares in size and is presently zoned 'Urban' in the Metropolitan Region Scheme. Lot 651 is located in SU16, which also includes Lots 39, 58, 83 and 93, and totals 20.8 hectares in size. Land to the west of the development is currently residential and is zoned R5/20, while land to the east is the Hazelmere Industrial Area. Lot 651 is currently vacant and requires the preparation of a structure plan as part of SU16 with land uses to be specified in an adopted structure plan. The wider Hazelmere Circus SU16 local structure plan area is identified as the Project Site in Figure 1.

2.2 Proposed Development

This report aims to guide the proposed land uses for Lot 651. The proposed development would consist of a mix of retail, commercial and industrial floorspace uses.

The potential development's trade area has been assessed at a 5km radius from Lot 651 to ensure competing centres are accounted for; a primary catchment of 1km is used to assess the retail and commercial need of residents in the area. It should be noted that one SA1 within the primary catchment has been excluded from

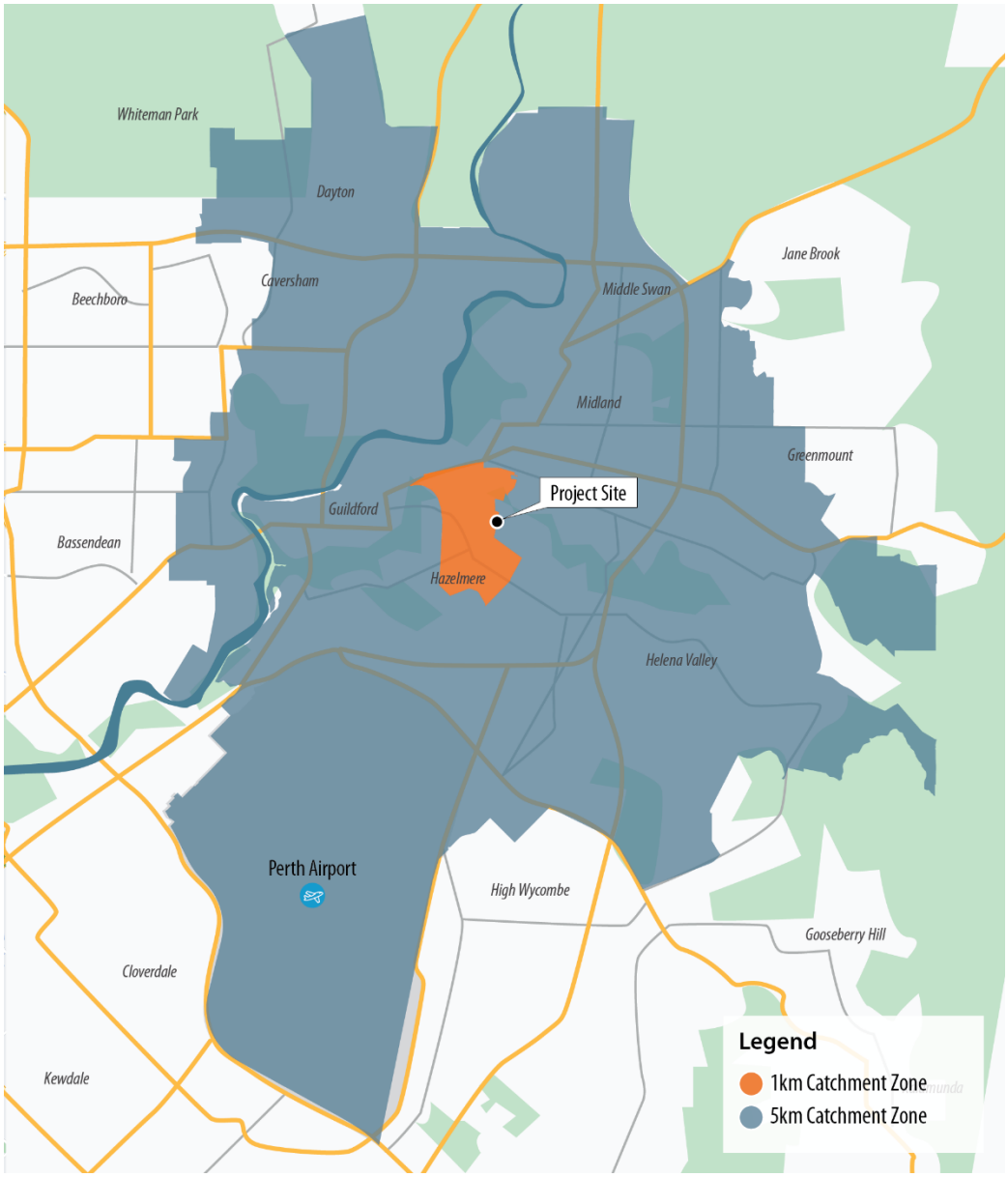
the Retail Gap Analysis as the majority of the population in this SA1 is proximate to another retail centre. This ensures that analysis does not overestimate the gap in retail floorspace in the primary catchment.

A trade area is the spatial boundary from which commercial floorspace generates the majority of its customers. Trade area definition allows for the measurement of the number of potential customers, their demographics and expenditure potential, as well as an assessment of the competitive environment.

SPP 4.2 states that neighbourhood and local centres are important community focal points that provide the primary daily to weekly household shopping and community needs of their catchment. They are also a focus for medium to high-density housing. Neighbourhood and local centres play an important role in providing walkable access to services and facilities for communities.

The modelled trade area of the prospective centre at Lot 651 on SU16 is comprised of all Statistical Area Level 1s (SA1) contained in the trade area and 1km primary catchment (Figure 2).

Figure 2. Modelled Trade Area of Prospective Development



Source: Pracsys 2021

The 5km trade area is used in the gravity model and ensures that all centres, which could reasonably experience an impact from the prospective centre, are included in the impact analysis.

The modelled trade area encompasses Guildford to the West, the Perth Airport to the South, Midland to the North and Helena Valley to the East. The trade area's catchment includes the LGAs of the Town of Bassendean, the Shire of Mundaring, the City of Swan and the Shire of Kalamunda.

This trade area has a population of 46,292.[1] Based on population growth rates for the City of Swan this is estimated to be 54,893 in 2021 and is expected to grow to 64,051 in 2026. For the purpose of this analysis, it

[1] ABS Census, 2016

will be assumed the development is completed in 2026, ensuring other proximate developments are included in the analysis. The primary catchment has a population of 1,299.[2 & 3] Based on population growth rates for the City of Swan this is estimated to be 1,540 in 2021 and is expected to grow to 1,797 in 2026.

This development will be tailored to the goods and services needs of workers in the Hazelmere industrial area and future industrial workers on SU16. Additionally, the surrounding residential population and future residents on land to the West of SU16, which has been rezoned as R5/20, will support retail and commercial uses at this site. The additional residential population that will locate West of SU16 has not been included in the analysis as the rate of development for this area is not clear, this provides a conservative estimate of the required floorspace to service the area. This development will provide proximate retail access and amenity for residents and workers, reducing the need to cross major highways to access daily shopping needs.

[2] IBID
[3] ABS Census, 2016

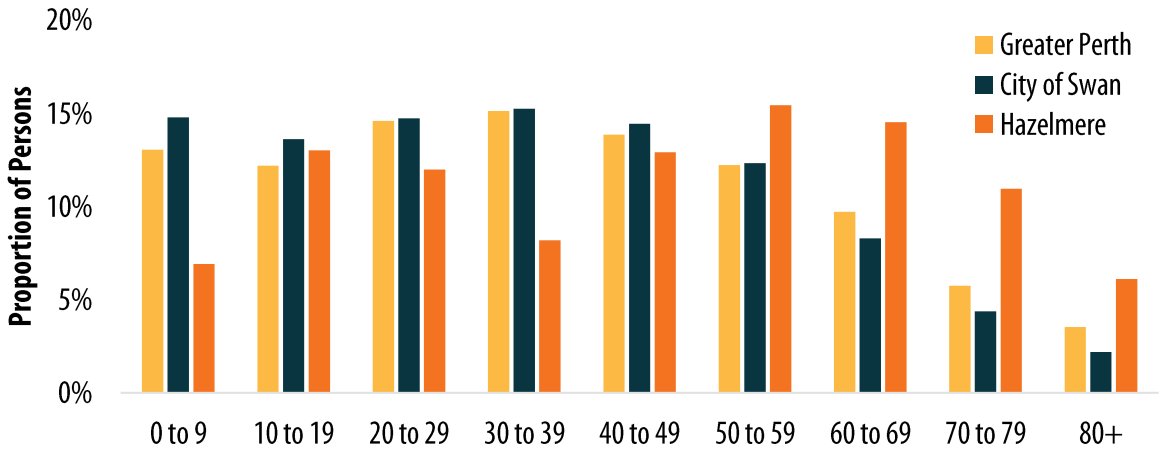
3 SOCIO-DEMOGRAPHIC ANALYSIS

The Needs Assessment considers population-driven commercial based land uses. An analysis of the current population of the City of Swan and surrounding areas is necessary to determine the drivers of demand in the area. This section outlines the key aspects of the demographic composition of the area surrounding the development. It focuses on the suburb area of Hazelmere, as well as benchmarking against the City of Swan and Greater Perth regions.

3.1 Potential Customer Base Profile

The suburb of Hazelmere has approximately 870 residents (2016)[4], making up only a small portion of the 162,000 (2021) residents in the City of Swan.[5] Residents in Hazelmere tend to be older than those in the City of Swan and Greater Perth area, with a significantly large portion aged over 50. (Figure 3).

Figure 3. Hazelmere Resident Age Profile, Versus Benchmark Areas



Source: ABS Census 2016, Pracsys 2021

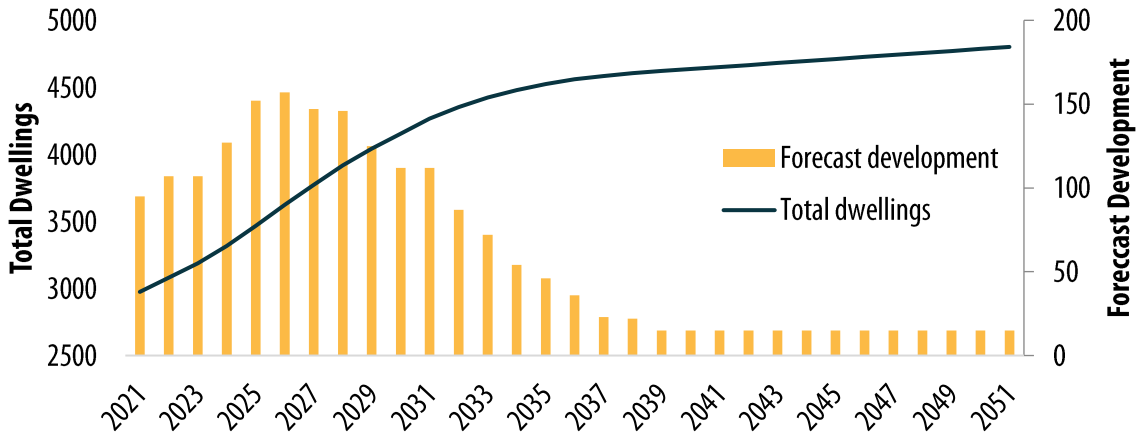
The high proportion of persons aged over 50 in Hazelmere departs from the City of Swan distribution, which has a higher proportion of young children and persons aged 30-49 than Greater Perth. Providing retail and commercial uses in close proximity to older populations improves their ability to access goods and services as they may be limited in their mobility.

Younger persons are expected to move into the Guildford-Hazelmere area with significant residential development going forward (Figure 4). A number of potential growth areas are in proximity to the proposed development including Rosehill Waters and land adjacent to the proposed development that is undergoing urban renewal and will have greater residential density. The majority of new housing developments are expected to be completed over the next decade and this could place strain on the current retail supply and road networks in the area. Additionally, as new housing developments in and around Hazelmere are

[4] ABS Census, 2016, https://www.abs.gov.au/census
[5] Forecast ID, 2021, https://forecast.id.com.au/swan

developed, it is expected that young families will move into the area creating demand for a greater variety of uses.

Figure 4. Forecast Residential Development in Guildford-Hazelmere



Source: Forecast ID 2021, Pracsys 2021

Hazelmere and its surrounding catchment support a significant number of workers, primarily in the industrial and manufacturing sector.[6] The development will include a significant amount of industrial employment-generating floorspace, and this will improve the viability and sustainability of the retail section of the development through worker daytime expenditure.

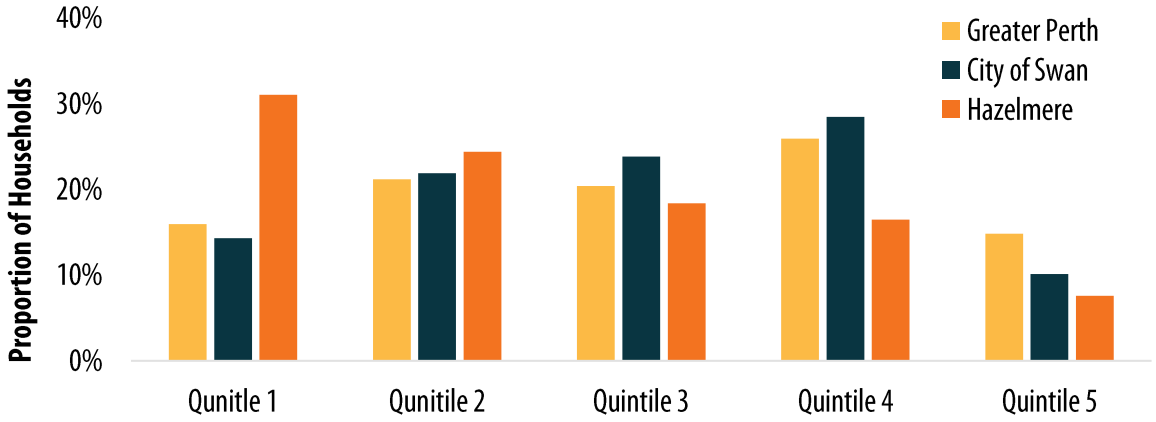
The combination of residential dwellings and industrial employment growth in the area is likely to generate significant retail expenditure and will assist in supporting the proposed retail floorspace at Lot 651.

[6] International Council of Shopping Centers, 2012, http://www.southfieldcitycentre.com/wp-content/uploads/2012/06/Office-Worker-Retail-Spending-in-a-Digital-Age.pdf

3.2 Income Profile

Hazelmere possesses a higher proportion of low-income earners, with 55% of households in the bottom two income quintiles (Figure 5).

Figure 5. Hazelmere Household Income Profile, Versus Benchmark Areas



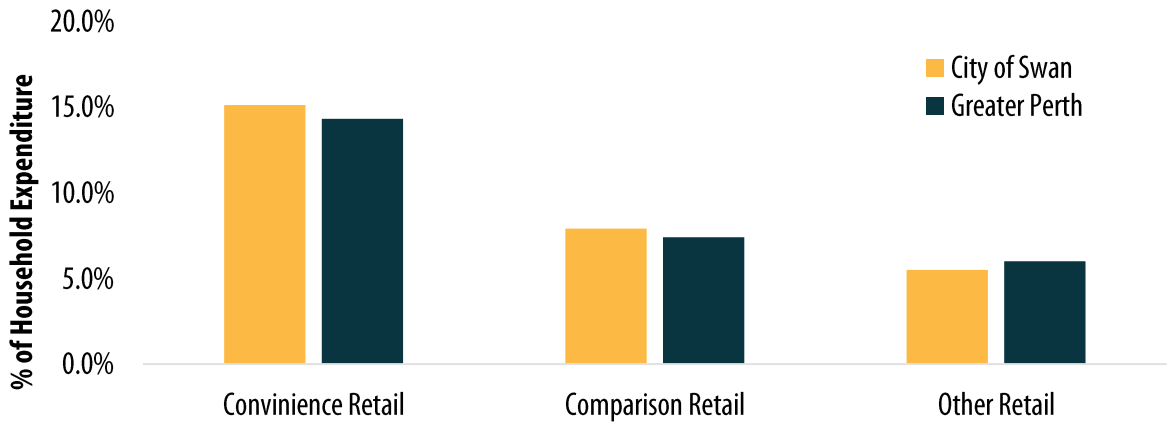
Source: ABS Census 2016, Pracsys 2021

This is not likely reflective of household expenditure in the area as the income profile in the area is reflective of the high proportion of persons aged over 50, who are likely to work part-time and casual hours. The Guildford – Hazelmere area also has an Index of Relative Socio-Economic Disadvantage of 1,034, above the Greater Perth region average of 1,026. This indicates that the relatively low income of persons in the area is not reflective of disadvantage in the region and that household expenditure on commercial uses will follow general trends.

3.3 Retail Expenditure Profile

Research suggests households within the City of Swan as a whole spend a slightly higher proportion of their expenditure on convenience and comparison retail (Figure 6).

Figure 6. Household Retail Expenditure Profile



Source: National Institute of Economic and Industry Research 2018

The provision of convenience retail would contribute to meeting the existing product demand within the site's catchment area. Given the higher proportion of convenience and comparison retail expenditure by City of Swan residents, there is potentially a need to provide a variety of retail floorspace in the Hazelmere area. Provision of this floorspace will reduce leakage to surrounding areas and reduce the need for and length of car trips.

4 FLOORSPACE NEEDS ANALYSIS

This section identifies current and future retail supply and demand for the identified trade area and primary catchment. It also presents a benchmark comparison for other population-driven uses in the trade area. A Floorspace Gap Analysis is used to assess the need for or gap in retail and commercial floorspace in the area. Retail Gravity Modelling is used to estimate the amount of viable retail floorspace that can be incorporated at Lot 651 on SU16.

Gaps have been identified based on the purchasing behaviour associated with different types of floorspace uses.

- Shop/Retail floorspace for this scale centre is likely to draw consumers from a small area therefore the primary catchment has been used to identify gaps. Retail Gravity Modelling has been used to verify the identified gaps
- Other Retail products are not daily or weekly shopping items therefore gaps have been identified at the Trade Area level and applied to the primary catchment population. Retail Gravity Modelling has been used to verify the identified gaps
- Other potential uses are not daily or weekly shopping items therefore gaps have been identified at the Trade Area level and applied to the primary catchment population

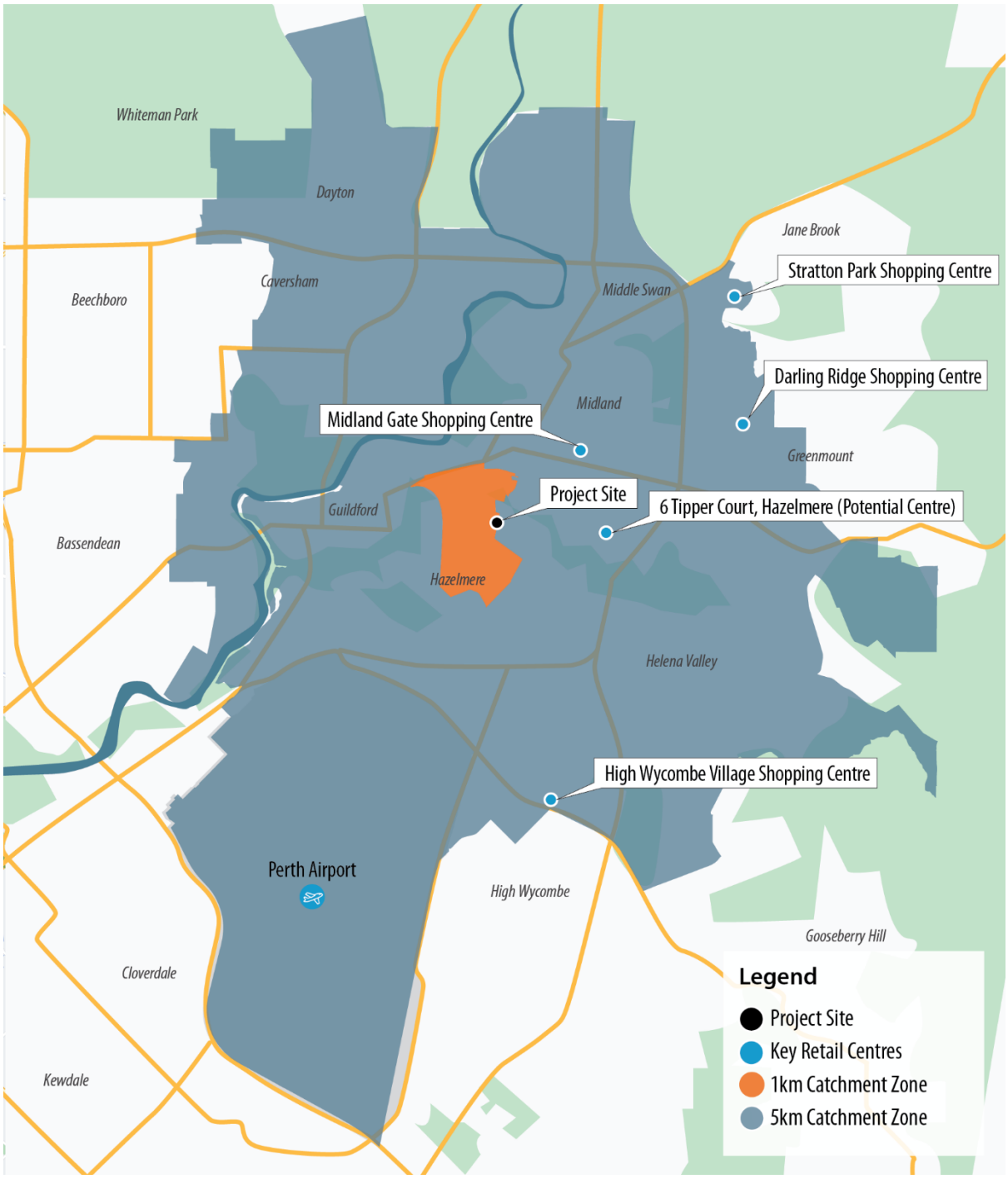
Given the barriers presented by major arterials, the primary catchment area is likely to be the source of the majority of demand and as such provides the basis for quantifying gaps. Retail Gravity Modelling has been used to supplement the gap analysis to consider competition in the areas surrounding the proposed development.

4.1 Retail Supply and Demand

Current Supply

Key Activity Centres in the Trade Area were identified to develop an estimate of the current retail floorspace for both Shop/Retail and Other Retail available to residents within the trade area (Figure 7).

Figure 7. Trade Area – Key Retail Centres



Source: Department of Planning, Lands and Heritage 2015/16, Pracsys 2021

The total provision of commercial floorspace in the trade area was estimated through:

- Department of Planning, Lands and Heritage: Land-use and Employment Survey (LUES)
- Review of structure plans within the City of Swan
- Manual estimation of new centres[7]

A total of 22 centres or floorspace aggregations were identified in the Trade Area (Figure 8). It should be noted that the majority of these centres are very small, with only seven of the twenty-two centres being larger than 2,000m^2 of NLA for Shop/Retail and Other Retail.

Figure 8. Activity Centre Retail Floorspace

Centre	NLA SHP (m^2)	NLA RET (m^2)	NLA Total (m^2)
Beverly Tce	110	0	110
Darling Ridge Shopping Centre	3,472	560	4,032
Guildford North Shopping Strip	1,446	0	1,446
Guildford South Shopping Strip	5,874	1,720	7,594
Hackett St	260	0	260
Hammersley Road	430	0	430
Hazelmere Industrial Support	90	0	90
Helen St	160	0	160
High Wycombe Hotel	5,809	0	5,809
Koongamia	453	0	453
Middle Swan	295	0	295
Midland Gate Shopping Centre	83,354	10,569	93,923
Midland North	60	50	110
Midland South	920	0	920
Midvale	1,150	880	2,030
Queens Road	301	0	301
Stratton Park Shopping Centre	1,557	0	1,557
Tanner St	850	320	1,170
Waterhall Shopping Centre (Estimated)	2,006	0	2,006
West Road	75	0	75
Wittenoom Rd	3,830	850	4,680
Woodbridge	340	0	340
Total	**112,842**	**14,949**	**126,911**

Source: Department of Planning, Lands and Heritage 2015/16

[7] Gross area was measured using the Google Maps mapping tool. For calculation of Net Lettable Area (NLA), it was assumed that NLA is equivalent to 90% of gross building area.

The estimated total provision of Shop/Retail floorspace within the trade area is approximately 113,000m² and the estimated total provision of Other Retail floorspace within the trade area is approximately 15,000 m².

Future Supply

The future supply of retail floorspace in the Trade Area is indicated by District Structure Plans and/or proposed future developments. Three potential future retail developments have been identified:

- Dayton Commercial Centre – notional 5,500m² of Shop/Retail floorspace [8]
- Rosehill Waters – notional 4,700m² of Shop/Retail floorspace [9]
- 6 Tipper Court, Hazelmere (potential) – 2,318m² of Shop/Retail floorspace [10]

In total, there is expected to be approximately an additional 12,500m² of Shop/Retail floor space to be developed in the catchment. It should be noted that:

- The Dayton Commercial Centre is on the outskirts of the trade area and will service the growing areas of Brabham and West Swan
- Rosehill Waters will be developed with residential developments that will form its primary catchment population
- 6 Tipper Court, Hazelmere is a potential centre and will only be initiated subject to a scheme amendment

These developments have been included in the gravity model to ensure all potential impacts are considered.

Current Expenditure

The Shop/Retail and Other Retail expenditure of the Trade Area has been modelled using the ABS Household Expenditure Survey combined with the distribution of income and population at the SA1 level. The current population of the Trade Area is estimated to be 49,400.[11] The population of the primary catchment, used for Retail Gap Analysis, is estimated to be 1,540. For the residential population, the average expenditure per dwelling is multiplied by the number of dwellings to estimate the total expenditure pool.

A total of 2,440 workers are within 2km of the proposed site. Department of Planning, Lands and Heritage data indicates there is one worker per 156m² of gross industrial floor area at the Hazelmere industrial zone and this ratio is used as a benchmark to estimate employment at SU16.[12] The traffic impact assessment for SU16 has identified there will be 20,113m² of gross industrial floor area at SU16, resulting in an estimated 129 workers at the site.[13] For workers, research indicates that the average worker spends $142 per week on

[8] Dayton District Structure Plan, 2021
[9] Rosehill Structure Plan, 2016
[10] City of Swan Local Planning Scheme, 2021
[11] ABS Census, 2016
[12] Department of Planning, Lands and Heritage, 2017, https://www.dplh.wa.gov.au/lues
[13] Donald Veal Consultants, 2020, *Proposed Structure Plan for Lot 651 Stirling Crescent, Hazelmere*

Shop/Retail during work hours; this has been applied to workers in surrounding areas to develop a total annual expenditure pool.[14]

For Shop/Retail, the analysis estimates the residential population within the trade area will spend $488.4 million on Shop Retail in 2026 and workers will spend $17.5 million per year, for a total catchment expenditure of $505.9 million per year in 2026.

For Other Retail, the analysis estimates the residential population within the trade area will spend $114.4 million in 2026. To ensure the analysis is conservative, the analysis does not assume any expenditure from workers on Other Retail. Estimates of retail demand are in 2026 as this is the year used to test floorspace viability through Retail Gravity Modelling.

Future Demand

The population of the Trade Area is forecast to grow by 4,300 persons from 2021 to 2026, reflecting a 5-year growth of 8.6%. This growth is expected to moderate slightly between 2026 to 2031, with the Trade Area population increasing by 4,400 or 8.3%. This will see approximately 8,700 new residents in the Trade Area by 2031, leading to significant growth in retail demand that will necessitate an expansion of retail supply.

The land to the West of the proposed site is undergoing urban renewal with a residential density of R5/20 and surrounding blocks of land are also being developed for residential purposes. The additional residential population that will locate West of SU16 has not been included in the analysis as the rate of development for this area is not clear, this provides a conservative estimate of the required floorspace to service the area. The proximity of the proposed site is likely to assist in capturing a significant share of expenditure from these developments.

[14] International Council of Shopping Centers, 2012, http://www.southfieldcitycentre.com/wp-content/uploads/2012/06/Office-Worker-Retail-Spending-in-a-Digital-Age.pdf

4.2 Retail Gap Analysis

The following analysis uses floorspace provision ratios to investigate a gap in the provision of Western Australian Land Use Classification (WASLUC) floorspace types in the Catchment. Floorspace provision ratios are a measure of floorspace per person for a particular geographical area.

The analysis assesses the floorspace provision ratio for the Trade Area and Primary Catchment against a set of proximate benchmark LGAs. The benchmark LGAs includes the City of Bayswater, The Town of Bassendean and the City of Belmont. To identify the prospective retail floorspace uses that can be accommodated at the site the analysis has identified underprovided floorspace uses by WASLUC code in the Catchment compared to the combined benchmark LGAs.

URPS has provided a number of prospective land uses for Lot 651 on SU16, prospective land uses include:

- Shop
- Showroom
- Fast Food Outlet
- Lunch Bar
- Restaurant
- Tavern
- Betting Agency
- Medical Centre
- Garden Centre
- Service Station
- Motor Vehicle Service
- Motor Vehicle Sale
- Convenience Store
- Warehouse for Storage

These land uses have been aligned with underprovided WASLUC codes to identify prospective land uses for the proposed site.

Estimated Gap for Shop/Retail

The benchmark comparison has been calculated based on the estimated population in 2026. The 2016 population of the primary catchment was 1,299.[15] Based on the population growth rate of the City of Swan, this is estimated to be 1,540 in 2021 and is expected to grow to 1,797 in 2026.[16] It is assumed the proposed site will be developed in 2026; this is the year used to identify floorspace gaps. Future centres that have been

[15] ABS Census, 2016
[16] The City of Swan growth rate is lower than the Hazelmere – Guildford growth rate over the 2021 – 2026 period according to Forecast.id and has been applied to provide a conservative estimate

approved but not developed centres are accounted for in the Analysis. Underprovided Shop/Retail uses are aligned with prospective uses identified for the site (Figure 9).

Figure 9. Prospective Shop/Retail Land Uses for Lot 651

		Potential Additional Floorspace (m^2)	
WASLUC CODE	**Prospective Land Use**	**2026**	**2031**
DEPARTMENT STORES - RETAIL	Shop	718	816
SUPERMARKETS AND GROCERS	Shop / Convenience Store	661	752
RESTAURANTS, CAFES & FUNCTION CENTRES	Restaurant / Tavern	302	343
TAKE AWAY FOOD AND MILK BARS	Fast Food Outlet / Lunch Bar	200	228
WOMEN'S, GIRLS' AND INFANTS' WEAR STORES - RETAIL	Shop	98	112
PHARMACIES, CHEMISTS	Medical Centre	97	110
ELECTRONIC EQUIPMENT AND PARTS RETAIL	Shop	82	94
LIQUOR - RETAIL	Shop	65	81
COMBINED MEN'S & WOMEN'S CLOTHING STORES- RETAIL	Shop	70	79
WOMENS HAIRDRESSERS (INCLUDING UNISEX)	Shop	66	76
BEAUTY SALONS	Shop	51	58
NEWSAGENTS	Shop / Convenience Store	30	34
MEATS - RETAIL.	Shop	24	27
FRUITS AND VEGETABLES - RETAIL	Shop	24	27

Source: URPS 2025, Pracsys 2021

Total underprovided uses equate to an estimated gap of approximately 3,000m^2 of Shop/Retail floorspace in the primary catchment. The floorspace gap in department store retail is considered inappropriate to locate at the proposed development as department stores provide a retail comparison offering that will be satisfied by the Midland Strategic Metropolitan Centre.

This site will service both the significant industrial workforce within the Hazelmere industrial area to the east and will offer an additional level of convenience retail to the existing and future residential population within the primary catchment. Floorspace uses will be tailored to service the industrial workforce, this will include:

- Comparison uses such as speciality stores
- Convenience uses such as:
    - Delicatessens
    - Newsagents
    - Fast Food Outlets
    - Cafes/Taverns

It should be noted that this underprovision is based on a comparison of primary catchment residents to residents of the benchmark LGAs. The proposed centre will also support industrial workers and there will be the opportunity to tailor some floorspace to cater to the specific socio-economic factors of those workers. For

example, a portion of these identified uses are likely to be incorporated into a Convenience Store, that may extend beyond normal trading hours to support industrial workers.

Estimated Gap for Other Retail

Underprovided Other Retail uses have been aligned with prospective uses identified for the site (Figure 10).

Figure 10. Prospective Other Retail Land Uses for Lot 651

		Potential Additional Floorspace (m^2)	
WASLUC CODE	**Prospective Land Use**	**2026**	**2031**
HARDWARE - RETAIL.	Shop	115	131
MOTOR VEHICLES (NEW AND USED CARS) - RETAIL	Motor Sale	56	64
MOTOR VEHICLE PARTS RETAIL - NEW	Motor Service	55	62
MOTOR VEHICLE RENTAL SERVICES	Motor Sale	33	37
FUEL - RETAIL	Service Station	30	34
TYRES, BATTERIES & ACCESSORIES-RETAIL	Showroom	28	31
MOTOR VEHICLES (USED CARS ONLY) - RETAIL	Motor Sale	25	28
NURSERIES - RETAIL	Garden Centre	21	24
PAINT AND WALLPAPER - RETAIL	Showroom	15	17
PLUMBING, HEATING & REFRIGERATION EQUIPMENT- RETAIL	Showroom	11	12

Source: URPS 2025, Pracsys 2021

In total, including underprovided uses not detailed in Figure 10, the Retail Gap Analysis estimates there is a gap of approximately 400m^2 of Other Retail floorspace in the primary catchment.

The proposed centre will also support industrial workers and there will be the opportunity to tailor some floorspace to cater to the purchasing requirements of those workers. A number of land uses included in the Other Retail portion of the development are likely to fall under Industry – Service.

This means that goods manufactured at the industrial portion of the development may be sold via a retail shopfront or the retail shopfront may be used as a depot for receiving goods that are being serviced. The expenditure related to these offerings would not be related to the local population and would require additional floorspace.

Estimated Gap for Commercial Uses

There are a number of other commercial floorspace uses that have been highlighted as potential inclusions in the proposed development. Floorspace gaps that do fall into the Shop/Retail or Other Retail Category are shown in Figure 11.

Figure 11. Prospective Non-Shop/Retail or Other Retail Land Uses for Lot 651

		Potential Additional Floorspace (m^2)	
WASLUC CODE	**Prospective Land Use**	**2026**	**2031**
MOTOR VEHICLE MECHANICAL REPAIR SERVICES NEC & MOTOR VEHICLE REPAIRS NEC	Motor Vehicle Service	181	212
MOTOR VEHICLES (NEW AND USED CARS) - RETAIL	Motor Vehicle Sale	66	76
GENERAL MEDICAL PRACTICES	Medical Centre	53	66
TYRES, BATTERIES & ACCESSORIES-RETAIL	Showroom	49	56
ELECTRONIC PARTS AND EQUIPMENT - WHOLESALE/WAREHOUSING	Showroom	43	49
GROCERIES (GENERAL LINE) - WHOLESALE /WAREHOUSING	Showroom	33	38
ELECTRONIC EQUIPMENT AND PARTS RETAIL	Showroom	28	32

Source: URPS 2025, Pracsys 2021

The total gap for commercial uses is estimated to be approximately 2,800m^2. Due to the use nature associated with commercial uses, these gaps highlight gaps in the Trade Area. Only the Primary Catchment population has been used in estimating the gap, providing a conservative estimate of the potential commercial uses that could be viable at the proposed site. One of the potential uses being considered for the site is a warehouse. This is considered appropriate due to the location of SU16 being adjacent to the Hazelmere industrial area and proximate to key transport and freight linkages.

Encouragingly, the trade area is estimated to have a lower floorspace to person ratio of vacant floorspace than the comparison benchmarked LGAs used in the analysis.

Retail Gap Analysis Summary

The Retail Gap Analysis has identified potential Shop/Retail, Other Retail and commercial uses that are underprovided at Lot 651 on SU16. WASLUC codes have been matched to all prospective land uses identified by URPS.

Lot 651 on SU16 has the potential to provide a range of land use gaps identified for the site. The proposed uses are not intended to compete with uses currently in the Midland Workshop and the site will attract a lower order of tenant. Additionally, land uses at this site will be tailored to service the industrial workforce in Hazelmere and are not intended to compete with the Midland Gate Shopping Centre.

The Retail Gap Analysis identified an underprovision of approximately 3,000m^2 of Shop/Retail floorspace, 400m^2 of Other Retail floorspace and 2,800m^2 of commercial floorspace. It should be noted that this Floorspace Gap Analysis does not assess uses currently overprovided in the trade area and/or primary catchment. Accordingly, alternative land uses considered for the site should be sense checked to ensure there are gaps that can be addressed to provide additional amenity to residents and workers.

5 RETAIL POTENTIAL ANALYSIS

To estimate the retail potential of the proposed site, retail gravity modelling has been undertaken. The Retail Gravity Model (also known as Huff's Gravity Model) is a modified version of Sir Isaac Newton's Law of Gravitation. The Gravity Model is a popular model widely used in international trade modelling, transport modelling and regional planning. Retail Gravity modelling studies retail supply, and the probability of a customer (demand) visiting a particular centre. The model accounts for the distribution and attractiveness of competing centres, along with the distance a customer will have to travel to each centre. Floorspace quantum (m^2) is used to represent the attractiveness of retail centres. Customers are willing to travel farther to shop at large centres, representing a higher level of attraction (they can generally satisfy multiple needs in one trip to a larger centre, which also contains a higher proportion of comparison goods).

The model provides an objective method of distributing expenditure among centres. Calibration is used to match the calculated distribution of expenditure to actual published turnover levels, optimising the model outputs. Having established a benchmarked current distribution of expenditure, new floorspace can be introduced and changes in expenditure distribution across time can be examined, allowing for various retail centre transformations such as planned expansions and new developments. This comprehensive approach creates a distribution of expenditure that is fundamentally unbiased, as it is based on mathematical rules. It is a widely used approach that has been accepted by the Department of Planning, Lands and Heritage and Western Australian Planning Commission (WAPC) through the review of a wide range of Structure Plans, Local Commercial Strategies and Retail Sustainability Assessments.[17] For more information on the gravity modelling methodology, please see Appendix I: Gravity Modelling Methodology.

5.1 Estimated Shop/Retail Potential

Turnover estimates can be used to verify if there is sufficient expenditure within the Catchment to support the proposed development. It is possible to estimate the potential turnover of retail centres using average floorspace productivity estimates for WA. Estimates and benchmarks have shown that the average shopping centre in WA has a floorspace productivity level of $7,400m^2$.[18]

Based on results from retail gravity modelling, in 2026, the development can support 3,000m^2 of Shop/Retail, at the WA average shopping centre productivity for a total turnover of $22.3 million. Results from gravity modelling indicate that the development would turnover higher in 2021, however, gravity modelling has been undertaken for 2026 to ensure proximate future developments are included in the analysis. Excluding Discount Department Store uses that are not appropriate for a small centre, this equates to approximately 2,300m^2 of Shop/Retail floorspace which could be viable at the proposed site. The gap analysis should provide

[17] For example, in April 2014, the West Australian Planning Commission approved the Melville City Centre Structure Plan, which proposed the expansion of the Garden City shopping centre. The RSA prepared by Pracsys in support of the application was based on gravity modelling. Please see Melville City Structure Plan 2015.
[18] Urbis 2015, Australian Shopping Centre Industry.

approximate maximum sizes for specific uses. For example, supermarket and grocery uses are not likely supportable over the identified 660m^2 gap. Smaller independent supermarkets can be viable with turnover productivity levels around $8,000m^2. Larger supermarkets tend to require turnover productivity levels around $10,000m^2; therefore, it is considered that a supermarket larger than the identified gap might not be viable (Appendix II: Required Floorspace Productivity).

5.2 Estimated Other Retail Potential

Based on results from retail gravity modelling, in 2026, the development can support up to 4,000m^2 of Other Retail floorspace, at a productivity level of $5,958m^2 for a total turnover of $23.8 million. This is considered a viable level of floorspace productivity based on the required floorspace productivity to ensure adequate retention rates detailed in Appendix II: Required Floorspace Productivity. Results from the gravity model reflect the nature of Other Retail which draws consumers from a wider catchment than Shop Retail uses. It is likely that the viable level of Other Retail will be somewhere between the identified gap (400m^2) and the gravity modelling estimate. It is likely that the demand from industrial uses at the site and from surrounding industrial areas will generate sufficient expenditure to support Other Retail uses towards the upper end of the range.

5.3 Retail Potential Analysis Summary

The Retail Potential Analysis has identified Lot 651 can support up to 3000m^2 of both Shop/Retail floorspace and 4,000m^2 Other Retail floorspace at a viable level of floorspace productivity. Potential non-Shop/Retail and Other Retail floorspace productivities have not been estimated through gravity modelling, however, they can be used to support the Shop/Retail and Other Retail portions of the proposed development.

6 CONCLUSION

Lot 651, Stirling Crescent, Hazelmere on SU16 presents a key opportunity to provide retail and commercial floorspace that can be used to support the current and future local residential population and adjacent industrial workforce.

Retail Gap Analysis has shown that the primary catchment around Lot 651 has an underprovision of retail and commercial floorspace, including:

- Approximately 3,000m^2 of Shop/Retail floorspace
- Between 400m^2 -4,000m^2 of Other Retail floorspace
- Approximately 2,800m^2 of commercial floorspace

Results from Retail Gravity Modelling demonstrate that this level of floorspace produces viable floorspace turnover for businesses.

The proposed development will provide adequate support to the surrounding residential population in the primary catchment and will be primarily used to support workers at proximate industrial land. It should be noted that land uses at Lot 651 on SU16 are not intending to compete with land uses currently located at the Midland Workshop land and will attract a lower order of tenant. Additionally, a portion of the retail floorspace at Lot 651 on SU16 will be Industry – Service, used primarily as a retail shopfront for goods produced at the industrial section of the development or for a depot to receive goods to be serviced.

7 APPENDIX I: GRAVITY MODELLING METHODOLOGY

Gravity models allow for the measurement of spatial interaction as a function of distance to determine the probability of a given customer shopping at a centre and provide an approximation of trade area and sales potential for a development. This modelling technique uses the distance between a household and each centre, and a measure of 'attractiveness' to define the probability model. The 'attractiveness' of a centre has been defined by total floorspace and the distance has been calculated by measuring straight-line distances between each centre and population. The gravity model probability formula is shown in **Error! Reference s ource not found.**.

Figure 12. Gravity Model Probability Formula

$$P_{ij} = \frac{\frac{A_{jk}^{a}}{D_{ij}^{ß}}}{\sum_{j=1}^{m} \frac{A_{jk}^{a}}{D_{ij}^{ß}}}$$

P_{ij}	=	Probability of customer living/working in statistical area i shopping at complex j.
A_i	=	Area of floorspace in centre, j in square metres, according to the type of supply, k.
D_{ij}	=	Distance between statistical area of households, i and complex j.
a	=	Area exponent
ß	=	Distance exponent
k	=	Type of supply or expenditure, either Convenience or Comparison
i	=	Statistical area (i=1,...,n)
j	=	Complexes (j=1,...,m)

Source: Carter, C (1993) 'Assumptions Underlying the Retail Gravity Model', *Appraisal Journal,* Vol 61, No 4, pp510; Pracsys (2020)

Figure 13. Gravity Model Demand Formula

$$D_{kj} = \sum_{i=1}^{n} (P_{ij} * E_i)$$

D_{kj} = Demand for retail category k, at centre j.

E_i = Expenditure pool of statistical area i.

Source: Carter, C (1993) 'Assumptions Underlying the Retail Gravity Model', *Appraisal Journal,* Vol 61, No 4, pp510; Pracsys (2020)

Error! Reference source not found. shows that the demand for retail category k[19], at centre j, is equal to the s um of the probabilities of customers living in statistical areas i to n, multiplied by the expenditure pool of statistical area i. In other words, the demand for retail is a function of the probability of customer from particular statistical area attending the centre multiplied by the expenditure pool of that statistical area. The expenditure is pool is derived through the population multiplied by its income distribution.

In its core form gravity modelling provides a clearer, reproducible outcome that can be easily assessed. However, it does not consider local factors, including:

- The comparative value proposition of centres (e.g. the presence of an 'anchor' attractor that draws significant market share);
- The brand preference of users; or
- The efficiency of transport networks, as well as geographical barriers (e.g. in some cases it may be easier for customers to access a centre that lies physically further away).

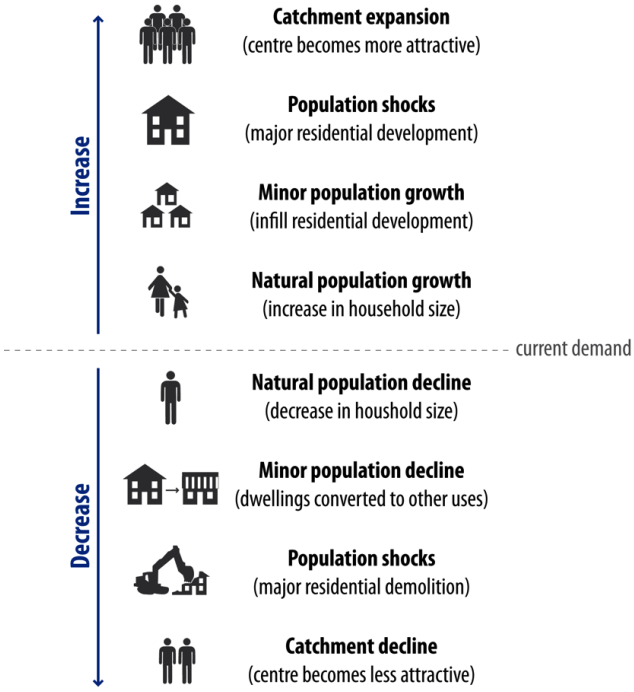
7.1 Drivers of Retail Floorspace Supply and Demand

Demand changes can result in increased or decreased expenditure. The potential causes of demand changes are shown in **Error! Reference source not found.**. These largely show that an increasing population increases d emand, and vice versa. There are significant amounts of commercial floorspace, especially office floorspace, flagged for the central sub-region of Perth and beyond. There will also be significant numbers of new dwellings provided across Perth. This increase in residents has the potential to boost demand for goods and services in the area.

[19] Retail categories are determined by their PLUC code and whether they are convenience or comparison goods. Convenience goods are day-to-day items such as groceries, pharmaceuticals and fast food. Comparison goods are items where consumers are willing to travel further distances, and are bought less frequently such as clothing, furniture, electronics, or other household items.

Demand can also increase from rising incomes, or wealth, because people have more disposable income to spend on retail. Demand can also be increased by reducing leakage. Leakage for retail is largely caused by online retail, as well as travelling.

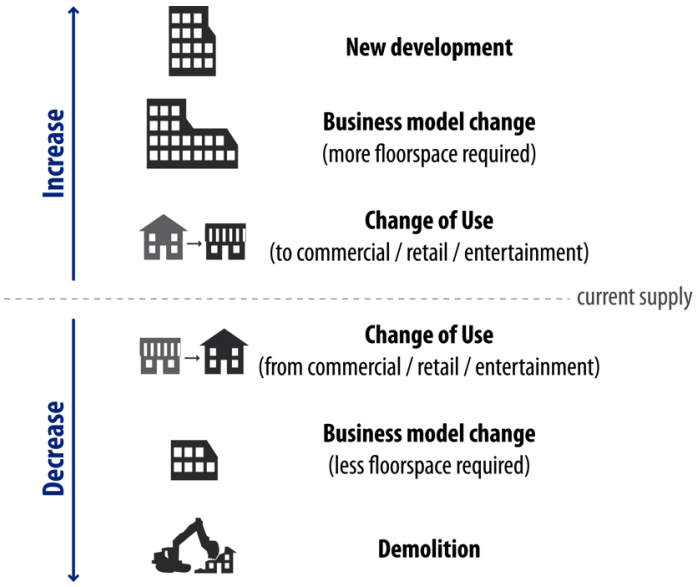
Figure 14. Drivers of Retail Floorspace Demand



Source: Pracsys 2020

Supply changes can result in increased or decreased retail floorspace. The potential causes of supply changes are shown in Figure 15.

Figure 15. Drivers of Retail Floorspace Supply



Source: Pracsys 2020

8 APPENDIX II: REQUIRED FLOORSPACE PRODUCTIVITY

The floorspace productivity rates required to ensure reasonable retention rates by shop type are shown in Figure 16.

Figure 16. Required Floorspace Productivity for Business Retention

Retail Category	Productivity ($/m²)
Take Home Food	$ 10,000
Take Home Liquor	$ 9,000
Dine Out Food	$ 6,500
Clothing/Footwear	$ 5,000
Convenience Retail	$ 7,000
Bulky Goods Retail	$ 5,500

Source: LandCorp 2017

Perth

Level 17, 1 Spring Street
Perth, WA 6000

(08) 6285 3177

Adelaide

27 Halifax Street
Enter via Symonds Pl
Adelaide, SA 5000

(08) 8333 7999

Melbourne

68 Clarke Street
Southbank, VIC 3006

(03) 8593 9650

Brisbane

GPO Box 2349
Brisbane, QLD 4000

(07) 3778 7420

URPS SHAPING GREAT COMMUNITIES

urps.com.au