TREEBY DISTRICT STRUCTURE PLAN

December 2017

PART ONE - IMPLEMENTATION

STRUCTURE PLAN TREEBY DISTRICT

CLE
TOWN PLANNING + DESIGN

TREEBY DISTRICT STRUCTURE PLAN

PART ONE - IMPLEMENTATION

Prepared by:

CLE
TOWN PLANNING + DESIGN

PO Box 796
Subiaco WA 6904
t: 9382 1233
f: 9382 1127
www.cleplan.com.au

2310Rep137D
December 2017

1.0 STRUCTURE PLAN AREA

This District Structure Plan applies to the area shown within the boundary on Plan A – Treeby (Banjup) District Structure Plan.

2.0 STRUCTURE PLAN CONTENT

This structure plan comprises:

- Part One – Implementation Section
- Part Two – Explanatory Section
- Appendices – Technical Reports.

Part One of the District Structure Plan comprises the structure plan map and planning provisions. Part Two of the District Structure Plan is the Explanatory Section which can be used to interpret and implement the requirements of Part One.

3.0 OPERATION

The District Structure Plan is a strategic planning document intended to guide and coordinate more detailed planning (including preparation of Local Structure Plans) for individual sites within the District Structure Plan area. The structure plan comes into effect on the date Council resolves it will become a guiding document for more detailed structure planning. Endorsement by the Western Australian Planning Commission (WAPC) under the provisions of the *Planning and Development (Local Planning Schemes) 2015 Schedule 2 – Deemed provisions* is not proposed although the District Structure Plan has been prepared with reference to WAPC policies and consultation with the Department of Planning.

4.0 REZONING, LOCAL STRUCTURE PLAN, SUBDIVISION AND DEVELOPMENT REQUIREMENTS

The land use arrangements, district level infrastructure and movement network illustrated in the District Structure Planning will inform the City's response to requests for rezoning and more detailed Local Structure Plans within the structure plan area. The layout illustrated within Plan A represents a high level structural response to key issues which may be subject to refinement at more detailed stages of planning.

Local Structure Plans prepared within the District Structure Plan area should:

- Generally conform with the layout illustrated within the District Structure Plan;
- Be accompanied by:
  - A Local Water Management Strategy consistent with any approved District Water Management Strategy;
  - An Environmental Assessment Report;
  - A Bushfire Hazard Assessment;
  - A Noise Impact Assessment; and
  - Other submission requirements consistent with the *Planning and Development (Local Planning Schemes) 2015 Schedule 2 – Deemed provisions.*

Subdivision and development will be determined in accordance with the applicable zoning, planning scheme provisions and, where applicable, approved Local Structure Plans and Local Development Plans.

5.0 ADDITIONAL INFORMATION

All urban development within the District Structure Plan area is subject to Development Contribution Plan No. 13.

In addition, urban development sites abutting Jandakot Road shall be required to provide for the widening and upgrade of any directly abutting portion of Jandakot Road to a 2 lane divided urban standard road, with provision (widening and earthworks) for ultimate upgrade to a 4 lane divided urban standard road. These works and associated widening required shall be agreed via legal agreement entered into with the City of Cockburn prior to approval of a Local Structure Plan for the site if deemed necessary.

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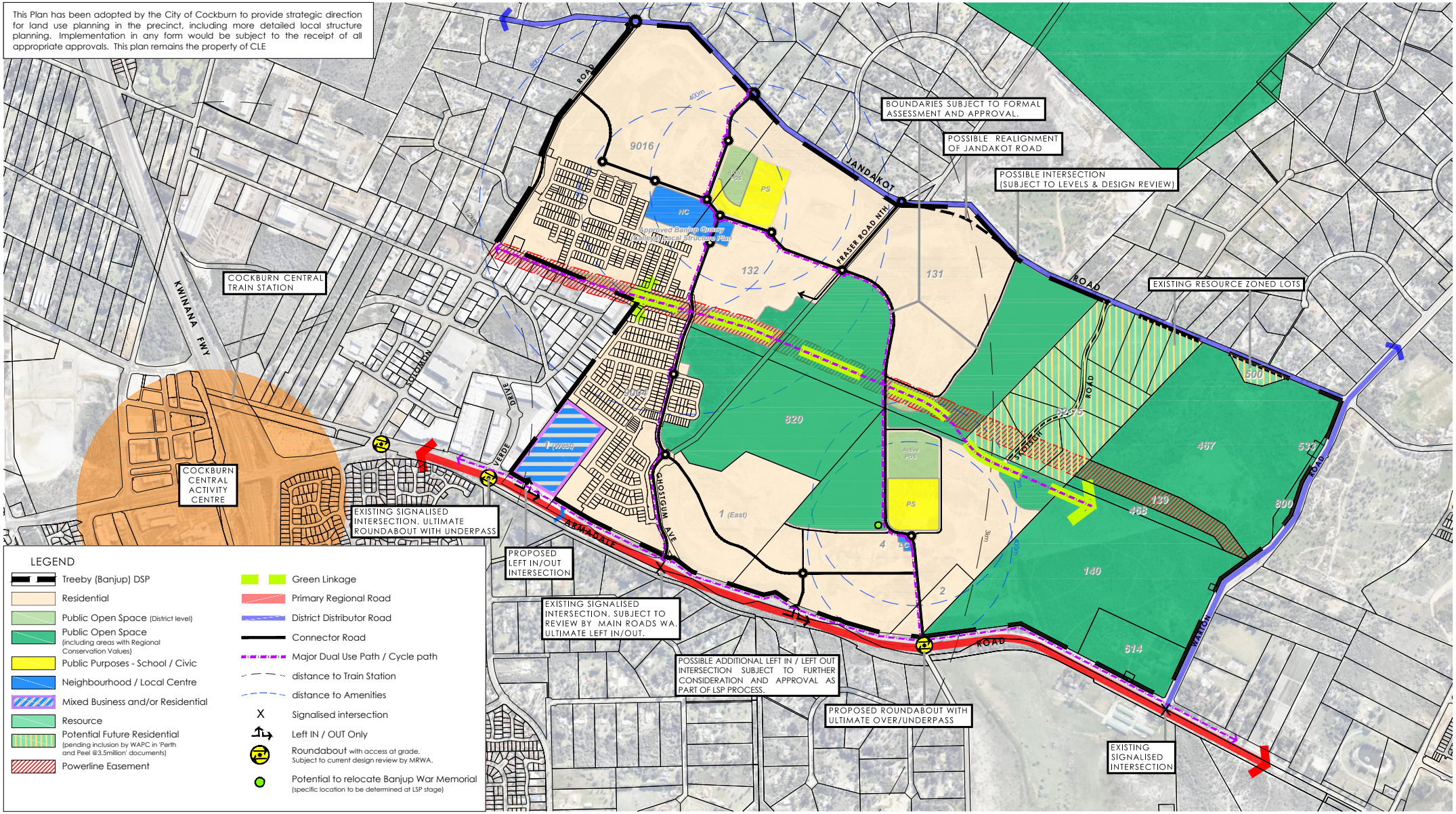
This Plan has been adopted by the City of Cockburn to provide strategic direction for land use planning in the precinct, including more detailed local structure planning. Implementation in any form would be subject to the receipt of all appropriate approvals. This plan remains the property of CLE



12.07.2015 nearmap.com

TREEBY (BANJUP) DISTRICT STRUCTURE PLAN

2310-122F-01 (29.09.2017), NTS

Banjup, City of Cockburn

TREEBY DISTRICT STRUCTURE PLAN

December 2017

PART TWO - EXPLANATORY SECTION

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TREEBY DISTRICT STRUCTURE PLAN

PART TWO - EXPLANATORY SECTION

Prepared by:

PO Box 796
Subiaco WA 6904
t: 9382 1233
f: 9382 1127
www.cleplan.com.au

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DEVELOPER

Perron Developments Pty Ltd

PROJECT TEAM

Town Planning - CLE Town Planning + Design

Environmental - 360 Environmental

Hydrology - JDA Consultant Hydrologists

Civil Engineering - Wood & Grieve Engineers

Traffic - Transcore

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TABLE OF CONTENTS

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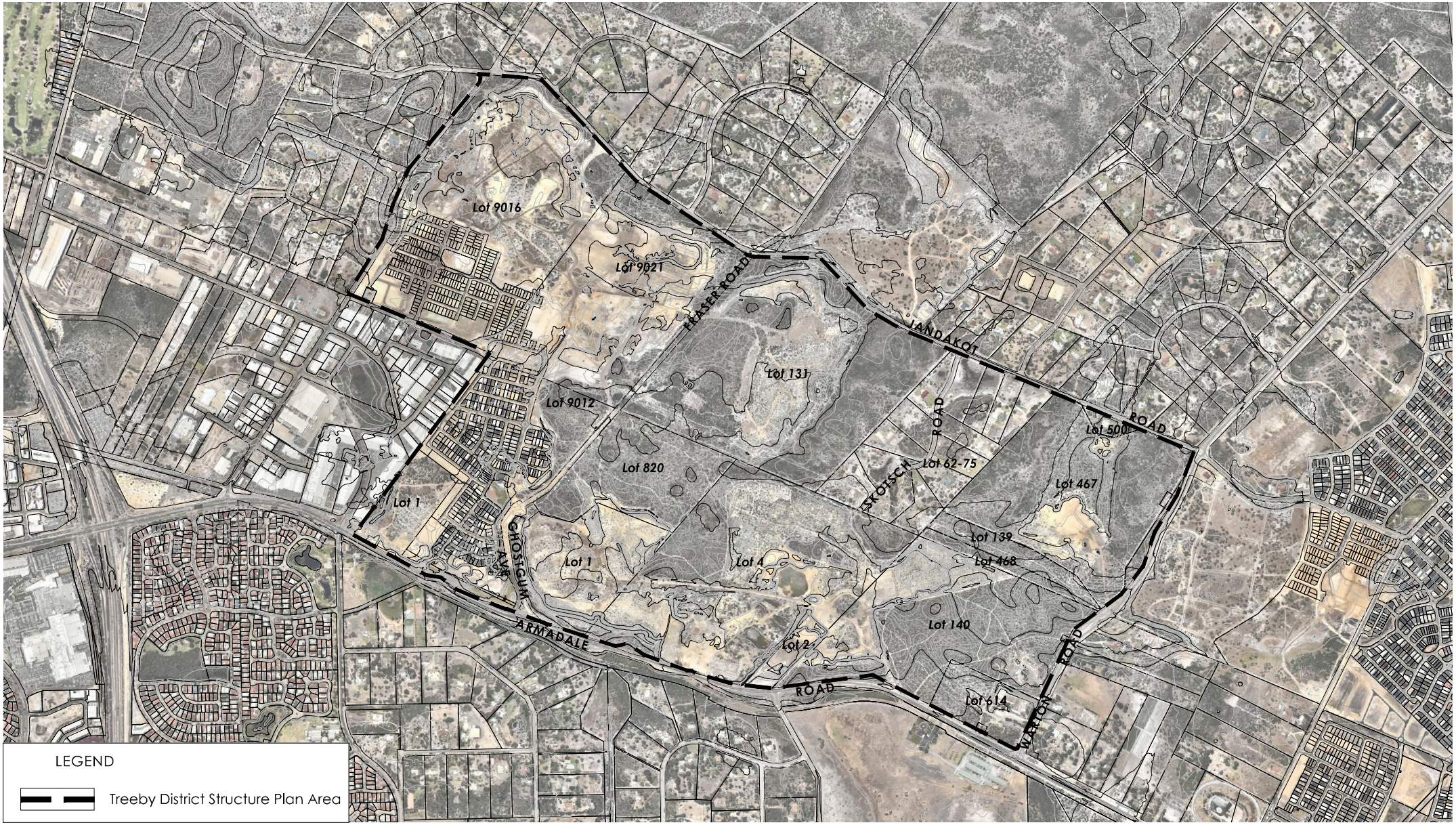
FIGURES

TABLES

APPENDICES



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Source: nearmap.com 28.01.2016

2310-136-01 (04.07.2016), NTS

SITE PLAN

Figure 1

1.0 PLANNING BACKGROUND

1.1 Introduction and Purpose

This District Structure Plan, hereinafter referred to as the Treeby District Structure Plan (TDSP) has been prepared at the request of the City of Cockburn in consultation with key stakeholders including relevant government agencies and major landholders. It is a strategic document to guide the City's decision making: it has not been prepared under Part 4 of Schedule 2 of the *Planning and Development (Local Planning Schemes) Regulations 2015* and endorsement by the Western Australian Planning Commission is not proposed to be sought.

The TDSP applies to the area generally bounded by Jandakot Road to the north, Warton Road to the east, Armadale Road to the south and Solomon Road to the west. This area totals around 460ha (refer Figure 1 – Site Plan). At the time of adoption, a separate visioning process was being undertaken for land outside the DSP on the north side of Jandakot Road, and a review of design and timing options for the upgrade of Jandakot Road.

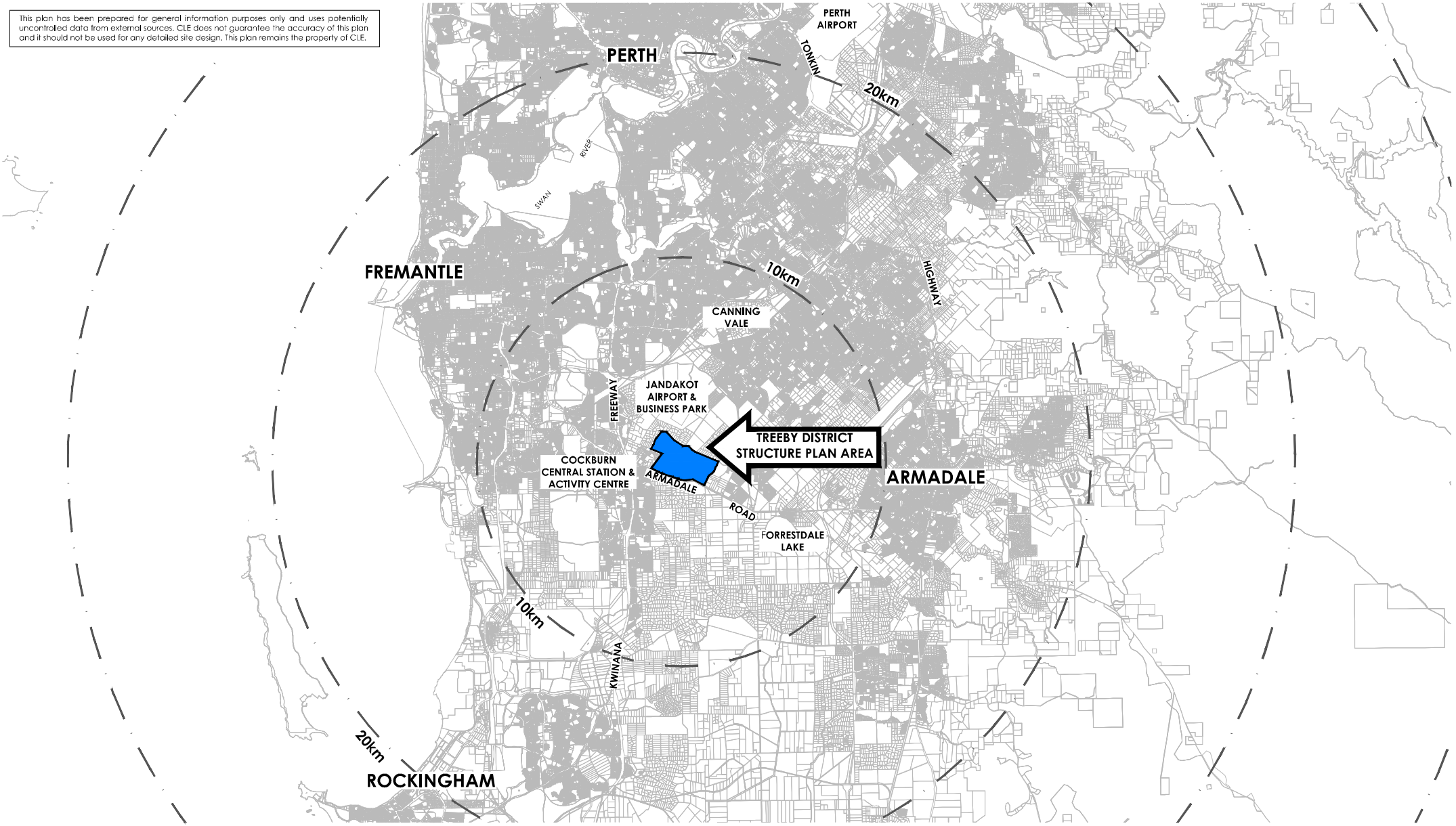
The primary objective of the TDSP is to provide a high level strategic spatial planning framework to coordinate the development of land and provision of district level services within the Banjup Urban Precinct. The TDSP identifies the basic physical arrangement of urban areas, the primary road network, neighbourhoods, schools, district open space, commercial centres, public transportation and other major infrastructure. The TDSP consolidates background information and provides broad direction to inform the preparation of Local Structure Plans as part of the more detailed planning process to follow.

The coordination of planning for the Banjup Urban Precinct (now defined as the Treeby DSP area) presents a valuable opportunity for the State to achieve many of its planning and land use objectives for Perth, and consolidation of urban development in the southern metropolitan corridor.

The lodgement of the TDSP aligns with the Project Plan released by the City of Cockburn in September 2015. The Project Plan provides a guide for the preparation of the TDSP which covers the following –

- Broad land-use arrangement, buffers and any relevant targets (eg. density targets);
- Coordination of major infrastructure including:
  - Schools;
  - District Water Management;
  - District Movement Networks;
  - Regional & District level Open Space / Conversation Areas;
  - District recreation facilities.
- Broad funding arrangements for improvements, potentially including the principles of a Development Contribution Plan (DCP).

The TDSP addresses and acknowledges all of the objectives of the City's Project Plan.



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2310-123-01 (04.07.2016), NTS

LOCATION PLAN

Figure 2

1.2 Land Description

The following section provides a brief overview of the TDSP area, and examines its context with respect to location, land use and ownership.

1.2.1 Location

The TDSP applies to the area generally bounded by Jandakot Road to the north, Warton Road to the east, Armadale Road to the south and Solomon Road to the west within the City of Cockburn. It is located approximately 19km south of the Perth CBD, 1km east of Cockburn Central Railway Station and Activity Centre, and 13km west of the Armadale Shopping Centre (refer Figure 2 - Location Plan).

1.2.2 Area and land use

The TDSP covers an area of approximately 460ha. Existing land use within the TDSP includes residential, extractive industry, rural residential, rural and open space / conservation. This includes:

- 118.48ha of Regional Open Space reserved for Parks and Recreation owned by the State;
- The Calleya (Banjup Quarry) residential development estate which consists of around 145ha of land in the western portion of the TDSP, currently under development by Stockland;
- The currently vacant Lot 1 (west) Armadale Road, to the southwest of the Calleya development (8.09ha);
- Fourteen (14) Resource zoned existing rural residential homesites accessed via Skotsch Road totalling 29.83ha; and
- Four (4) consolidated vacant sites previously used for quarrying activities and now identified for development:

Table 1: Primary Potential Development Sites

Lot Details	Landowner	Area(ha)
Lot 1 (east) Ghostgum Avenue	Department of Housing	20.35
Lot 2 Armadale Road	Ronci, Palmerino	3.15
Lot 4 Armadale Road	Midland Brick Co Pty Ltd - under contract to Perron Developments P/L	58.77
Lot 131 Jandakot Road	Limebrook Holdings Pty Ltd. - subject to a JV arrangement with Perron Developments P/L	64.75

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Source: nearmap 28.01.2016

2310-124-01 (04.07.2016), NTS

LAND OWNERSHIP PLAN

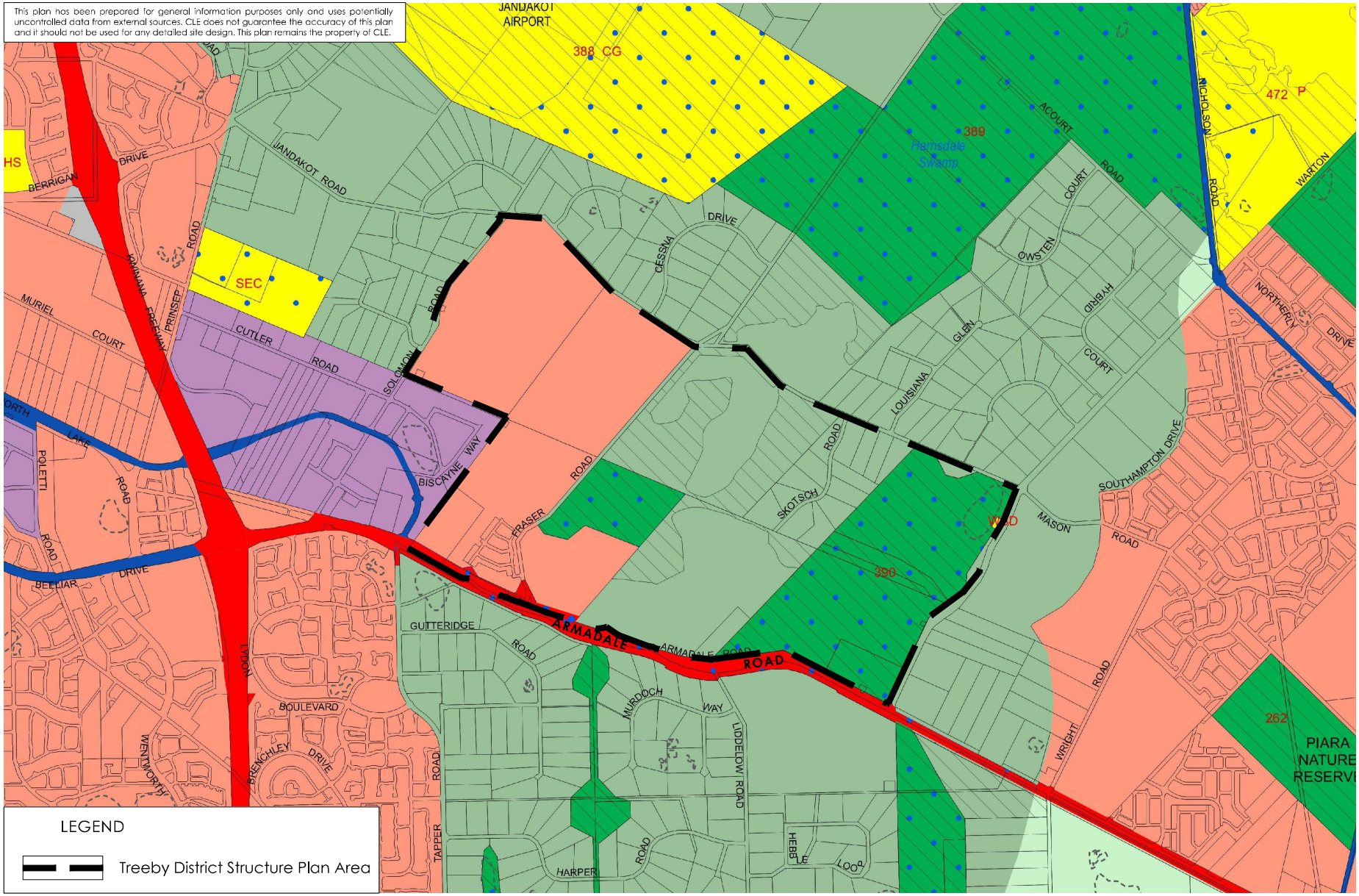
Figure 3

1.2.3 Legal Description and Ownership

The following table provides a summary of the land ownership within the TDSP, excluding created single residential lots within Calleya. A Land Ownership Plan is provided at Figure 3.

Table 2: Land Ownership

Lot Number	Owner	Certificate Of Title	Area(ha)
1 (west)	Armadale Road Pty Ltd	1209-240	8.09
1 (east)	Housing Authority	2887-742	20.35
2	Ronci, Palmerino	1250-966	3.15
4	Midland Brick Co Pty Ltd	333-129A	58.77
131	Limebrook Holdings Pty Ltd	1524-135	64.75
62-75	Various Skotsch Road private landowners		29.83
500	Dougan, Kiara Helen & Law-David, Daniel John	1663-61	1.19
139	State of WA	LR3144-998	5.30
140	State of WA	LR3096-571	42.56
467	State of WA	LR3081-261	40.31
468	State of WA	LR3024-166	2.59
614	State of WA	LR3032-307	7.68
820	WA Planning Commission (State of WA)	2710-373	20.05
9012	Stockland WA Development Pty Ltd	2867-287	7.43
9021	Stockland WA Development Pty Ltd	2898-453	41.26
9016	Stockland WA Development Pty Ltd	2898-982	41.56



Legend

- Scheme boundary

Reserved lands
- Parks and recreation
- R — Restricted public access
- Railways
- Port installations
- State forests
- Civic and cultural
- Waterways
- Public purposes - denoted as follows:
  - H — Hospital
  - HS — High school
  - TS — Technical school
  - CP — Car park
  - U — University
  - CG — Commonwealth Government
  - SEC — State Energy Commission
  - SU — Special uses
  - WSD — Water Authority of WA
  - P — Prison

Reserved roads
- Primary regional roads
- Other regional roads

Zones
- Urban
- Urban deferred
- Central city area
- Industrial
- Special industrial
- Rural
- Rural - water protection
- Private recreation

Notice of delegation
- (Site No) Bush forever area

Redevelopment schemes
- Redevelopment scheme/act area

Special control areas
- Water catchments
- Environmental conditions

CLE TOWN PLANNING + DESIGN

Source: WAPC_MRS_Map24_25000_Forrestdale_17.06.2016

2310-127-01 (07.07.2016), NTS

METROPOLITAN REGION SCHEME PLAN

Figure 4

1.3 Planning Framework

1.3.1 Zoning and Reservations

1.3.1.1 Metropolitan Region Scheme

The TDSP area is subject to various zonings and reservations under the Metropolitan Region Scheme (MRS) including 'Urban', 'Rural', 'Rural-Water Protection', 'Parks and Recreation'. A 'Bush Forever' overlay associated with Bush Forever site 390 applies to many parts of the area containing remnant vegetation. The Parks and Recreation reserves are also subject to a Water Catchment Special Control Area. The table below provides details of the MRS zoning for key lots. A Metropolitan Region Scheme (MRS) zoning plan is also provided at Figure 4.

Table 3: MRS Zoning (Summary)

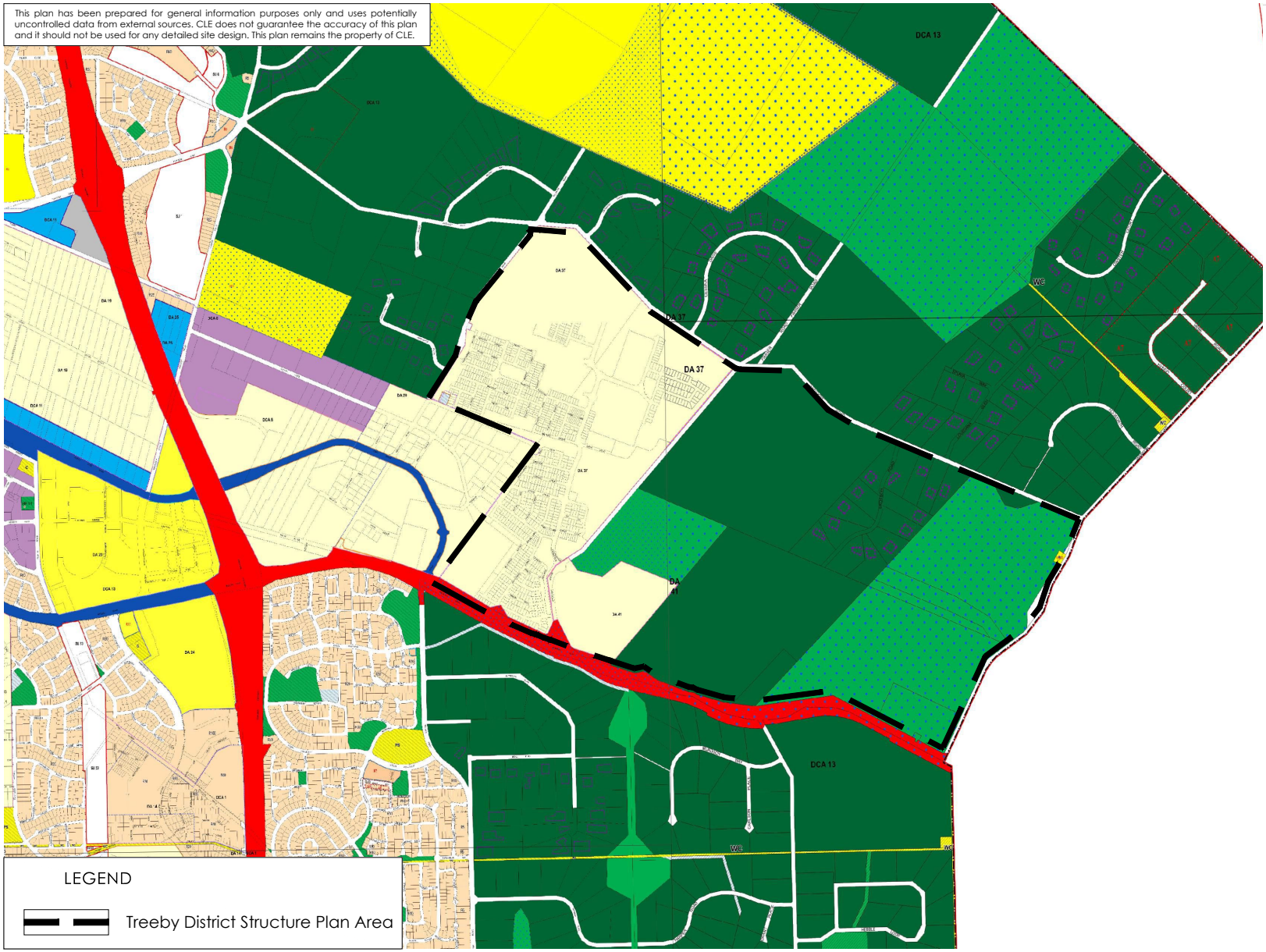
Lot Details	Metropolitan Region Scheme Zone / Reserve
Lots 1 (West), 9012, 9014, 9016, Lots 1 (east)	Urban
Lots 139, 140, 467, 468, 614, 820	Parks and Recreation, Water Catchment SCA, Bush Forever overlay
2, 500, 800 and Lots 62-78 Skotsch Road.	Rural – Water Protection.
Lot 4, 131	Rural – Water Protection, Bush Forever overlay (portions).

Lots 9012, 9014 and 9016 within the western portion of the TDSP are zoned 'Urban' under the MRS and are covered by the Banjup Quarry (Calleya) Local Structure Plan, facilitating urban development of this area. An MRS Amendment to rezone Lot 1 (east) to Urban has recently been gazetted, paving the way for a similar process and outcome for this site. A request to rezone Lots 2 and 4 to 'Urban was also lodged with the WAPC in April 2014, however this request has been held pending further progression of the Perth and Peel @ 3.5 Million (planning) Frameworks currently being finalised.

The 98ha of Parks and Recreation reserve on the eastern portion of the area, and the centrally located 20ha reserve east of Fraser Road south (now Ghostgum Avenue) are covered by the MRS Bush Forever overlay associated with Bush Forever site 390. Site 390 also extends over portions of Lots 4 and 131 which are currently zoned as Rural Water-Protection. These areas of Bush Forever will be subject to review and refinement through the rezoning and local structure planning process. In total 172ha of land within the TDSP is currently shown as Bush Forever within the MRS.

Small slivers of Primary Regional Roads reserve apply along the southern boundary of the DSP area providing for widening of Armadale Road.

The 'Rural - water protection' zone over the balance of the area reflects its historic use and the presence of the Jandakot water mound.



LEGEND

REGION SCHEME RESERVES (MRS)

- Civic and cultural
- Other regional roads
- Parks and recreation
- R Parks and recreation restricted
- Port installations
- Primary regional roads
- Railways
- State forests
- Waterways
- Water catchments
- Public purposes
- CP Public purposes - car park
- CG Public purposes - Commonwealth Government
- HS Public purposes - high school
- H Public purposes - hospital
- P Public purposes - prison
- SU Public purposes - special uses
- SEC Public purposes - State Energy Commission
- TS Public purposes - technical school
- U Public purposes - university
- WSD Public purposes - Water Authority of WA

LOCAL SCHEME RESERVES

(see scheme text for additional information)

- Lakes and drainage
- Local road
- Parks and recreation
- C Public purposes : Civic
- AG Public purposes : Dept of
- FS Public purposes : Fire station
- GS Public purposes : Gas pipeline
- OP Public purposes : Oil pipeline
- P Public purposes : Police station
- K Public purposes : Pre-school
- PS Public purposes : Primary school
- WC Public purposes : Water Corporation
- WP Public purposes : Western Power

LOCAL SCHEME ZONES

(see scheme text for additional information)

- Development
- District centre
- Industry
- Light and service industry
- Local centre
- Mixed business
- Mixed use
- Regional centre
- Residential
- Resource
- Rural
- Rural living
- Special use

OTHER CATEGORIES

(see scheme text for additional information)

- Scheme boundary
- Local Government boundary
- Hope Valley - Wattleup Redevelopment Area
- R20 R Codes
- A1 Additional uses
- R1 Restricted uses
- SU1 Special use area
- Peel-Harvey coastal plain catchment area
- Building envelope
- BVA Bushfire vulnerability areas
- DA1 Development area
- Development contribution area
- JA Jandakot airport
- Heritage place
- No zone
- Waterbodies

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Source: WAPC_LPS_City of Cockburn (Town Planning Scheme No. 3)

2310-128A-01 (12.10.2017), NTS

LOCAL PLANNING SCHEME PLAN

Figure 5

1.3.1.2 Local Planning Scheme

The City of Cockburn Town Planning Scheme No. 3 (TPS 3) zoning applicable to the TDSP area is shown at Figure 5 (Local Scheme Zoning). Table 4 below also provides summary details of the local planning schemes zones applicable to key lots within the TDSP.

Table 4: Local Scheme Zoning (Summary)

Lot Details	Local Planning Scheme Zone
Lots 1 (west), 1 (east), 9012, 9014, 9016	Development
Lots 139. 140, 467, 468, 614, 820	Parks and Recreation
Lots 2, 131, 500, 800, 4 and 62-78 Skotsch Road	Resource

The Development zone, generally reflecting areas zoned Urban under the MRS, provides for adoption and application of local structure plans to guide subsequent subdivision and development (as is occurring over the Calleya estate). The Resource zone reflects the water protection provisions of the current MRS zoning applicable over non reserved sites and caters for larger lot (Rural Residential style) development. This would require amendment (following MRS rezoning) to facilitate urban development.

City of Cockburn Development Contribution Plan No. 13

Schedule 12 of TPS3 specifies infrastructure and community items that are required to be funded through development contribution plans. The TDSP is within Development Contribution Area No. 13 (DCP 13). DCP 13 includes regional, sub-regional and local infrastructure items that have been determined as necessary to support the community within its boundaries, with allocation of a proportion of the cost of these items levied upon new lots created in the area.

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1.3.2 Planning Strategies and Sub-Regional Structure Plan

1.3.2.1 State Planning Strategy 2050

The State Planning Strategy (SPS) provides the basis for the long-term State and regional land use planning within Western Australia. It sets out the key principles, strategies and actions relating to the environment, community, economy, infrastructure and regional development which should guide the creation of State Planning Policy, Regional Strategies/ Frameworks and all future planning decisions.

The SPS identifies planning considerations and approaches that directly relate to the formulation of Cockburn Central Activity Centre Plan and set the agenda for more compact urban development in close proximity to public transport nodes as well as regeneration projects throughout Perth, those being:

- Place based approaches – That plan for the local economy, enhance and protect the identity of places, and provide for diverse, accessible and liveable communities.
- Affordable living – Identifying opportunities for housing diversity, infill development opportunities in appropriate locations and sustainable developments.
- Health and wellbeing – Identifying opportunities for the built environment to encourage the wellbeing of communities such as through the design of environments, streets and open spaces that people want to be active within.
- Land availability – Providing diverse and affordable housing outcomes.

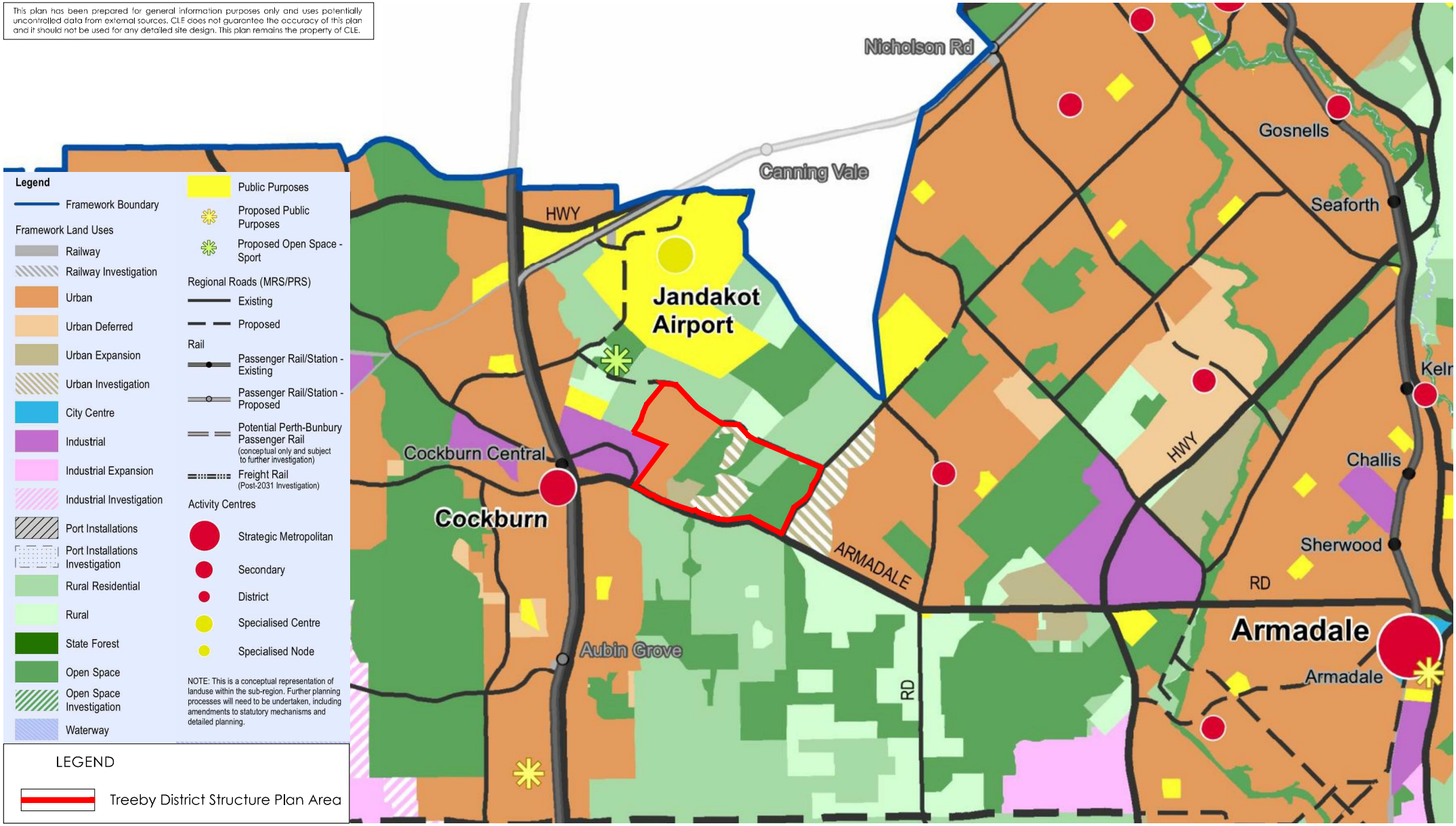
Expansion of the Cockburn Central catchment to accommodate additional masterplanned communities on disused ex-quarry sites directly aligns with many of the objectives of the Strategy.

1.3.2.2 Directions 2031 and Beyond: Metropolitan Planning Beyond the Horizon

'Directions 2031 and Beyond' provides a high level spatial framework and strategic plan for the metropolitan Perth and Peel region. It has a 20 year horizon within which time it anticipates how the projected growth and development of Perth can be best accommodated. Amongst other things, it anticipates the need for an additional 328,000 dwellings to accommodate the growing population, with half of these sought as infill development to limit the expanding urban footprint, service extension and vegetation clearing on the fringes of the city.

Directions 2031 seeks a 50% improvement on current infill residential development trends of 30 and 35%; and has set a target of 47 per cent or 154,000 of the required 328,000 dwellings as infill development. This translates to 11,100 as part of infill / redevelopment opportunities within the City of Cockburn.

Directions 2031 also promotes a 50 per cent increase in the current average residential density 10 dwellings per gross urban zoned hectare; and, has set a target of 15 dwellings per gross urban zoned hectare of land in new development areas. This translates to 18,280 new dwellings as part of Greenfield development opportunities within the City of Cockburn.



Directions 2031 and Beyond: Metropolitan Planning Beyond the Horizon was adopted by the WAPC in August 2010 and is the current spatial planning framework document for Perth and peel, guiding the planning vision and direction to 2031 and beyond.

The reuse of ex-quarry sites within Banjup within an established residential area in close proximity to existing infrastructure, transport and services aligns strongly with the strategy.

1.3.2.3 Draft Perth and Peel @ 3.5 Million

Draft Perth and Peel @ 3.5 Million seeks to build on and extend Directions 2031 in providing an overarching strategic planning framework for the metropolitan Perth and Peel regions, considering an increased population projection of 3.5 million by 2050. The documents include Central, North-West, and North-East and South Metropolitan Peel subregional frameworks (discussed below) which provide spatial guidance on where development should occur over the next 35 to 40 years. The document continues to promote more efficient use (and reuse) of land and infrastructure, and maintains a target of 47% of new lots by infill. It anticipates the need for 800,000 new dwellings to accommodate an additional 1.5 million people within the region by 2050, of which 380,000 are sought in strategic infill positions. Additional residential development within the DSP area would contribute to these targets, whilst protection of significant remnant vegetation and wetland areas responds to environmental objectives.

1.3.2.4 Draft South Metropolitan Peel Sub Regional Framework

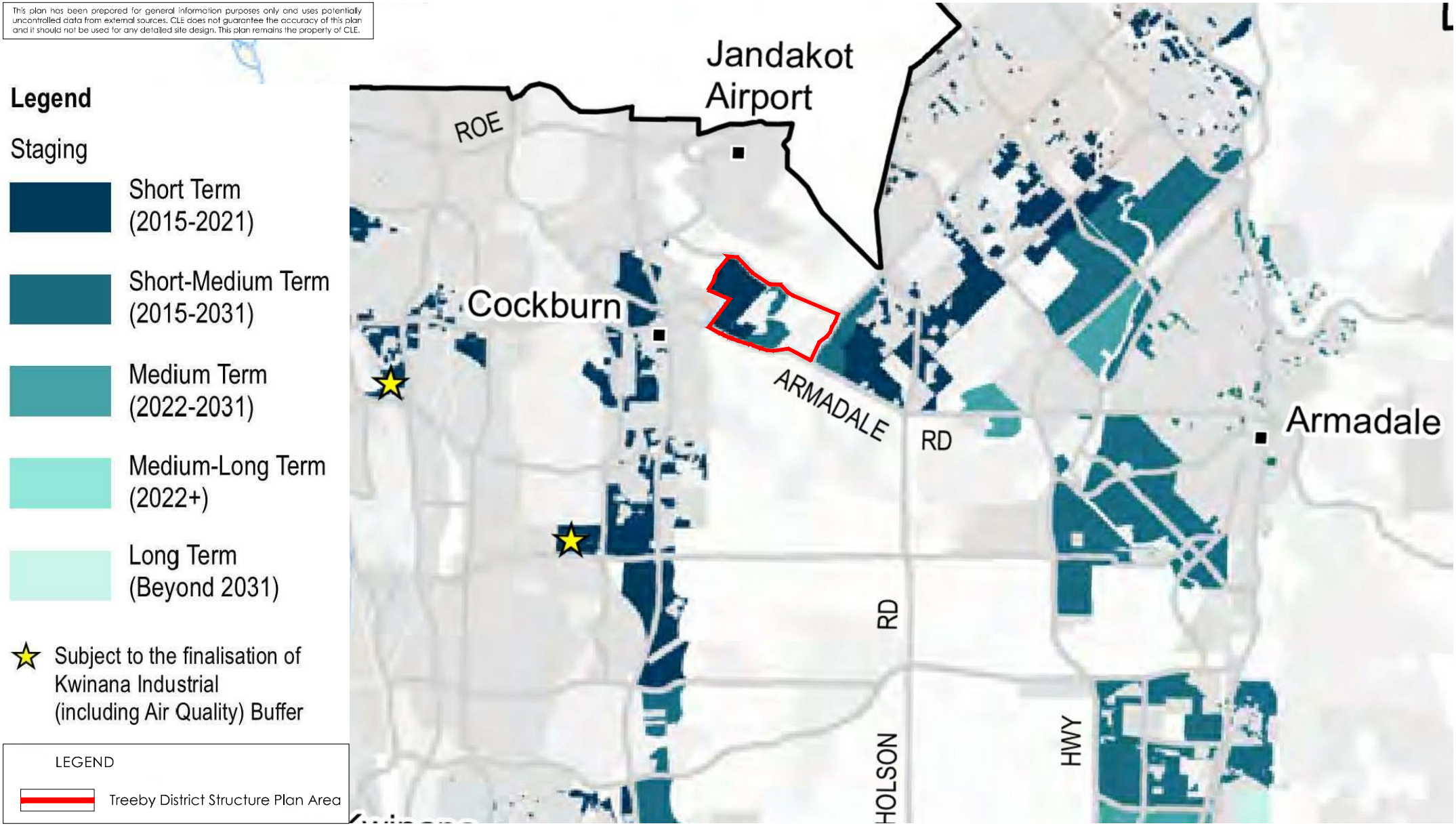
The Draft South Metropolitan Peel Sub Regional Framework (the Framework) is one of three frameworks prepared for the outer sub regions of Perth and Peel, which along with the Central Sub-Regional Planning Framework established a long term integrated framework for land use and infrastructure provision as a component of the Perth and Peel @ 3.5 Million strategy.

The framework identified the need to accommodate more than 1.26 million people in the south metropolitan region by 2050 and identifies both the locations within which new development is to occur, and an indication of anticipated staging and sequencing of urbanisation to inform public investment in regional, community, service and service infrastructure.

The Planning Framework endeavours to facilitate the more consolidated urban form promoted by Directions 2031 and Perth and Peel @ 3.5 Million by limiting the identification of new Greenfield areas to where they provide a logical extension to the urban form, and placing a greater emphasis on urban infill and increased residential density.

The Framework satisfies the density objectives of Draft Perth and Peel @ 3.5 with a target of 30,119 dwellings to be provided in the City of Cockburn, of which 14,678 dwellings are to be via infill development opportunities and 15,441 via Greenfield development. This mix of infill and Greenfield development will contribute an estimated additional population of 66,957 people in the City of Cockburn.

The Framework identifies the larger site areas unaffected by Bush Forever site 390 within the BDSP as Urban and Urban Investigation area (refer Figure 6), with the staging and sequencing of land development being in the short term (2015 - 2021) and medium term (2015 - 2031) (refer Figure 7). The TDSP is consistent with this, albeit seeking a minor refinement to the basic boundaries illustrated in the Framework on the basis of the more detailed site analysis undertaken as part of the DSP exercise.



DRAFT SOUTH METROPOLITAN PEEL SUB-REGIONAL FRAMEWORK - URBAN STAGING

Source: Draft South Metropolitan Peel Sub-regional Planning Framework_May 2015

2310-130-01 (07.07.2016), NTS

Figure 7

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1.3.2.5 City of Cockburn Planning Strategy

The City of Cockburn's Local Planning Strategy sets out long term planning direction and provides the rationale for the zones and other provisions of the City of Cockburn Town Planning Scheme No.3. The Local Planning Strategy outlines the general aims and intentions for future long-term growth and change within the City of Cockburn. The Strategy includes a comprehensive list of strategies and actions to guide the development of regional and local communities, with the following particularly relevant to the TDSP:

Transport

- Maximise development near public transport routes
- Minimise trip lengths in order to maximise local convenience and minimise the environmental impacts of private car users.
- Encourage cycling by defining an implementing cycle networks and promoting the provision of end-of-trip facilities.

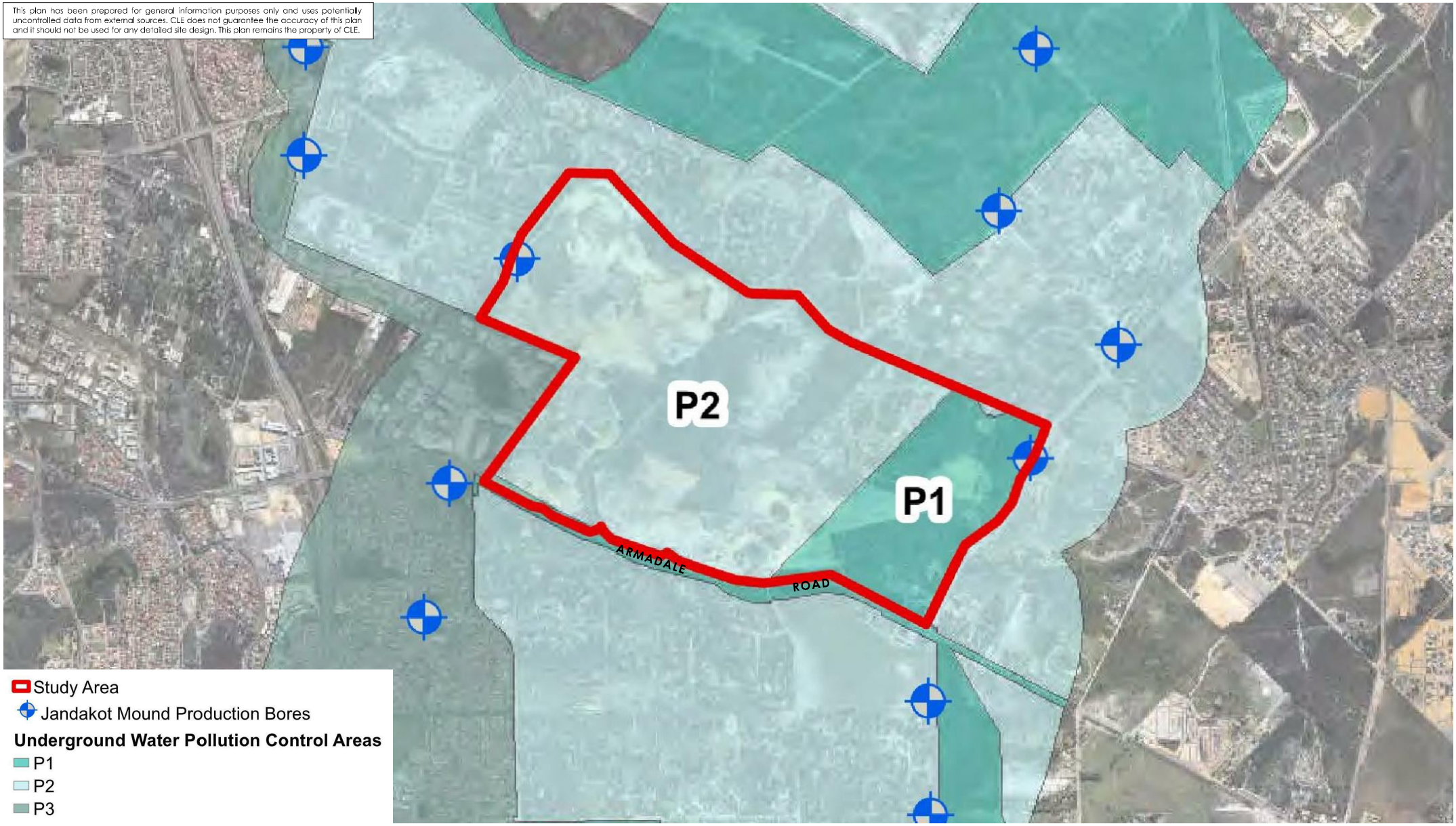
Open Space

- Maintain the amount of local open space per capita
- Improve the quality, amenity and accessibility of local and regional open space.

Heritage

- Enhance local identity and character by preserving buildings and places with historic, architectural, scientific or scenic value. (and by deduction, encouraging development in those locations without such attributes).

The TDSP either directly contributes to these directions, or provides a framework by which they can be pursued in more detailed planning processes to follow.



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Source: JDA_Treeby (Banjup) Strategic District Water Management Strategy_May 2016

2310-132-01 (07.07.2016), NTS

UNDERGROUND WATER POLLUTION CONTROL AREAS

Figure 8

1.3.3 Planning Policies

1.3.3.1 SPP 2.3 Jandakot Groundwater Protection

The Jandakot Groundwater Protection policy aims to prevent, control and manage development and land use changes in the Jandakot Groundwater Protection Policy Area to limit impacts on groundwater. It works in concert with the Jandakot Underground Pollution Control Area (UWPCA) (declared under the *Sewerage and Drainage Act 1909)*, and seeks to give statutory effect to, and implement the *Jandakot Land Use and Water Strategy*, and the *Jandakot Groundwater Protection Area Drinking Water Source Protection Review*. These documents allocate management priority designations 1-3 to land within the Policy Area and, amongst other things, outline the framework for assessing development within its boundaries. Priority 1 (risk prevention) applies to state owned Parks and Recreation Reserves, Priority 2 (risk minimisation) to privately owned rural areas and Priority 3 (risk management) to urban areas – refer Figure 8 Underground Water Pollution Control Areas.

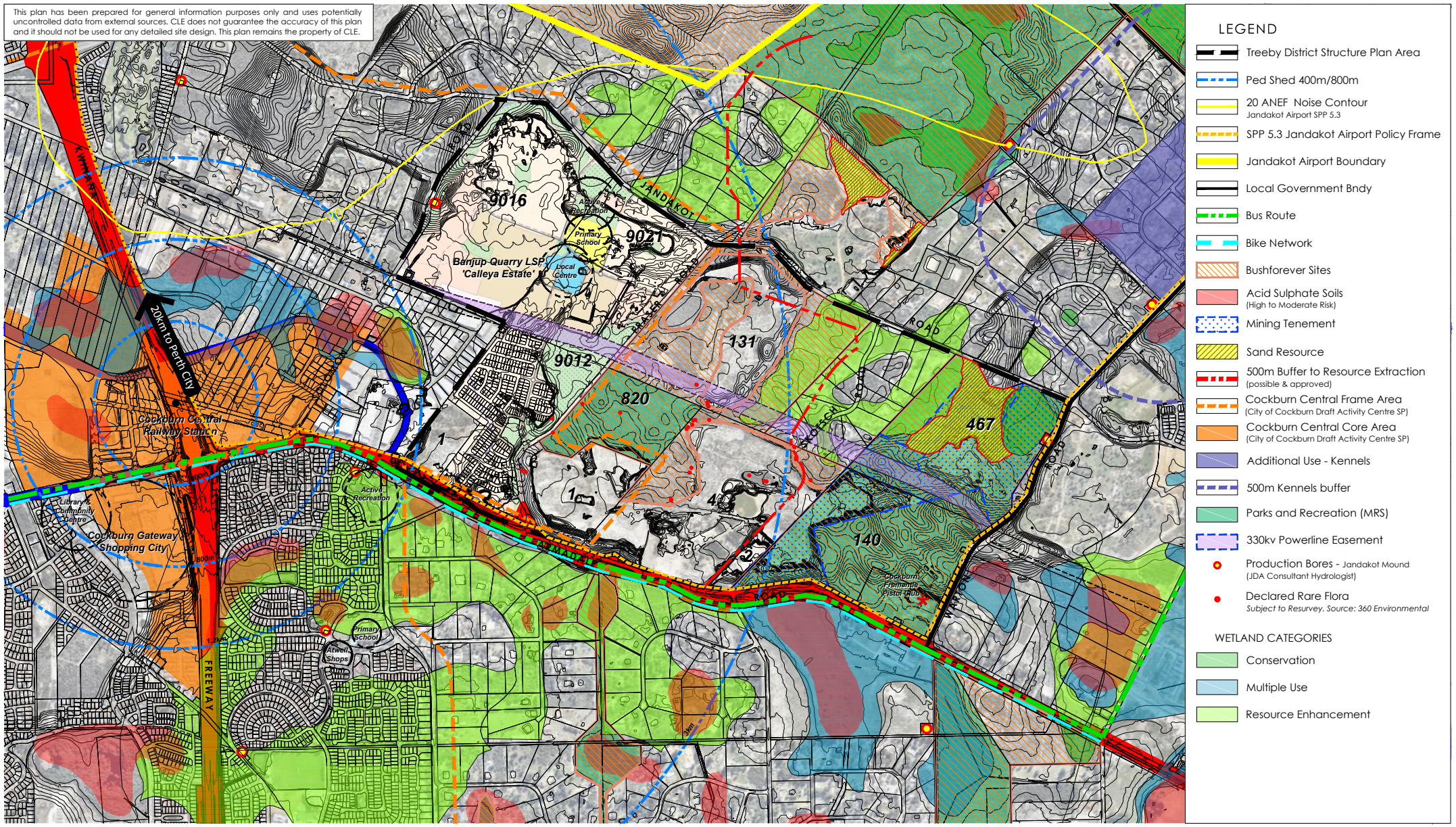
Further urbanisation within the DSP area will require recategorisation of some existing Priority 2 areas to Priority 3. A revision to SPP 2.3 advertised for public comment outlines the circumstances under which this will be contemplated, as follows:

- Large land holdings that were previously cleared and disturbed;
- Land directly adjacent to already developed areas;
- Land identified as appropriate for more intensive development through strategic planning instruments such as regional or sub-regional structure plans;
- Where appropriate risk mitigation measures are available; and
- Where net long tem public benefit is demonstrated.

Recent advice from the Department of Water has indicated that should the WAPC determine through a strategic planning process (i.e. South Metropolitan Peel Sub Regional Planning Framework) that development in this location is warranted taking into account social, environmental and economic factors, the Department will re-classify rezoned areas to P3, which is compatible with urban development.

1.3.3.2 SPP 2.8 Bushland Policy for the Perth Metropolitan Region

SPP 2.8 – Bushland Policy for the Perth Metropolitan Region seeks to provide a policy and implementation framework to ensure bushland protection and management in the Perth region. It identifies bushland areas, and specifies the policy approach to their management based on categorisation. Bush Forever site 390 within the DSP area (illustrated on Figure 4 – Metropolitan Region Scheme plan) is classified as 'BFA – Urban, industrial or resource development' under SPP 2.8, essentially on the basis of its status under private ownership and its prior land use. The Policy consequently requires consideration of impacts on the bushland in the future planning of the site, and promotes negotiation of the conservation of all or part of the site as part of the process. The proposed retention and management of the majority (95%) of the Bush Forever site proposed by the DSP achieves alignment with the key precepts of the policy. More detailed negotiation on the areas to be retained versus removed, and any applicable offsets package will occur through the rezoning and local structure planning stages.



LEGEND

- Treeby District Structure Plan Area
- Ped Shed 400m/800m
- 20 ANEF Noise Contour
  Jandakot Airport SPP 5.3
- SPP 5.3 Jandakot Airport Policy Frame
- Jandakot Airport Boundary
- Local Government Bndy
- Bus Route
- Bike Network
- Bushforever Sites
- Acid Sulphate Soils
  (High to Moderate Risk)
- Mining Tenement
- Sand Resource
- 500m Buffer to Resource Extraction
  (possible & approved)
- Cockburn Central Frame Area
  (City of Cockburn Draft Activity Centre SP)
- Cockburn Central Core Area
  (City of Cockburn Draft Activity Centre SP)
- Additional Use - Kennels
- 500m Kennels buffer
- Parks and Recreation (MRS)
- 330kv Powerline Easement
- Production Bores - Jandakot Mound
  (JDA Consultant Hydrologist)
- Declared Rare Flora
  Subject to Resurvey. Source: 360 Environmental

WETLAND CATEGORIES

- Conservation
- Multiple Use
- Resource Enhancement

CLE TOWN PLANNING + DESIGN

Source: nearmap 12.07.2015

2310-131B-01 (12.10.2017), NTS

OPPORTUNITIES AND CONSTRAINTS PLAN

Figure 9

1.3.3.3 SPP 4.2 Activity centres for Perth and Peel

SPP 4.2 Activity Centres for Perth and Peel identifies the broad requirements for the planning and development of new activity centres and the renewal of existing centres in Perth and Peel. A primary objective of the policy is to increase the density and diversity of housing within and around activity centres to the improve land use efficiency, residential amenity and access to services, housing variety and centre vitality. The Cockburn Central Secondary Centre is located approximately 1km west of the DSP boundary. Development of the DSP area will increase the population catchment east of the activity centre, contributing the Policy objectives. Provision for smaller more local services within the DSP area is also accommodated within the TDSP, consistent with the recommendations of the policy.

1.3.3.4 SPP 5.3 Jandakot Airport Vicinity

SPP 5.3 Jandakot Airport Vicinity applies to land in the vicinity of Jandakot airport, which is, or may in the future, be affected by aircraft noise. The objectives of the policy are to:

- Protect Jandakot Airport from encroachment by incompatible land use and development, so as to provide for its ongoing, safe and efficient operation; and
- Minimize the impact of airport operations on existing and future communities with particular reference to aircraft noise.

The Policy describes two areas to which the policy applies. Firstly a Core Area defined by the 20ANEF contour and a Frame Area defined by the area between the 20ANEF contour and Roe Highway, Ranford Road, Warton Road, Armadale Road and Kwinana Freeway.

The TDSP is wholly located outside the 20ANEF contour, with the policy consequently containing no constraints to development within it. Notwithstanding, the City expects that memorials be placed on all new residential lots within the policy area identifying the existence of the airport and associated noise to ensure understanding of this by future lot purchasers, and that has a Noise Management Plan be prepared for all lots within the DSP.

The location of the TDSP area in relation to the airport and 20ANEF contour is illustrated in the Opportunities and Constraints Plan provided at Figure 9.

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1.3.3.5 SPP 5.4 - Road and Rail Transport Noise and Freight Considerations in Land Use Planning

SPP 5.4 addresses how amenity impacts, specifically transport noise, associated with high volume roads, rail lines and freight routes should be addressed through the planning system. The policy provisions are applicable to development along both Armadale Road and Jandakot Road because of the expectation that traffic volumes along these roads will exceed 20,000 vehicles per day within 20 years. Armadale Road is also designated a primary freight route which also triggers application of the policy.

The policy seeks to ensure that transport noise impacts on sensitive land uses (including residential development) is kept within targets for both night and day time, through the appropriate design of development. This will require assessment of anticipated transport noise reaching sensitive land uses and submission of mitigation measures to achieve the noise targets specified by the Policy as a component of local structure planning for each development site abutting either road. Typical mitigation measures include use of noise walls or bunds to screen noise reaching development sites, and application of 'Quiet House Design' requirements on dwellings requiring this to meet the specified threshold.

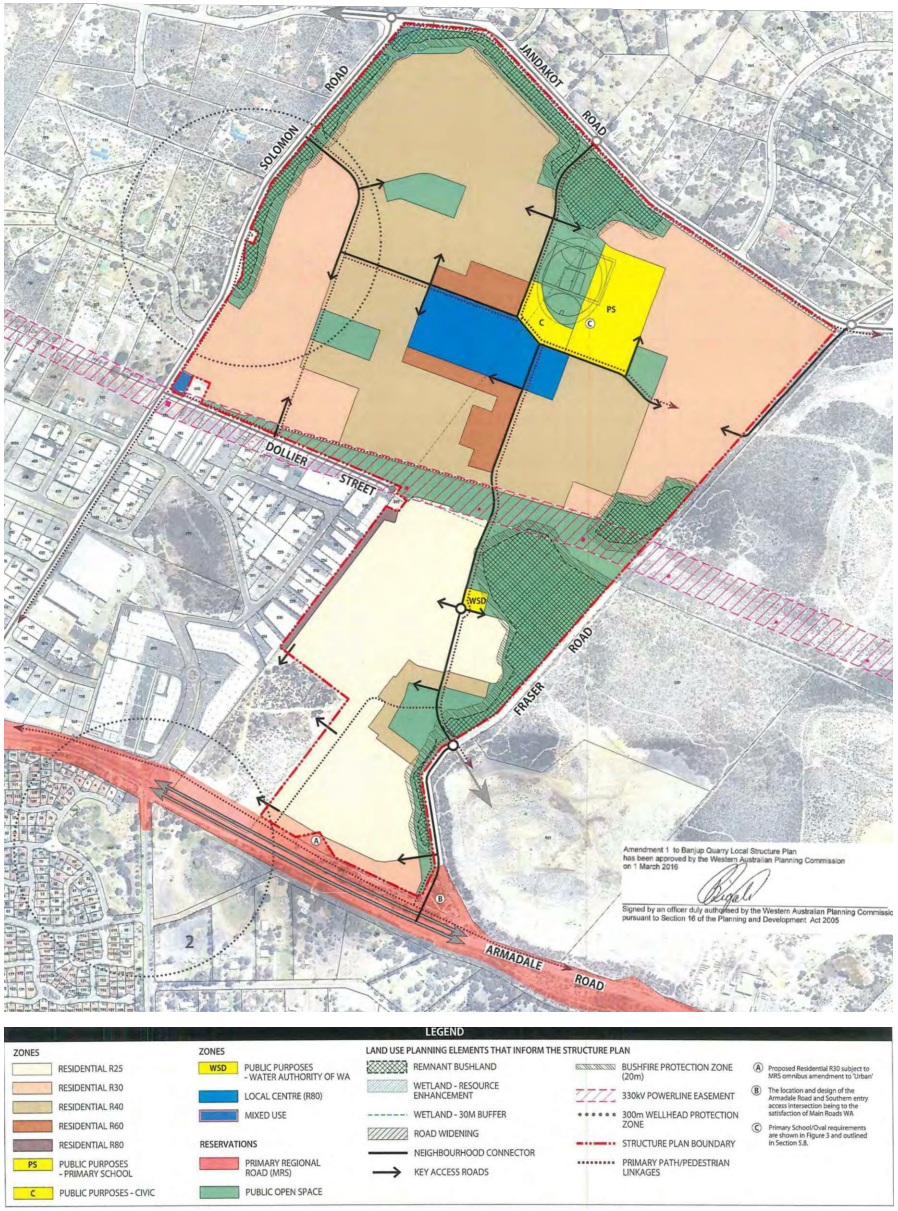
It is understood from discussions with the City of Cockburn that conflicts can occur between the construction standards application for Quiet House Design Package B and BAL19+ construction standards and therefore it is preferable to avoid an overlap between these where possible.

In addition to SPP 5.4, consideration should be given to other potential noise sources (including the Jandakot airport and nearby land uses including the Jandakot Pistol Club) in the local structure planning of the area to ensure that noise impacts experienced within residential areas are reduced and that conflicts between the new residences and existing operations are minimised through appropriate separation, treatment and / notification on title.

1.3.3.6 SPP 2.4 Basic Raw Materials

This policy sets out matters which are required to be taken into account when considering zoning, subdivision and development applications for extractive industries or on land identified as containing a strategic resource. The key objectives of this policy are to:

- Identify the location and extent of known basic raw material resources;
- Protect Priority Resource Locations, Key Extraction Areas and Extraction Areas from being developed for incompatible land uses which could limit future exploitation;
- Ensure that the use and development of land for the extraction of basic raw materials does not adversely affect the environment or amenity in the locality of the operation during or after extraction; and
- Provide a consistent planning approval process for extractive industry proposals including the early consideration of sequential land uses.



CLE TOWN PLANNING + DESIGN

Source: Banjup Quarry Local Structure Plan_February 2016, City of Cockburn website

2310-139-01 (10.10.2016), NTS

BANJUP QUARRY (CALLEYA) LOCAL STRUCTURE PLAN

Figure 10

The DSP features several sites previously used for extractive industry (primarily sand quarrying) including Calleya, Lots 1 (east), 4, 131, and 140. A live mining tenement also exists over portion of Lots 140, 139, 468 and 467 however it is uncertain whether further clearing will be permitted within this reserve to enable extraction of the remaining sand resource. Redevelopment and / or rehabilitation of sites following the completion of resource extraction as proposed within the DSP consistent with the policy. Maintenance of a temporary buffer to the live tenement and associated weighbridge in the west of the DSP area may be required along the eastern boundary of lots 2 and 4 should further mining be approved within tenement however the impacted area is small and will only be a consideration for a limited period pending completion of sand extraction. Similarly a buffer to approved sand extraction on Lot 130 north of Jandakot Road may impact on the northern portion of Lot 131 but is expected to be shortlived and can therefore be easily addressed through staging, in the event that it has not concluded at the point that development of this site commences.

1.3.3.7 Local Planning Policies

In addition to the state and regional planning policies in operation, the City has a number of local planning policies relevant to the planning of the DSP area. These include (but are not limited to):

- LPP 1.12 Noise Attenuation
- LPP 5.1 Public Open Space
- LPP 5.2 Incorporating Natural Areas in Public Open Space
- LPP 5.3 Control Measures for Protecting Water Resources in Receiving Environments
- LPP 5.4 Location of High Voltage Overhead Power Lines and Microwave Towers
- LPP 5.6 Vehicle Access
- LPP 5.7 Uniform Fencing
- LPP 5.15 Access Street – Road Reserve & Pavement Standards

These do not pose a conflict with the DSP but will require consideration in the more detailed design and implementation planning processes to follow.

1.3.4 Other Approvals and Decisions

1.3.4.1 Banjup Quarry Local Structure Plan

Lots 9012, 9014, 9015 and the newly created residential lots west of Fraser Road south (now Ghostgum Avenue) form part of the 144ha Banjup Quarry structure plan area, being developed by Stockland as the Calleya Estate. The area was rezoned from 'Rural-Water Protection' to 'Urban' under MRS Amendment 1221/41 in November 2012 following which it was rezoned for development under the City's Local Planning Scheme.

The Banjup Quarry Local Structure Plan was formally adopted by the City of Cockburn in May 2013, and endorsed by the Western Australian Planning Commission (WAPC) (subject to conditions) on the 22nd October 2013. An amended version of the Plan approved in 2015.

The LSP provided for a 1.46ha Neighbourhood Activity Centre (NAC) incorporating a Mixed Use and Commercial (Shop/Retail) development, Public Purpose site (Primary School with co-located community land uses) and can support in excess of 2000 dwellings at 15 dwellings per gross hectare, with 1990 dwellings representing the estimate stated in current version of the LSP.

The first subdivision application (WAPC 148012) was approved by the WAPC on the 22nd October 2013, comprising 460 residential lots within the southern precinct of the LSP area, much of which has now been developed.

A second subdivision application (WAPC 149633) was approved by the WAPC on 8 August 2014, comprising approximately 1300 lots in the northern precinct (north of the Western Power easement) and inclusive of Primary School, Civic, Local Centre and Light Industry zoned sites.

Staged development of the estate is anticipated to continue over coming 5-7 years (dependent of rate of sales) to completion.

1.3.4.2 MRS Amendment 1289/57 – Lot 1 (east) Armadale Road to 'Urban'

Amendment 1289/57 to the Metropolitan Region Scheme rezoned Lot 1 (east) Ghostgum Avenue / Armadale Road from Rural to Urban and reserved the abutting Lot 820 to the north for Parks and Recreation. This was gazetted on 20 May 2016. Rezoning under the local planning scheme and formal submission of a local structure plan will be required prior to development of this site for urban (residential) purposes.

In considering the Amendment, the EPA noted the existence of flora and vegetation on Lot 1 requiring consideration in the structure planning and subdivision of the site. It recommended that fringing remnant vegetation be retained and that textual provisions be included in the Planning Scheme to this effect. The EPA also suggested that the interface with Bush Forever site 390 to the north be suitably treated to minimise adverse impacts from development, and that the protection afforded to the population of *Calandenia huegelii on-site under both the Environmental Protection and Biodiversity Conservation Act 1999 and the Wildlife Conservation Act 1950* as an endangered species be noted, and that protection be incorporated into subsequent site planning processes. It is noted that while the EPA are suggesting additional scheme provisions, this amendment is yet to be formally considered by the WAPC and the Minister for Planning. The City of Cockburn has not supported the inclusion of specific scheme text as requested, as the matters can be appropriately dealt with via the structure planning process.

2.0 EXISTING ENVIRONMENT: SITE CONDITIONS AND CONSTRAINTS

An Environmental Assessment Report (EAR) has been prepared by 360 Environmental, refer Appendix 1. The report identifies key environmental issues relevant to the TDSP, provides the key findings of environmental assessments that relate to the TDSP, and recommends appropriate management responses to facilitate and guide future development and local structure planning within the TDSP. The EAR concludes that none of the key environmental issues identified on the site pose a significant constraint to implementation of the TDSP and that the overall environmental outcomes achieved are positive.

2.1 Biodiversity and Natural Area Assets

2.1.1 Remnant Vegetation

Much of the DSP area has been cleared as a result of previous land uses and mining activities. The majority of vegetation remaining falls within Bush Forever Site 390. In accordance with State Planning Policy 2.8 (SPP 2.8), the Bush Forever Site 390 falls under the 'Bush Forever Area (BFA) – Urban, Industrial and Resource Development' site implementation category. SPP 2.8 recognises that regionally significant bushland in this category is constrained by existing commitments, approvals and policies. Therefore, development proposals should seek to achieve a reasonable balance between conservation and development or resource extraction through a negotiated outcome which has regard for the specific conservation values involved.

A total of 176ha of open space incorporating environmental values (including 94% of the portion of Bush Forever site 390 within the DSP area) is proposed for retention under the DSP. An area of approximately 10.5ha of Bush Forever within Lot 131 is proposed for residential development. Of this area, 4.2ha (40%) comprises of vegetation that is mapped as 'Completely Degraded' or previously cleared as a result of past sand quarrying activities and poorly rehabilitated. Further assessment of this component of the plan will occur through the subsequent rezoning and local structure planning processes, in accordance with SPP 2.8 which specifies the impact assessment process to be followed. Offsets for the removal of the better quality vegetation may be required and will be negotiated through the statutory approval process.

2.1.2 Conservation Significant Flora

Caladenia huegelii, a conservation significant flora species (better known as a spider orchid), has been identified within the TDSP. *Caladenia huegelii* is classified as Threatened in accordance with the *Wildlife Conservation Act 1950* (WC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The population of *Caladenia huegelii* is mainly known to occur within Bush Forever 390 and all *Caladenia huegelii* within Bush Forever 390 are proposed to be retained. Two isolated occurrences located outside the Bush Forever area within Lot 4 will be proposed for relocation.

2.1.3 Conservation Significant Fauna

The TDSP has been assessed as containing suitable habitat for conservation significant fauna including the Carnaby's, Baudin's and Forest Red-tailed Black Cockatoos. Retention of the majority of existing remnant vegetation within the structure plan area limits impact on these species.

The proposal to develop Lot 4 of the TDSP has been referred to the Federal Department of Environment under the *EPBC Act 1999*. The referral attracted a "not a controlled action" level of assessment, meaning that it is considered not to significantly impact on matters of national environmental significance including listed black cockatoos.

2.2 Landform and Soils

The Department of Agriculture and Food Western Australia (DAFWA) has mapped the entire site as forming part of the Bassendean System (DAFWA 2012). The Bassendean System is described as occurring on the Swan Coastal Plan from Busselton to Jurien and consists of sand dunes and sand plains with pale deep sand, semi-wet and wet soil.

2.2.1 Acid Sulphate Soils

Acid Sulphate Soil (ASS) mapping undertaken by the DER indicates that the site is within an area mapped as being of "moderate to low risk of ASS". Areas mapped as being of "high moderate risk of ASS" occurs approximately 50m south of the site. Further assessment and management of this will form a routine component of the detailed planning and development phases in the event of disturbing activities such as earthworking being proposed within this area.

2.3 Groundwater and Surface Water

The TDSP falls within the Jandakot Underground Water Pollution Control Area (JUWPCA). The western portion of the TDSP (the Calleya Estate) was originally classified as Priority 2 (P2) area. The Department of Water (DoW) endorsed the area to be reclassified to Priority 3 (P3) for urban development following its rezoning as it was concluded that the drinking water resource risk could be adequately managed through application of best practice water management, and the WAPC had determined that the benefits of urbanisation in this location warrant this. A similar position has been taken in relation to Lot 1 (east) during the rezoning process for this site. The balance of the privately owned TDSP area is classified as P2 with the eastern (reserved) portion of the site classified as Priority 1 (P1) under the JUWPCA. Rezoning and urbanisation within the Priority 2 area will necessitate demonstration of adequate risk management and public benefit against the criteria listed in the revised SPP 2.3, and through District and Local Water Management Strategies. This issue is further addressed within the Strategic District Water Management Strategy prepared for the precinct, discussed in section 3.6 below.

Surface water is present within several excavated depressions across the mined portions of the DSP area which will require recontouring and / or management as part of redevelopment.

The mapped Resource Enhancement wetland within Lot 131 is proposed for retention within a public reserve, and will be subject to an appropriate management strategy.

2.4 Bushfire Hazard

SPP 3.7 Planning in Bushfire Prone Areas seeks to apply risk-based land use planning and development controls to ensure that bushfire hazards are considered in planning decisions, to preserve life and reduce the impact of bushfire on property and infrastructure. The Policy is to be read in conjunction with the Deemed provisions of the *Planning and Development (Local Planning Scheme) Amendment Regulation 2015*, the supporting *Guidelines for Planning in Bushfire Prone Areas*, and *Australian Standard 3959: Construction of Buildings in Bushfire Prone Areas.*

Areas of the DSP are mapped as Bushfire Prone and so will require detailed Bushfire Hazard Assessment and application of Bushfire Management Plans to address bushfire risk. Likely measures include provision of hazard separation through the placement of roads and / or managed local open space abutting areas of retained vegetation, and application of BAL construction standard requirements to lots in closest proximity to areas of retained vegetation. This approach has been successfully applied within Calleya. Detailed assessment will be required as a routine component of the preparation of local structure plans.

2.5 Heritage

The Department of Aboriginal Affairs (DAA) Aboriginal Heritage Information System (AHIS) indicates the location of three 'Other Heritage Places' and no 'Registered Sites' with the TDSP. The three 'Other Heritage Places are defined below –

- Banjup Calsil – Place ID. 3301 associated with artefacts/ scatter. The status of the place is 'Stored Data/Not a Site', which means it has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972*.
- Readymix Sandpit 1 – Place ID. 4108 associated with artefacts/scatter. The status of the place is 'Lodged Site', which means it has not been determined whether or not it meets Section 5 of the *Aboriginal Heritage Act 1972.*
- Camp Site – Place ID. 18752 associated with artefacts/ scatter. The status of the place is 'Lodged Site', which means it has not been determined whether or not it meets Section 5 of the *Aboriginal Heritage Act 1972*.

The location of these places is shown in Figure 12 of the Environmental Assessment Report. The latter two places are located within Calleya and in the very south-west corner of the DSP area (potentially outside its actual boundaries), respectively. The Calsil site impacts a substantial portion of the regional reserve in the east of the DSP area and portion of Lots 2, 4 and the Skotsch Road estate.

The closest 'Registered Site' is Kraemer Reserve (Place ID. 21811), which is approximately 1.1km to the south of the Study Area. The site is registered due to its mythological significance.

Obligations precluding interference with registered sites without prior clearance, and disturbance of any artefacts discovered exist under the Aboriginal Heritage Act which will need to be observed in any development within the DSP.

2.6 Context Analysis and Opportunities and Constraints

An Opportunities and Constraints Plan has been prepared illustrating the context and the site and its key opportunities and constraints (refer Figure 9). This illustrates the strategic location of the site from an urban infill potential and the availability of goods, services, transport and urban infrastructure already in place. It also identifies a number of constraints to which the DSP and subsequent local structure plans must respond. Items illustrated on the plan include:

- The area's exceptional access to employment opportunities, retail and services, both within the immediate area, and accessible via the Perth-Mandurah Rail Line nearby;
- Its proximity to the Cockburn Central railway station providing direct access to the Perth CBD, Mandurah, and other stops along the line (including Murdoch providing a regional hospital and university facility);
- The surrounding road network and cycle network;
- Existing cadastral boundaries, illustrating areas in consolidated ownership versus those previously developed;
- Existing planning for the Calleya Estate;
- Areas of regional reserve, and Bush Forever sites;
- Surveyed Declared Rare Flora (surveyed locations subject to confirmation);
- Areas cleared for sand mining versus areas of remnant vegetation;
- Mapped wetland areas;
- The location of ground water extraction bores;
- The boundaries of the Jandakot Airport and associated ANEF noise contours;
- The Cockburn - Fremantle Pistol Club;
- The absence of buffers associated with kennel zones to the north east affecting the area;
- Mapped sand resources;
- The 330kv powerline easement running east west through the DSP area;
- Walking and cycling catchments to Cockburn Central railway station and activity centre.

The TDSP provides a design response to these considerations as detailed in section 3.0 below.

3.0 DISTRICT STRUCTURE PLAN

The District Structure Plan has been drafted to respond to the key opportunities and constraints presented by the precinct and provide a broad framework for future land use planning and infrastructure provision. It seeks to optimise the reuse of consolidated sites which have previously been cleared for sand mining given the strategic location of the precinct, whilst preserving areas of significance, and recognising existing uses and approvals. It provides for:

- The continued development of the Banjup Quarry / Calleya estate in accordance with the approved Local Structure Plan;
- The development of Lot 1 (west) Armadale Road for either Service Commercial and/or Residential purposes, in accordance with an approved Local Structure Plan (to be prepared);
- The development of Lot 1 (east), 4, 2 and 131 for urban residential purposes in accordance with approved Local Structure Plans (to be prepared following or concurrent with rezoning);
- Potential residential development of Lot 500 and the Skotsch Road precinct subject to inclusion in the WAPC Perth and Peel @ 3.5 MIllion documents;
- Retention of Lots 467, 139, 468, 140,614 and 820 for Regional Open Space;
- Retention of additional areas (totalling 58 ha to create a total of approximately 177ha) of open space incorporating environmental values and vegetation retention;
- Restriction of access from Armadale Road to approved access points into Lot 1 (west) (Left in Left out), Ghostgum Avenue / Calleya (full movement but ultimately subject to restriction to Left in Left out) and Lots 2 and 4 (full movement at extension of Liddelow Road). Potential for an additional Left in Left out into Lot 4 to relieve pressure on the full movement intersections has also been recommended by Transcore to improve traffic flow and load share however the impact of this intersection on the function of Armadale Road has been flagged by MRWA as of concern and so it is subject to further investigation and approval during the local structure planning phase;
- Extension of internal north south road linkages through Calleya (as approved) and through Lots 4 and 131 to Fraser Road to provide for through connection between Armadale Road and Jandakot Road;
- Extension of internal east-west linkages to facilitate internal movement within the DSP area, and access to local services and amenities;
- Upgrade of Jandakot Road to a two lane divided urban road with ultimate provision for upgrading to a four land road (subject to the outcomes of the City's design review);
- Provision of two centrally located Primary Schools (within Calleya and Lot 4);
- Provision of a Neighbourhood (within Calleya) and a Local (within Lot 4) Activity Centre to cater for provision of local services to supplement those available within Cockburn Central and the broader district.

Development in accordance with the DSP is estimated to yield approximately 3500-3800 dwellings (including the 1990-2350 estimated to be created/potentially created within the approved Calleya area). In the event that portion or all of Lot 1 (west) is developed for Residential instead of Service Commercial purposes, this might yield a further 100 commercial lots (approximately) or a higher number of retirement dwellings.

3.1 Land Use

The Structure Plan provides a general indication of land use designation and arrangements. However, refinements to the details of boundary alignment and layout may occur as part of the more detailed site planning occurs.

The basic land use areas indicated on the DSP are as follows:

Table 5 – Land Use Schedule (Plan 2310-122D-01)

	Sub Total (ha)	Total (ha)
Total DSP Area		458ha
Non Residential Land Uses		
Mixed Business (assume 100% Urban-zoned portion of Lot 1 west)	7.03	
Neighbourhood & Local Centres	4.57	
Primary School & Community Purpose	8.20	
Non Residential Land Use Total		19.61
Rural Residential [1]		31.02
Open Space with Conservation Values		
Existing Parks & Recreation Reserve	118.48	
Additional Open Space incorporating Conservation Values	58.75	
Open Space with Conservation Values Sub Total		177.23
Gross Residential Area		230.30

** All areas approximate only.*

** Areas of open space credited under WAPC policy (including potential areas with conservation value) to be determined through Local Structure Plan and subdivision processes.*

[1] Pending identification of Lot 500 and Skotsch Road for urban purposes by the WAPC in the Perth and Peel @ 3.5 Million documents

3.1.1 Residential Densities and Yield Projections

The Calleya LSP estimates a total residential lot yield of 1,990 with ultimate planned potential up to 2,350 to provide an upper range catering for growth over time. These yields are provided via a range of residential densities including 'traditional' R20/25 single residential lots with a proportion of smaller R30, R40 and a smaller component of R60 lots within strategic locations.

Extension of these principles and the Perth and Peel @ 3.5 Million target of 15 dwellings per hectare to Lots 1 (east), Lots 4 and 2 and the portion of Lot 131 identified for urban investigation will generate approximately 1,500 additional lots. Lot 1 (West) might provide a further 100 lots (approximately) if fully developed for traditional residential purposes.

Density allocation within development sites should follow the principles of Liveable Neighbourhoods (as illustrated at Calleya) with a base providing for traditional single residential lots with higher density lots concentrated around local amenities, open space and transport routes. Further detail on density codings will be provided through local structure plans prepared for each site.

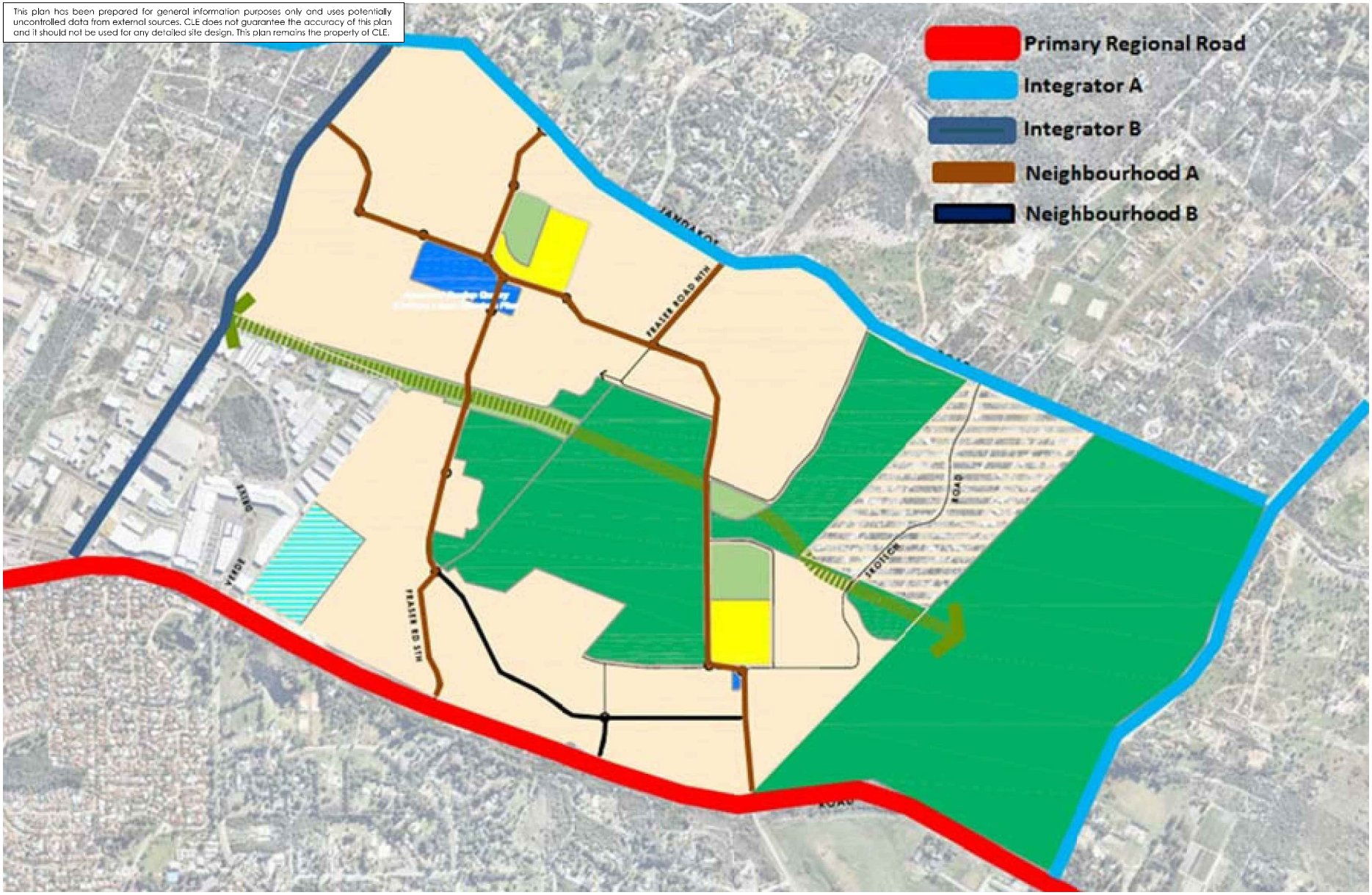
3.1.2 Non-Residential Land Uses/Facilities

The site is exceptionally well located in relation to access to employment opportunities, retail and services. Cockburn Central, a strategic metropolitan centre, is located within 1.5km-3km from the DSP whilst the rail line provides direct connection to the Perth CBD 20km to the north. Jandakot Business Park and other district business and industrial areas nearby provide further opportunities.

To supplement these, the DSP provides for a Neighbourhood Centre within Calleya and a small Local Centre within Lot 4 to provide for a range of daily needs within walking distance of most urban areas of the DSP. Uses accommodated within these centres might include a deli, cafe, medical services, childcare and / or local offices, depending on market demand. The Neighbourhood Centre might also incorporate a small supermarket and specialty shops.

The Calleya Neighbourhood Centre incorporates provision for a community centre to be developed in conjunction with the local school and active recreation facilities, consolidating this as a focus for community interaction. Collocation of the school with the local centre is also proposed on Lot 4 to facilitate multi-purpose trip, manage traffic and access, and provide a concentration of activity within a central point within the precinct. The shared use oval abutting the Lot 4 primary school has also be notionally sized to accommodate a senior sized oval, should there be unmet demand for this (as has been the case elsewhere within the region).

Lot 1 (west) abuts service commercial (showroom type) development to the west, and residential to the east and north. As such, this site has the opportunity to accommodate either land use or a combination of the two (subject to appropriate planning and interface treatment). Any residential component would be required to integrate with Calleya, and access provision has been incorporated in the Calleya LSP to facilitate this. The City has indicated that non residential uses would be expected to restrict access and egress to Armadale Road (and / or integration with development to the west if this can be negotiated). The details



Source: Transcore_Banjup District Structure Plan_Transport Assessment_June 2016

2310-140-01 (11.10.2016), NTS

PROPOSED ROAD HIERARCHY (INTERIM)

Figure 11

of land use mix, access and layout for this site will be determined through the subsequent LSP. Given its location, either land use option integrates with the DSP, and its size limits the impact on either land use scenario on the overall outcome.

3.2 Public Open Space and Recreation

The DSP illustrates the existing network of state owned regional reserves supplemented by additional areas (approximately 58ha) of open space incorporating environmental values. These areas incorporate the majority of Bush Forever site 390 and an area of contiguous conservation within Lot 9012. These areas, ultimately forming part of a district parkland, total 177ha. Whilst much of this area is proposed for retention for environmental reasons, it includes parts with an existing or potential recreation function, including cleared areas previously subject to sandmining. There is also the opportunity to integrate the park with the 330kv Western Power Easement running east-west through the precinct to provide not only a 'green linkage' through the area, but also a potential recreation linkage. Preparation of a masterplan over the park could assist in achieving a well thought out and integrated management arrangement which maximises both conservation, recreational and aesthetic benefits, and creates a focus for the district.

Two active recreation areas are identified on the DSP to provide for playing fields abutting schools. The precise sizing and location of these will be subject to detailed planning in conjunction with the City, but both cater for multiple sporting uses including potential senior sized football oval. The City has indicated the need for clubrooms (change rooms, toilets and the like) to service these.

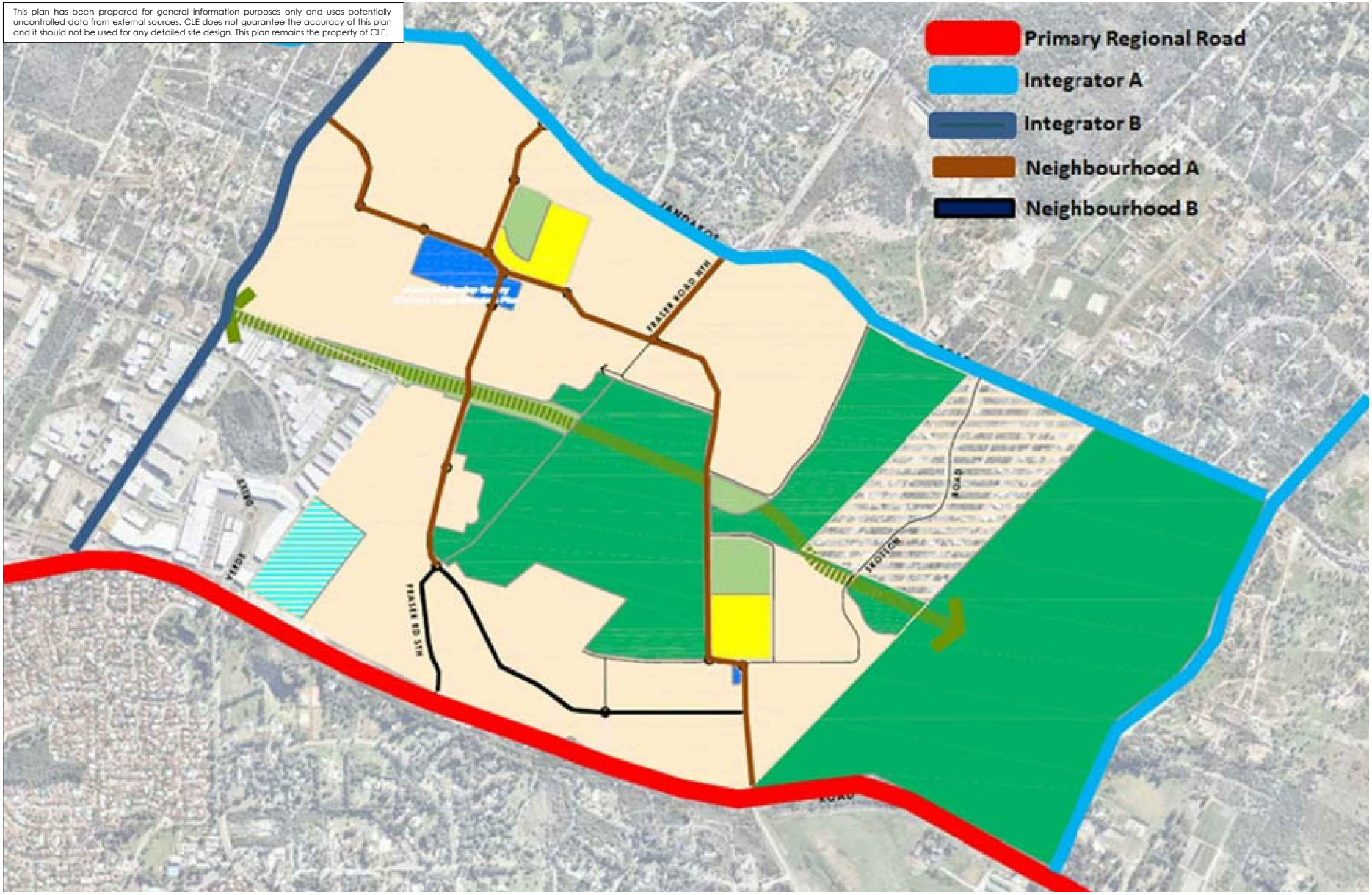
Local open space areas are not illustrated on the DSP (being a detailed design item) however provision for these will be required in addition to those areas identified on the DSP in accordance with Liveable Neighbourhoods policy. These will need to be placed to ensure accessibility to local residents, and provision of a range of functions accommodating different recreational and social needs. Management considerations will also inform detailed open space planning and treatment in the detailed design processes to follow.

3.3 Education Facilities

Provision for two primary school sites, one within Calleya and one in the east of the DSP within Lot 4 is made within the DSP to accommodate projected population. This rate of provision is consistent with Liveable Neighbourhoods and the advice of the Department of Education based on the estimated lot yield. The eastern (Lot 4) school site is shown at 4ha at the request of the Department of Education catering for the higher end of the yield range and some incremental growth.

In the event of urban designation of Lot 500 and Skotsch Road precinct, liaison with the Department of Education on Primary School capacity would be necessary as part of any rezoning proposal. The Department of Education has advised that no high school is required for the site with demand to be met by existing and planned high schools within the locality including Lakelands, Atwell and Harrisdale.

Tertiary education facilities are provided at a range of locations accessible from the DSP area including at Murdoch, Bentley, Crawley, Armadale, Mandurah, Fremantle, Perth CBD and within private facilities within nearby business parks.



Source: Transcore_Banjup District Structure Plan_Transport Assessment_October 2016

2310-144-01 (25.10.2016), NTS

PROPOSED ROAD HIERARCHY (ARMADALE ROAD DEVIATION)

Figure 12

3.4 Employment

The DSP area has excellent access to a range of employment opportunities provided at:

- Cockburn Central (1.5-3km from DSP);
- Jandakot Business Park (2.5km from DSP);
- Perth CBD (20km from DPS on train line);
- Canning Vale industrial area (6km from DSP));
- Armadale centre (10km from DSP); and
- Bentley Business Park (15km from DSP).

Employment opportunities within the DSP will include those available at the two local primary schools, within the Neighbourhood and Local centres, within the community facility, and within home based businesses.

3.5 Movement Networks

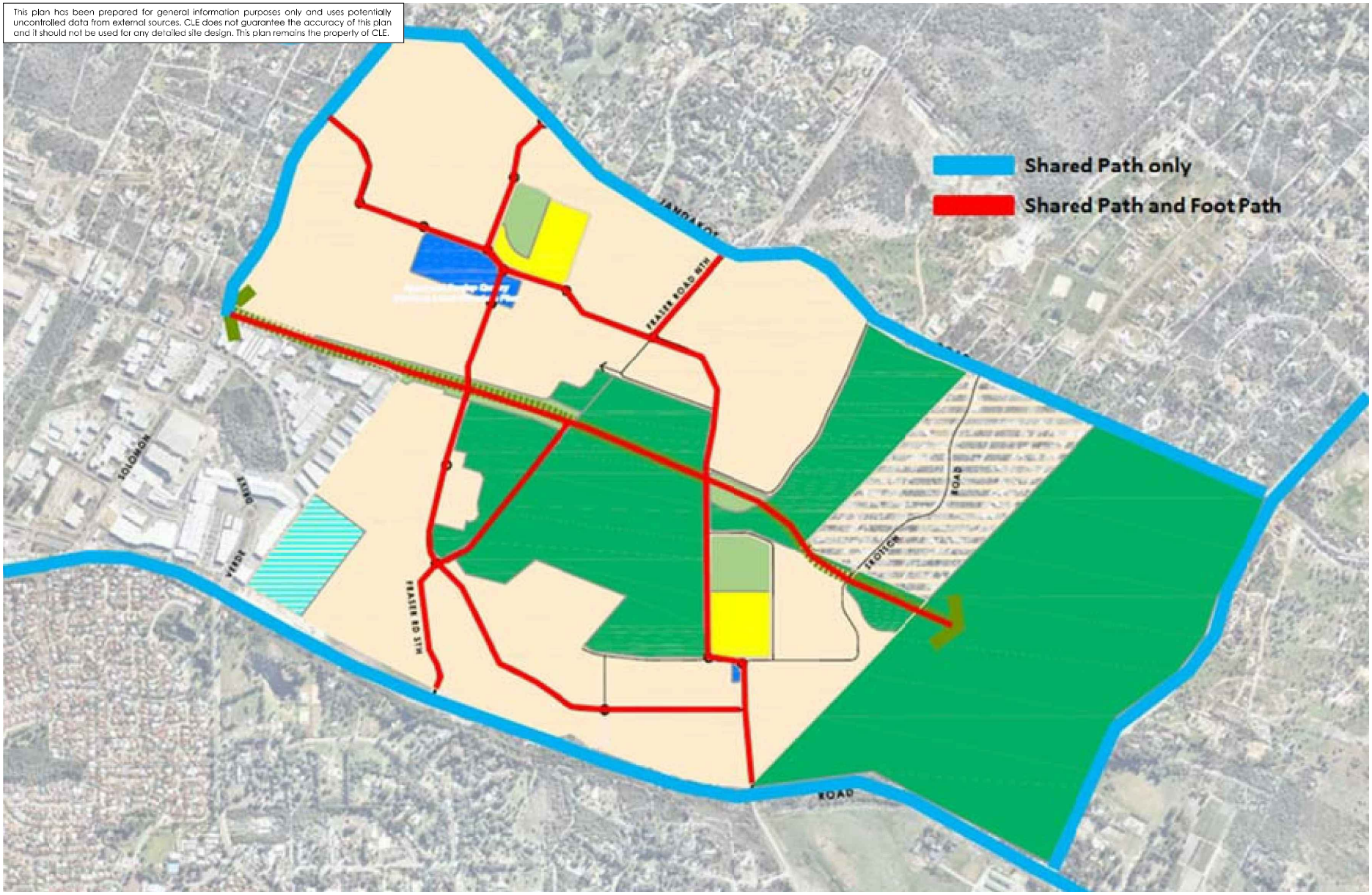
The Precinct is bounded by an established (and largely higher order) road network, with the local network being extended through the Calleya development providing for internal movement. Extension of this to integrate with additional development sites, and optimise access to services and amenities is relatively simple, though access to Armadale Road and Jandakot Road is restricted due to projected volumes, existing access points and topography, making interconnection of the internal network particularly critical. Transcore traffic engineers have provided input into the preparation of the DSP and prepared the appended Transport Assessment (refer Appendix 2) confirming the suitability of the structure proposed in the DSP. The following section outlines the key elements of the Transport Assessment including details of the existing and proposed road networks and road hierarchy classifications. The section also provides an overview of public transport, cyclist and pedestrian network provision within the TDSP area.

3.5.1 Ultimate Road Network

The proposed road network for Banjup provides sufficient and logical connectively through Primary Regional, Integrator and Neighbourhood Connector Roads, compatible with sub-regional planning outcomes including the existing and potential future network changes. The proposed internal road network (shown in Figure 11) of the TDSP reflects local structure planning within the Calleya Estate and facilitates good traffic circulation throughout the balance of the TDSP, and appropriate connectivity to the surrounding regional roads including Armadale Road and Jandakot Road. A revision of this to reflect longer term upgrading plans for Armadale Road is shown in Figure 12.

The Transport Assessment notes that:

- Armadale Road is a Primary Distributor and is proposed to be upgraded to dual carriageway in the vicinity of the DSP in the short-medium term, and 6 lanes in the long term, at which point the projected traffic volume is expected to be over 50,000vpd. The proposed internal road network includes three connections with Armadale Road, including:
  - One full movement intersection (at Liddelow Road);
  - The existing Ghostgum Avenue intersection (ultimately requiring modification to Left in Left out upon construction of the Armadale Road deviation); and
  - A Left in Left out intersection to Lot 1 (west)



Source: Transcore_Banjup District Structure Plan_Transport Assessment_October 2016

2310-141-01 (25.10.2016), NTS

PROPOSED PEDESTRIAN AND CYCLIST NETWORK

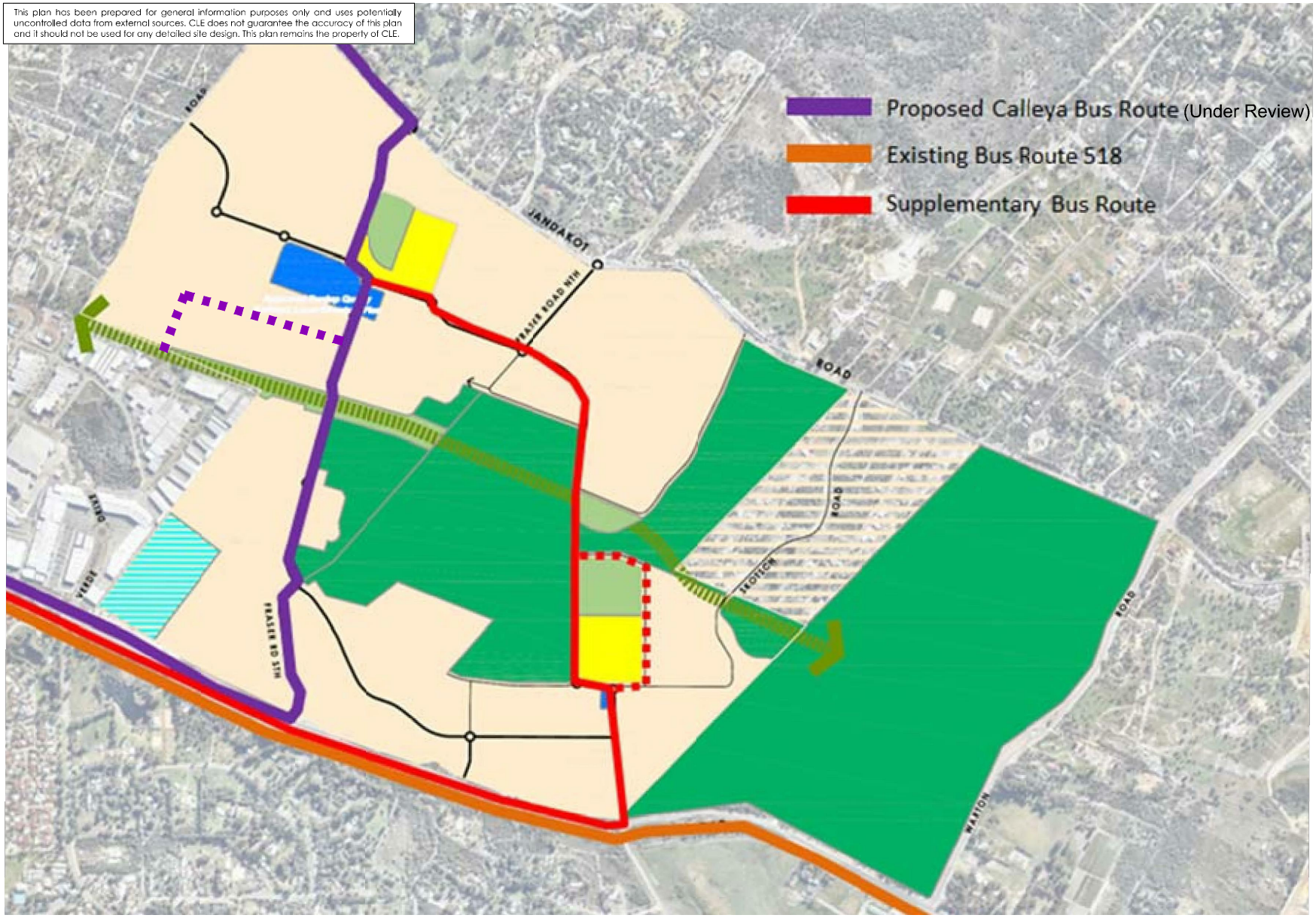
Figure 13

A further Left in Left out only intersection was proposed between Liddelow Road and Ghostgum Avenue to improve connectivity and permeability of the DSP areas and to relieve pressure on the 4-way intersection/s, however this will only proceed if MRWA concern with it can be resolved.

- Jandakot Road forms the northern boundary of the DSP area and is classified as an Integrator A road requiring dual carriageway standard with a predicted traffic volume of 20,000-30,000vpd. The ultimate road design will include two traffic lanes in both directions and a 6m median. This upgrade will require land resumption to accommodate the widening though the design and upgrade timeframe are subject to review. The internal road network includes four connections to Jandakot Road including roundabout intersections at Solomon Road, the north-south Neighbourhood Connector A road through Calleya, and Fraser Road, and a priority T-intersection at Skotsch Road.
- Warton Road is a north-south District Distributor A road of dual carriageway standard, connecting Jandakot Road with Armadale Road along the eastern boundary of the DSP area. The Jandakot Road intersection is currently controlled with a roundabout whilst the Armadale Road intersection is signalised. Warton Road experiences traffic volumes of approximately 18,600 vpd.
- Solomon Road is a north-south Integrator B road, running between Armadale Road and Jandakot Road on the western edge of the DSP area. It will carry a projected traffic volume of approximately 12,000vpd. Two priority controlled T-intersections are proposed to connect the DSP area with Solomon Road, at Dollier Road and the east-west Calleya Estate Neighbourhood Connector A road.
- A Planning Control Area has been issued by the WAPC for the future upgrade and deviation of Armadale Road west of the DSP area. The upgrade would involve modification to the alignment of Armadale Road including trenching portions of the road to improve through movement capacity and reduce traffic congestion in and around the Cockburn Central activity centre and Station precinct. Regardless of whether these additions to the regional road network eventuate, this proposal can connect into the current network configuration.
- The DSP proposes a permeable network of north-south and east-west Neighbourhood Connector roads providing good access to the Calleya Neighbourhood Centre, two primary schools and residential areas. The roads provide efficient connectivity to the surrounding arterial road network of Armadale Road, Jandakot Road and Solomon Road.

Neighbourhood Connectors within the eastern portion of the DSP area (Calleya Estate) are classified as Neighbourhood Connector A roads, and have been established as part of Local Structure Plan associated with this site. The eastern portion of the TDSP area includes a north-south Neighbourhood Connector A road through lots 4 and 131, providing a connection between Jandakot Road, Armadale Road and linking into the Calleya Estate. The proposed east-west road between lots 4 and 1 (east), and the Left in Left out access point to Armadale Road are classified as Neighbourhood Connector B roads.

Traffic volumes on Neighbourhood Connector roads are predicted to be less than 5,000vpd; therefore no restrictions to direct lot access are required for lots within the DSP area.



Source: Transcore_Banjup District Structure Plan_Transport Assessment_October 2016

2310-145-01 (25.10.2016), NTS

POTENTIAL FUTURE BUS ROUTES (PTA)

Figure 14

3.5.2 Pedestrian and Cycle Network

The TDSP proposes a pedestrian and cycle network that will provide excellent accessibility and permeability for residents within the DSP area, connecting the area to neighbouring precincts and strategic locations. On average, the walking / cycling distance between the DSP area and the Cockburn Central Station/ Activity Centre will be 2 to 3km. The DSP includes a network of shared paths and footpaths on all Neighbourhood Connector A roads and the east –west neighbourhood Connector B road proposed through lots 4 and 1 (east) refer Figure 13. Shared or dedicated cycle and foot paths are also proposed on the existing arterial road network, including Armadale Road, Solomon Road and Jandakot Road, and potentially through the parkland and Western Power easement running east-west through the site (subject to open space masterplan).

3.5.3 Public Transport

Public transport provision for the Banjup DSP area is anticipated to include the following:

- Continuation of route 518 along Armadale Road between Murdoch and Piara Waters;
- A proposed route through the Calleya Estate between Jandakot Road and Armadale Road servicing the Calleya Neighbourhood Centre and primary school. This route is likely to ultimately connect Banjup with the Cockburn and Murdoch Stations. The precise route is currently under review given MRWA plans restrict access from Armadale Road, with several options being considered.
- A possible supplementary bus service between the Calleya Neighbourhood Centre and the eastern residential area and primary school, providing access to Cockburn Central (refer Figure 14). The WAPC Transport Assessment Guidelines for Developments (2006) suggest that it is desirable for at least 90% of dwellings to be within 400m of a bus route. The provision of the secondary bus route in the east of the DSP area would satisfy this objective.
- Possible future bus rapid transit route between Armadale and Cockburn Central on Armadale Road, proposed as part of the Public Transport Plan for Perth in 2031.

Access to the Cockburn Central Railway Station can be enhanced through extension of an east-west cycle / pedestrian link through the DSP area and connection to Dollier and Solomon Roads to the station.

3.6 Water Management

The TDSP is located within the Jandakot Underground Water Pollution Control Area (UWPCA) and incorporates Priority 1 and 2 areas. This makes consideration of groundwater impacts a critical consideration in any land use planning for the future of the site, and one which as been very carefully assessed in the formulation of this proposal. A Strategic District Water Management Strategy has been prepared by JDA Hydrologists for the TDSP (refer Appendix 3) to provide direction on appropriate management of water and groundwater, in particular, to inform more detailed site strategies required to support individual rezoning and local structure plan proposals.

The SDWMS investigations conclude that the extensive work undertaken in relation to site conditions, hydrogeology and groundwater management for the Calleya and Lot 4 rezoning proposals is pertinent to abutting sites (which exhibit similar attributes), with the conclusion that groundwater impacts can be appropriately managed through best practice management practices similarly extended.

Initiatives recommended to be applied to limit potential groundwater impact associated with urban development, include:

- Extension of deep sewer to all lots;
- Application of water sensitive urban design principles including at-source stormwater infiltration, rain gardens and water harvesting;
- Appropriate road design and treatments to minimise the risk of high speed car collision (which may result in oil or petrol spillage);
- Provision of lot types which maximise land use efficiency and reduce excessive garden area (and hence fertiliser and pesticide use);
- Encouragement of home purchasers to use native plants for landscaping (which will also reduce fertiliser and pesticide use);
- Use of promotional information to land purchasers aimed at raising awareness of water issues; and,
- An on-going monitoring programme.

Exclusion of higher risk land uses (such as service stations) is also proposed.

The analysis concludes that reclassification of the land within the TDSP from a P2 to P3 water protection zone classification (with retention of P1 or P2 in areas of retained bushland), can be supported against the criteria listed within the revised SPP 2.3, subject to implementation of appropriate Local Water Management Strategies and Urban Water Management Plans consistent with the direction set within the SDWMS.

3.7 Service Infrastructure

Wood and Grieve Engineers have reviewed service capability within the area and prepared the appended Engineering Infrastructure Report for TDSP, refer Appendix 4. This concludes that the DSP area can be serviced by the construction, upgrade and / or extension of regional service infrastructure to the site, with details as follows.

3.7.1 Sewer

Water Corporation has commenced conceptual wastewater supply planning for the DSP area. Approval of MRS amendments within the DSP area will trigger review of the Water Corporation formal sewer planning scheme and detailed network design.

Wastewater disposal will be achieved via a network of gravity fed reticulation sewers, gravitating to two Waste Water Pumping Stations (WWPS). One station has been constructed within the Calleya Estate which discharges to existing infrastructure west of the DSP area. The balance of the DSP area discharges to a proposed type 40 WWPS within Lot 4, which will discharge to the existing Calleya estate WWPS.

A site of approximately 1000m^2 is required centrally within lot 4 to accommodate an additional pumping station, which will be determined through local structure planning. Design of local structure plan development concepts will have a layout sympathetic to the landform and will provide direct links through the development to the WWPS to minimise sewer length and depth.

3.7.2 Water Supply

The Water Corporation has commenced conceptual water supply planning for the DSP area, as an extension to the Thompson Lake Gravity Supply Scheme. This indicates provision of a water main extension from the existing DN760 main crossing Liddelow Road south of Armadale Road. Provision of a potable water supply to individual lots would be achieved through the construction of a network of smaller DN100 to DN250 pipes throughout the internal road network.

Approval of the MRS amendment will provide the catalyst for more detailed planning for water supply over the site.

3.7.3 Power

Power supply can be achieved via expansion and/ or upgrade to the existing Western Power network in the Vicinity of the DSP area. 22kv power lines are currently installed within the Armadale Road and Jandakot Road reserves and high voltage underground power has been installed within the Calleya estate.

It is anticipated that the existing Armadale Road and Jandakot Road overhead power lines will be replaced with underground cables as part of the development. An underground network will be provided throughout the DSP area providing low voltage connections to each lot.

3.7.4 Telecommunications

National Broadband Network (NBN) has been installed within the Calleya estate. It is expected that this would be extended through the DSP area (in a common trench with underground power) as a component of urban development, and would be progressively constructed with fibre distribution hubs located throughout the site as required.

3.7.5 Gas

The DSP can be serviced by ATCO Gas's DN300 high-pressure steel gas main located in the Armadale Road reserve. It is anticipated that ATCO Gas will service the development with reticulation of natural gas within a common trench with water reticulation. A pressure reducing valve will also be required to reduce operating pressures to that suitable for residential reticulation.

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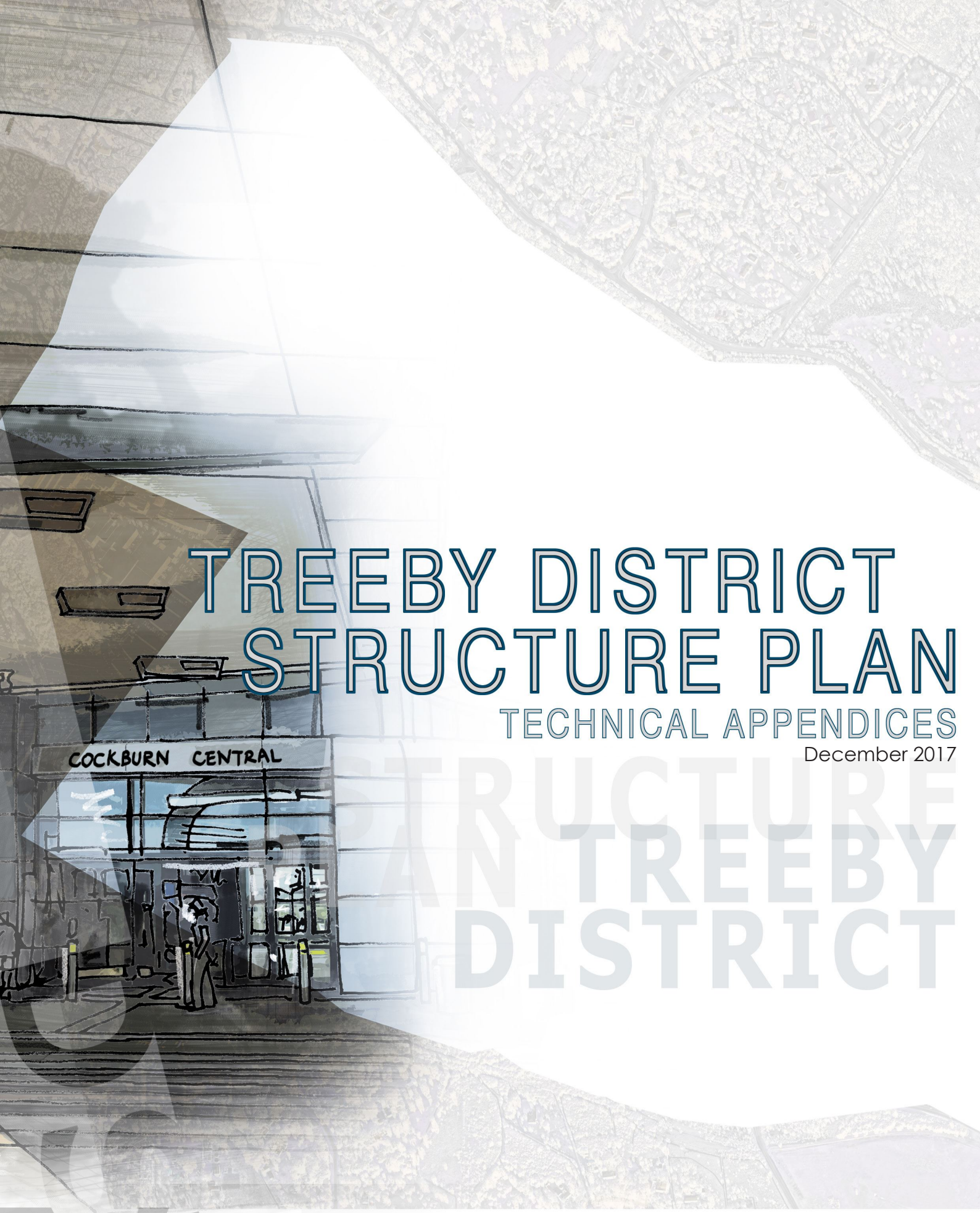
4.0 IMPLEMENTATION

The TDSP provides a broad overarching framework to coordinate more detailed local structure planning required of individual development sites following their rezoning. It also outlines the basic principles upon which such rezonings may be based.

Implementation of the TDSP will primarily occur through the rezoning of identified development sites under the MRS and TPS3, and subsequent local structure planning which would refine and build upon the basic structure and principles outlined in this document. It is anticipated that individual LSPs would be required for Lots 1 (west), 1 (east), 4, 2 and 131 with Lots 4 and 2 expected to combine. An LSP would also be required for the Skotsch Road precinct in the event of its rezoning for urban development. These LSPs would provide more detailed analysis and justification for the layouts proposed in accordance with the WAPC's Structure Planning Framework.

Preparation of an overarching Masterplan for the interconnected regional open space area may also be desirable and could form a component of an offset package for removal of a portion of remnant vegetation in the north of Lot 131. Individual open space management plans are routinely required as a condition of subdivision approval for individual sites however the Masterplan would provide a framework for a more integrated and strategic approach to management, given the scale of the open space area and the multiple functions and conditions it currently contains.

The sites are already subject to Development Contribution Plan No. 13 which provides for per lot contributions towards regional, district and local community infrastructure. Rezoning of additional sites within the TDSP area would trigger a review of the DCP to factor in the additional lots over which DCP items costs would be allocated. Inclusion of limited additional items (namely an additional district recreational facilities required to support the active open space shown on Lot 4) into a new DCP or through private arrangement may be appropriate, and upgrading obligations associated with the portion of Jandakot Road abutting urban areas will also require agreement.



TREEBY DISTRICT STRUCTURE PLAN

TECHNICAL APPENDICES

December 2017

CLE TOWN PLANNING + DESIGN

TREEBY DISTRICT STRUCTURE PLAN

TECHNICAL APPENDICES

Prepared by:

PO Box 796
Subiaco WA 6904
t: 9382 1233
f: 9382 1127
www.cleplan.com.au

2310Rep118D_Appendices
December 2017

APPENDICES

Appendix 1

Environmental Assessment Report

(360 Environmental)

360 environmental

Treeby District Structure Plan

Environmental Assessment Report

Prepared for:

Perron Developments Pty Ltd

December 2017

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Admin Review	Submitted to Client	
					Copies	Date
1405AB	A INTERNAL DRAFT	RHa	KC & SB	HT	1 Electronic (email)	30/05/2016
1405AB	B CLIENT DRAFT	RHa	CLE	-	1 Electronic (email)	1/06/2016
1405AC	C CLIENT FINAL	KC	-	HT	1 Hardcopy 1 Electronic (email)	30/06/2016
1405AD	C CLIENT FINAL	KC	SB	HT	1 Hardcopy 1 Electronic (email)	08/07/2016
1405AE	E CLIENT FINAL	KC	SB	AT	1 Hardcopy 1 Electronic (email)	07/09/2016
1405AF	F CLIENT FINAL (Incorporating Council Recommendations)	KC		TM	1 Electronic (email)	19/10/2017
1405AG	G CLIENT FINAL (Incorporating Council Recommendations)	KC		SH	1 Electronic (email)	05/12/2017

Executive Summary

360 Environmental Pty Ltd (360 Environmental) has been engaged by Perron Developments Pty Ltd (Perron) to prepare an environmental assessment report (EAR) to support the preparation and submission of the Treeby District Structure Plan (DSP) on behalf of the City of Cockburn. The DSP area includes approximately 461 ha within the City of Cockburn. The DSP covers landholdings bounded by Warton Road, Jandakot Road, Solomon Road, and Armadale Road, Banjup ('the study area').

The Treeby DSP has been identified by the City of Cockburn as a key initiative for 2016. This initiative has been the result of recent urban development within the Study Area and changes to the metropolitan strategic planning framework over the locality of Banjup.

The purpose of the EAR is to;

- Review a number of environmental assessments that have been undertaken over the Study Area;
- Identify the key environmental issues relevant to the DSP;
- Demonstrate the proposed change in land use will not result in adverse environmental impacts; and
- Recommend appropriate management responses to facilitate and guide future development and local structure planning within the Study Area.

Key Environmental Issues

Bush Forever

A large portion of the Study Area has been historically cleared and disturbed for sand quarrying operations. Approximately 95% of Bush Forever is proposed to be retained as part of future development. However, 10.5 ha within Lot 131 is proposed to be developed for residential purposes, of which approximately 40% (4.2 ha) is comprised of vegetation condition that is mapped as being ''Completely Degraded'. Additionally, approximately 47% of the Bush Forever area that is proposed to be developed has been previously cleared as a result of past sand quarrying activities and poorly rehabilitated (4.9 ha).

It is important to note that within Lot 131 approximately 1.8 ha (that is not currently in Bush Forever) is proposed to be included within the Public Open Space, of which approximately 90% (1.6 ha) is comprised of vegetation that is mapped as being in 'Excellent' condition.

Most of the vegetation remaining within the Study Area forms part of Bush Forever Site 390. In accordance with SPP 2.8, Bush Forever Site No. 390 falls under the 'Bush Forever Area (BFA) - Urban, industrial and resource development' site implementation category. The policy recognises that regionally significant bushland in this category is constrained by existing commitments, approvals and policies. Therefore, development

proposals should seek to achieve a reasonable balance between conservation and development or resource extraction through a negotiated outcome which has regard for the specific conservation values involved (WAPC 2010).

Given the above any proposed MRS rezoning of areas within the DSP that may result in unavoidable impacts on regionally significant bushland within Bush Forever Site No. 390 will be the subject of an impact assessment being undertaken. The impact assessment will be done in accordance with the process outlined in Appendix 1 of SPP 2.8 and the framework provided in Figure A of this report.

The primary purpose of this impact assessment will be to inform:

- The development of a statement of environment effect (guided by Appendix 1 of SPP 2.8);
- The development of a Bush Forever offsets package that will provide a net environmental outcome; and
- Assist in any future negotiated outcome over the final boundary for Bush Forever Site No. 390.

The provision of a Bush Forever offsets package will lead to a positive net environmental outcome. There are opportunities to provide an offset package through the addition of remnant vegetation (outside of Bush Forever) on site, purchase of vegetated land and the rehabilitation of land in the immediate vicinity to achieve an appropriate offset ratio, which will be determined through the application of Appendix 4 of SPP 2.8 and in consultation with the Department of Planning and the Office of the EPA..

Conservation Significant Flora

One conservation significant flora species has been found on site, *Caladenia huegelii* that is Threatened under the *Wildlife Conservation Act 1950* (WC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). There are no *Caladenia huegelii* within Bush Forever Site 390 that within areas proposed to be cleared and all known *Caladenia huegelii* within Bush Forever Site 390 are to be retained.

Conservation Significant Fauna

The Study Area has been assessed as containing suitable habitat for a number of conservation significant fauna, including the Carnaby's, Baudin's and Forest Red-tailed Black Cockatoos.

The proposal to develop Lot 4 of the site has been referred to the Federal Department of Environmental under the EPBC Act 1999. As a result the proposal attracted a "not a controlled action" level of assessment, meaning the project is considered not to significantly impact on matters of national environmental significance such as black cockatoos.

Jandakot Underground Water Pollution Control Area

The Study Area forms part of the Jandakot Underground Water Pollution Control Area (JUWPCA). The majority of the Study Area is classified as P2 and the eastern portion of the site is classified as a Priority 1 (P1) area under the UWPCA.

The western portion of the Study Area (Calleya Estate) was originally classified as a Priority 2 (P2) area; however the Department of Water (DoW) formally endorsed the area to be reclassified to Priority 3 (P3) for urban development as it was demonstrated that the drinking water source will be protected.

Lot 1 (previously Lot 821) has recently been rezoned to 'Urban' under the MRS. During the MRS Amendment submission period, the DoW advised that following the WAPC's determination to rezone the site to 'Urban', the DoW would reclassify the site from a P2 to a P3 protection status and may recommend mitigation measures are applied to the development.

Provided the MRS rezoning process concludes that it is acceptable to rezone land to 'Urban' or 'Urban deferred', land proposed to be developed for residential housing can be reclassified from P2 to P3. The remaining areas proposed to become 'Urban' within the Study Area meet these requirements due to previous clearing and disturbance and the presence of the Calleya Estate that is zoned 'Urban'. Furthermore, the WAPC identified a substantial portion of the Study Area as 'Urban Investigation' and 'Urban Expansion' in the Draft Metropolitan Perth and Peel Sub-regional Planning Framework (WAPC 2015b). This indicates that the WAPC would consider more intensive development within the current P2 areas proposed to be rezoned to 'Urban'.

Furthermore, the following initiatives will ensure potential risks to the drinking water source are minimised:

- Extension of deep sewer to all lots;
- Implementation of water sensitive urban design principles including at-source stormwater infiltration, rain gardens and water harvesting;
- Preservation of large areas of existing native vegetation and wetland;
- Future urban design with incorporates the current trend for smaller lot sizes with reduced landscaping and irrigation areas (thereby reducing fertiliser and pesticide use);
- An on-going monitoring programme; and
- Exclusion of high risk land uses from the development area (e.g. service station).

Environmental Outcomes

Based on the high-level review undertaken, the following key environmental issues are identified:

- Terrestrial flora and vegetation;
- Terrestrial fauna; and
- Hydrological process.

Future development, in accordance with the DSP, will deliver the following key environmental outcomes:

- Provision of regional and local POS areas will result in establishing a consolidated, highly manageable and substantially sized reserve within the Study Area;
- Provision of a Bush Forever offsets package, which will lead to a net positive environmental outcome;
- Linear east-west open space along the south of Lot 131 and north of Lot 4 will connect with the state-owned 98 ha Bush Forever reserve located in the western portion of the site;
- Retention of the 17.5 ha of wetland and Bush Forever landholding in the eastern portion of Lot 131 provides a north-south connection in addition to the east-west connection established along the southern boundary;
- Development and implementation of an Open Space Masterplan and subsequent environmental management plans (i.e. Vegetation Management Plan, Wetland Management and Bushfire Management Plan) will ensure the long-term management and viability of the proposed conservation areas; and
- Application of water management initiatives and a framework to the guide future development of the site to ensure water sensitive urban design is achieved (i.e. LWMS and UWMP).

Other environmental issues (such as wetlands, acid sulfate soils, potential contamination etc) are capable of being resolved (i.e. avoided or managed) through site-specific investigations and detailed engineering drainage design.

Therefore, a key conclusion of this environmental assessment report is that, based on the review undertaken and the environmental outcomes proposed by the DSP and future land use planning, none of the key environmental issues pose a significant constraint to future residential development of the Study Area.

Table of Contents

List of Tables

List of Figures (within report)

List of Figures

List of Appendices

1 Introduction

1.1 Location

360 Environmental Pty Ltd (360 Environmental) has been engaged by Perron Developments Pty Ltd (Perron) to prepare an environmental assessment report (EAR) to support the preparation and submission of the Treeby District Structure Plan (DSP) on behalf of the City of Cockburn. The DSP area includes approximately 461 ha in the City of Cockburn.

The DSP covers landholdings bounded by Warton Road, Jandakot Road, Solomon Road, and Armadale Road, Banjup that is approximately 17.7 km south east of the Perth CBD (Figure 1) ('the study area'). The lots included in the DSP boundary are shown on Figure 1.

1.2 Planning Context

1.2.1 Draft Perth and Peel @ 3.5 Million Sub-Regional Planning Framework

The draft Perth and Peel @ 3.5 million suite of strategic land use planning documents aim to accommodate 3.5 million people by 2050. The WAPC identified a substantial portion of the Study Area as 'Urban Investigation' and 'Urban Expansion' in the Draft Metropolitan Perth and Peel Sub-regional Planning Framework (WAPC 2015b).

1.2.2 Draft Perth and Peel Green Growth for 3.5 million

In response to the draft Perth and Peel Sub-Regional Frameworks, the draft Perth and Peel Green Growth Plan for 3.5 Million (draft Green Growth Plan) has been prepared. The public submission period recently ended.

The draft Green Growth Plan proposes (DPC 2016):

- To secure upfront Commonwealth environmental approvals and streamline State environmental approvals for development required to support growth to 3.5 million people; and
- Provide protection of bushland, rivers, wildlife and wetlands through implementation of Strategic.

Much of the Study Area is identified for urban development and is consistent with the draft Perth and Peel at 3.5 Million Sub-Regional Frameworks which describes much of the site as Urban Investigation. However, there is some inconsistency over Lot 131 and it is noted that the boundary for the urban areas to be largely based on the Bush Forever boundary (Bush Forever Site 390).

An important conclusion of the environmental work done to date is that the distribution and condition of the native vegetation on the site does not correspond with the Bush Forever mapping. Conformance to the current Bush Forever boundary will result in an

area that will be impractical to manage from a conservation perspective. Furthermore, the current boundary will also result in a highly compromised urban development form, undermining some of the benefits of master planned development and integration of land use, environmental and transport planning in this location.

Therefore, a critical element of the proposed DSP and future land use planning will be to achieve an outcome which balances the key conservation values of the Study Area with the planning, social and economic considerations for the general area.

1.2.3 State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region

The WAPCs *State Planning Policy 2.8: Bushland Policy for the Perth Metropolitan Region* (SPP 2.8) aims to ensure bushland protection and management issues are appropriately addressed and integrated with broader land use planning and decision-making by providing a policy and implementation framework for regionally significant bushland within the Perth Metropolitan Region (WAPC 2010).

SPP 2.8 recognises the protection and management of significant bushland areas as an integral part of the planning process and while doing so, it also seeks to integrate and balance wider environmental, social and economic considerations (WAPC 2010).

In accordance with SPP 2.8, Bush Forever Site 390 falls under the 'Bush Forever Area (BFA) - Urban, industrial and resource development' site implementation category. The policy recognises that regionally significant bushland in this category is constrained by existing commitments, approvals and policies. Therefore, development proposals should seek to achieve a reasonable balance between conservation and development or resource extraction through a negotiated outcome which has regard for the specific conservation values involved (WAPC 2010).

Therefore, any proposed MRS rezoning of areas within the DSP that may result in unavoidable impacts on regionally significant bushland within Bush Forever Site No. 390 will result in an impact assessment being undertaken. The impact assessment will be done in accordance with the process outlined in Appendix 1 of SPP 2.8 and the framework provided overleaf (Figure A).

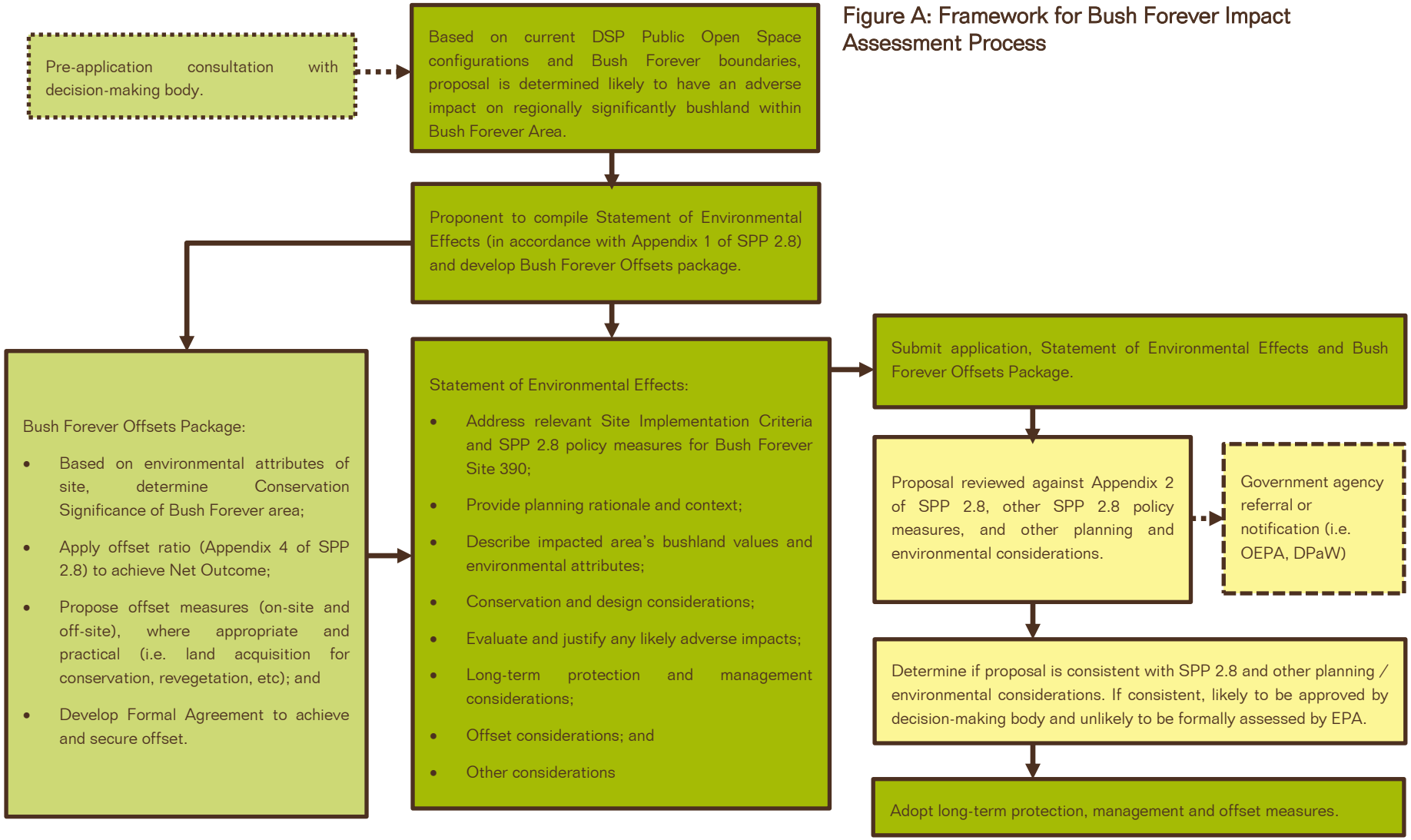
The primary purpose of this impact assessment will be to inform

- The development of a statement of environment effect (guided by Appendix 1 of SPP 2.8);
- The development of a Bush Forever offsets package that will provide a net environmental outcome; and
- Assist in any future negotiated outcome over the final boundary for Bush Forever Site No. 390.

The provision of a Bush Forever offsets package will lead to a positive net environmental outcome. There are opportunities to provide an offset package through the addition of remnant vegetation (outside of Bush Forever) on site, purchase of vegetated land and the rehabilitation of land in the immediate vicinity to achieve an appropriate offset ratio,

which will be determined through the application of Appendix 4 of SPP 2.8 and in consultation with the Department of Planning and the Office of the EPA..

Figure A: Framework for Bush Forever Impact Assessment Process



1.3 Treeby District Structure Plan

The Treeby DSP has been identified by the City of Cockburn as a key initiative for 2016. This initiative has been the result of recent urban development within the Study Area and changes to the metropolitan strategic planning framework over the locality of Banjup.

1.3.1 Key Characteristics

The draft DSP consists of an existing regional reserve, the approved Calleya estate, a rural residential precinct and four potential development sites (Appendix A).

The draft DSP key site and proposal characteristics are summarised in Table 1.

Table 1: Key characteristics of the Treeby District Structure Plan

ASPECT	DESCRIPTION
Project Location	The DSP area is approximately 17.7 km south-east of the Perth CBD

DSP Context	Total DSP Area – 460 ha (approx.)
	The DSP consists of the following land uses:
	• Existing regional reserve – 118.5 ha
	• Approved residential development (Calleya Estate) – 105.9 ha
	• Existing Rural Residential precinct – 30 ha (approx.)
	• Four potential development sites:
	  ○ Lot 1 Armadale Road – 20.4 ha
	  ○ Lot 2 Armadale Road – 3.2 ha
	  ○ Lot 4 Armadale Road – 58.8 ha
	  ○ Lot 131 Jandakot Road – 64.8 ha
	• Proposed additions to the regional reserve:
	  ○ Lot 4 Armadale Road – 4 ha (approx.)
	  ○ Lot 131 Jandakot Road – 33 ha (approx.)
	• Primary regional roads
	• Primary schools
	• Neighbourhood / Local Centre
	• Active and local public open space
	• Powerline easement

ASPECT	DESCRIPTION
Responsible Authority	City of Cockburn

1.3.2 Objectives

In order to provide an effective planning framework for future development within the Study Area, the draft DSP has been prepared. The DSP establishes a framework to co-ordinate current and future land uses as well as the delivery of infrastructure.

The overarching objectives of the DSP will be to:

- Provide a high level strategic, spatial planning framework to coordinate the development of land and provision of district level services within the Urban Precinct;
- Establish the basic road network and interconnectivity across the precinct (including access from Armadale Road and Jandakot Road);
- Establish the basic structure / location of district open space and conservation areas;
- Establish the location and provision of school sites;
- Identify potential commercial nodes and the basic land use allocation through the remainder of the area; and
- Guide the preparation and coordination of future local structure planning.

1.4 Local Structure Plans in the Study Area

1.4.1 Calleya Estate

The Calleya Estate Local Structure Plan (LSP) area is zoned 'Development' under the *City of Cockburn Town Planning Scheme No. 3* (TPS No. 3) and 'Urban' under the Metropolitan Region Scheme (MRS). This Estate consists of Lot 9014 (previously Lot 132) Fraser Road, Lot 9016 (previously Lot 9002) Jandakot Road and 9012 (previously Lot 9004) Armadale Road, Banjup. It is approximately 144 ha in size and covers the former Banjup sand quarry site.

This LSP area is proposed to be redeveloped into a residential estate by Stocklands and will include community and educational facilities, and pedestrian connections. The LSP was endorsed by the Western Australian Planning Commission (WAPC) in October 2013. An amendment to the LSP, which primarily consisted of design reconfigurations and an increase in dwelling density, was endorsed by the WAPC in March 2016.

1.4.2 Lot 1 (Previously Lot 821)

Lot 1 on Plan 407384 (previously Lot 821) is zoned 'Urban' under the MRS. The Housing Authority has prepared a LSP to facilitate development of Lot 1 for residential housing.

1.5 Past Environmental Assessments and Approvals

1.5.1 Environmental Assessment and Studies

A number of environmental assessments have been undertaken over the Study Area. The environmental studies undertaken within the Study Area (based on the Lot numbers at the time of report being prepared) are listed below:

- Targeted Flora and Vegetation Survey for Lots 132, 9002 and 9004 Armadale Road, Banjup by RPS in 2010;
- Flora and Vegetation Survey for Lots 1 and 868 Armadale Road, Banjup in 2010;
- Level 2 Flora and Vegetation Survey of Lot 4 Armadale Road, Banjup by ENV Australia in 2013;
- Level 2 Flora and Vegetation Survey of Lot 131 Jandakot Road, Banjup by 360 Environmental in 2015;
- Level 2 Flora and Vegetation Survey of Lot 467 Jandakot Road, Banjup by Brian Morgan on behalf of RPS in 2011;
- Level 1 Flora and Vegetation Survey and Fauna Survey for Lot 821 Armadale Road, Banjup by PGV Environmental in 2012;
- Targeted Carnaby's Black Cockatoo and Graceful Sun Moth Fauna Surveys for Lots 1 and 868 and Lots 132, 9002 and 9004 Armadale Road, Banjup by RPS in 2010;
- District Water Management Strategy (DWMS) for Lots 1, 132, 9002, 9004, 132 Armadale, Banjup by Emerson Stewart Consulting in 2011;
- Local Water Management Strategy (LWMS) for Lots 9004 Armadale Road, Lot 9002 Jandakot Road and Lot 132 Fraser Road, Banjup by Emerson Stewart Consulting in 2013;
- DWMS for Lot 821 Armadale Road, Banjup by Hyd2o in 2013;
- DWMS for Lots 2 and 4 Armadale Road, Banjup by JDA Hydrology Consultants in 2015;
- EAR for Lots 1, 868, 132, 9002 and 9004 Armadale Road, Banjup;
- EAR for Lots 2 and 4 Armadale Road, Banjup by 360 Environmental in 2014;
- EAR Lot 821 Armadale Road, Banjup by PGV Environmental in 2012; and

- Environmental Pre-Referral Document for Sand Extraction for Lot 467 Jandakot Road and Lot 140 Armadale Road by RPS in 2013.

1.5.2 Environmental Approvals

The Calleya Estate and Lot 1 Armadale Road (the very south-western Lot) was referred to the Environmental Protection Authority (EPA) as part of the MRS rezoning to 'Urban' (MRS Amendment 1221/41). The MRS amendment was referred to the EPA for its consideration. In September 2011, the EPA advised the scheme amendment did not require formal assessment and no public advice was given.

Lot 1 (previously Lot 821) was referred to the EPA as part of the MRS rezoning to 'Urban' (MRS Amendment 1289/57). The MRS amendment was referred to the EPA for its consideration. In May 2015, the EPA advised the scheme amendment did not require formal assessment and that it had based its decision on the following:

- Remnant vegetation along the south western and southern boundaries being retained as well as the area of remnant vegetation on the eastern side of the site, containing *Caladenia huegelii*; and
- The District Water Management Strategy for the site has been approved by the Department of Water and the proposed amendment is in accordance with the Draft State Planning Policy No. 23 – Jandakot Groundwater Protection.

Lot 4 Armadale Road was referred under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2013 for potential impacts on Matters of National Environmental Significant (MNES). The proposed clearing for residential development of Lot 4 (excluding the Bush Forever) received 'not a controlled action' on 16 December 2016 (Appendix B).

1.6 Purpose of this Report

The purpose of this environmental assessment is to:

- Demonstrate a clear understanding of the key environmental issues relevant to the Study Area and the draft DSP;
- Provide an overview of the general environmental features of the Study Area through review of existing information and desktop assessment;
- Identify and map the environmental constraints and opportunities associated with the DSP and Study Area;
- Reference past environmental assessments and environmental approvals within the Study Area;
- Demonstrate the proposed change in land use will not result in adverse environmental impacts;

- Develop and recommend appropriate environmental implementation mechanisms to be incorporated into the DSP and guide future rezoning and local structure planning within the Study Area; and
- Identify any further technical studies that may be required to support future local structure planning within the Study Area.

2 Key Environmental Legislation and Policies

2.1 State Legislation

2.1.1 Environmental Protection Act 1986

The *Environmental Protection Act 1986* (EP Act) is the key legislative tool for environmental protection in Western Australia. It is administered by the EPA and the Minister for the Environment. Under Part IV of the EP Act, the EPA undertakes environmental impact assessment of development proposal and schemes. The environmental impact assessment process provides an orderly and systematic evaluation of a proposal and its potential impact on the environment. A critical component of the assessment is the consideration of ways in which the proposal, if implemented, could avoid or reduce any potential impact on the environment.

Any future rezoning within the DSP area will be referred and assessed by the EPA in accordance with Section 48 of the EP Act and the *Planning and Development Act 2005*.

2.1.2 Relevant Legislation and Regulations

Future development within the DSP area will be required to comply with the requirements of other relevant state legislation and regulations. Table 2 provides a summary of the key state legislation and regulations relevant to the future residential development.

Table 2: Key State Legislation

Key Legislation	Responsible Government Agency	Aspect
Aboriginal Heritage Act 1972	Department of Aboriginal Affairs	Archaeological and ethnographic heritage
Aboriginal Heritage Regulations 1974	Department of Aboriginal Affairs	Archaeological and ethnographic heritage
Agricultural and Related Resources Protection Act 1976	Department of Agriculture	Weeds and feral animals
Bush Fires Act 1954	Department of Fires and Emergency Services	Bush fire control
Conservation and Land	Department of Park and	Flora and fauna / habitat /

KEY LEGISLATION	RESPONSIBLE GOVERNMENT AGENCY	ASPECT
Management Act 1984	Wildlife Department of Agriculture	weeds / pests / diseases
Conservation and Land Management Regulations 2002	Department of Park and Wildlife Department of Agriculture	Flora and fauna / habitat / weeds / pests / diseases
Contaminated Sites Act 2003	Department of Environment Regulation	Management of contaminated soils and water
Environmental Protection Act 1986	Environmental Protection Authority Department of Environmental Regulation	Part IV – Environmental Impact Assessment Part V – Works Approvals and Licences
Environmental Protection (Clearing of Native Vegetation) Regulations 2004	Department of Environmental Regulation	Clearing of native vegetation
Environmental Protection (Noise) Regulations 1997	Department of Water and Environmental Regulation	Noise emissions
Planning and Development Act 2005	Department of Planning	Structure planning and subdivision approval.
Public Health Act 2016	Department of Health	Provides a framework for the regulation of public health.
Rights in Water and Irrigation Act 1914	Department of Water	Governs management of the use, service and health of water and watercourses (including beds and banks). Water licensing is required in all proclaimed areas and for all artesian groundwater wells

KEY LEGISLATION	RESPONSIBLE GOVERNMENT AGENCY	ASPECT
		throughout the state.
Wildlife Conservation Act 1950	Department of Parks and Wildlife	Wildlife conservation and protection

2.1.3 Relevant Standards, Guidelines and Policies

Future development within the DSP is subject to compliance with applicable standards and guidelines developed by the State's regulators to assist proponents and the public to understand the minimum requirements for environmental protection. The following table details the key standards, guidelines and state planning policies relevant to future residential development.

Table 3: Relevant Standards, Guidelines and Policies

DOCUMENT	DESCRIPTION
EPA Guidance Statements	
Guidance Statement No. 3: *Separation Distances between Industrial and Sensitive Land Uses* (EPA 2005)	Provides advice on the use of generic separation distances (buffers) between industrial and sensitive land uses to avoid conflicts between incompatible land uses.
Guidance Statement No. 6: *Rehabilitation of Terrestrial Ecosystems* (EPA 2006)	Provides guidance to ensure the return of biodiversity in rehabilitated areas by increasing the quality, uniformity, and efficiency of standards and processes for rehabilitation of native vegetation in Western Australia and to allow more effective monitoring and auditing of outcomes.
Guidance Statement No. 33: *Environmental Guidance for Planning and Development* (EPA 2008)	Provides information and advice to assist land use planning and development processes to protect, conserve and enhance the environment. Describes the processes the EPA may apply under the EP Act to land use planning and development in Western Australia, and the environmental impact assessment process applied by the EPA to schemes.
Guidance Statement No. 41: *Aboriginal Heritage*	Provides guidance on the EPA's position on the assessment of Aboriginal heritage and information that the EPA will consider when assessing proposals

DOCUMENT	DESCRIPTION
Assessment (EPA 2004b)	where Aboriginal heritage is a relevant environmental factor.
Guidance Statement No. 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004c)	Provides guidance and information on the EPA's expected standards and protocols for terrestrial flora and vegetation surveys to environmental consultants and proponents.
Guidance Statement No. 55: *Implementing Best Practice in Proposals submitted to the Environmental Impact Assessment Process* (EPA 2003)	Provides guidance on the EPA's position on the use of best practice to protect the environment, and the approach that the EPA will take when assessing best practice implementation in proposals.
Guidance Statement No. 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004d)	Provides guidance and information on the EPA's expected standards and protocols for terrestrial flora and vegetation surveys to environmental consultants and proponents.
EPA Bulletins	
Environmental Protection Bulletin No. 1: *Environmental Offsets* (EPA 2014b)	Clarifies how the EPA will consider offsets through the environmental impact assessment process.
Environmental Protection Bulletin No. 16: *Minor or preliminary works and investigation work* (EPA 2011b)	Clarifies what information a proponent needs to submit to the EPA if it wants the EPA's consent to undertake minor or preliminary works.
State Planning Policies	
State Planning Policy 2.3: *Jandakot Groundwater Protection Policy* (WAPC 2003)	Provides guidance to ensure development over the Jandakot public groundwater supply mound is compatible with the long term us of the groundwater for human consumption.

DOCUMENT	DESCRIPTION
State Planning Policy 2.8: *Bushland Policy for the Perth Metropolitan Region* (WAPC 2010)	Provides a policy and implementation framework that will ensure bushland protection and management issues in the Perth Metropolitan Region are appropriately addressed and integrated with broader land use planning and decision making.
State Planning Policy 2.9: *Water Resources* (WAPC 2006)	Provides clarification and additional guidance to planning decision-makers for consideration of water resources in land use planning strategy.
State Planning Policy 3.7: *Planning in Bushfire Prone Areas* (WAPC 2015)	Provides guidance on the implementation of effective risk-based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure.
State Planning Policy 4.1 (Draft): *State Industrial Buffer (Amended)* (WAPC 2009a)	The policy applies state wide, to planning decision-making, and proposals which seek to provide for new industrial areas and uses, and essential infrastructure, sensitive land uses in proximity to existing industrial areas.
State Planning Policy 5.3: Land Use Planning in the Vicinity of Jandakot Airport (WAPC 2017)	This policy applies to land in the vicinity of Jandakot Airport, which is, or may be in the future affected by aircraft noise associated with the movement of aircraft. The policy measures apply to land within the 20 Australian Noise Exposure Forecast (ANEF) contour and frame area.
State Planning Policy 5.4: *Road and Rail Transport Noise and Freight Considerations in Land Use Planning* (WAPC 2009b)	The policy aims to promote a system in which sustainable land use and transport are mutually compatible.

2.2 Commonwealth Legislation

2.2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) protects Matters of National Environmental Significance (MNES), and is administered by

the Commonwealth Minister of the Environment. If an action is likely to have a significant impact on any MNES a referral to the Commonwealth Department of Energy and Environment (DoEE) is required.

Future development of the site will be required to consider undertaking a significant impact test against the Commonwealth Significant Impact Guidelines 1.1 – Matters of National Environmental Significance prior to determining whether to refer a proposal to the Commonwealth.

3 Existing Environment

3.1 Climate

The closest official Bureau of Meteorology (BoM) weather station currently operating is Jandakot Aero Station, which is located approximately 3 km north-west of the Study Area. The climate is identified as warm Mediterranean, with mean minima of approximately 6.7°C during July and mean maxima of 31.7°C during February (BoM 2016). Rainfall totals approximately 824.3 mm per annum (BoM 2016).

3.2 Zoning

The western portion of the site known as the Calleya Estate area is zoned 'Urban' under the MRS and 'Development' under the TPS (Figure 2). Lot 1 to the south-west of the Calleya Estate is zoned 'Urban' under the MRS, and 'Urban Deferred' under the TPS.

Lot 1 on Plan 407384 (previously Lot 821) has recently been zoned 'Urban' under the MRS and 'Resource' under the TPS.

The remainder of the site is a mix of 'Rural-Water Protection' and 'Parks and Recreation' under the MRS and 'Resource' and 'Region Reserve- Parks and Recreation' under the TPS (Figure 2). The Parks and Recreation boundaries under the MRS and TPS align within the site and are also classified as 'water catchment' special areas.

The objective of the 'Rural-Water Protection' zone is to ensure there is no increased risk of contamination of the water source (WAPC 2015a). The use and development of the 'Resource' zoned land must be in accordance with the *Statement of Planning Policy No. 2.3- Jandakot Groundwater Protection Policy*.

A MRS Amendment proposal to rezone Lots 2 and 4 Armadale Road from 'Rural- Water Protection' to 'Urban' will be lodged in the near future. Lot 131 Jandakot Road is also proposed to be rezoned from 'Rural- Water Protection' to 'Urban' in the near future.

3.3 On-site and Surrounding Land Uses

3.3.1 On-site Land Uses

The site contains three active mining tenements for sand quarries. Information about the current mining tenements within the site is presented in Table 4 below. A number of sand quarries registered through the Department of Mines and Petroleum (DMP), and that are no longer active, previously occurred on the Calleya Estate LSP area, the Housing Authority LSP Area (Lot 1, previously 821), Lot 2 and 4 Armadale Road (DMP 2016). Lot 131 Jandakot Road also contained a sand quarry that was not administered under a mining tenement due to the extraction of raw materials occurring on private land.

Table 4: Information about mining tenements within Study Area (Source: DMP 2016).

Tenement Number	Material Extraction	Lot Number/s	Date of Grant	Tenement Status	Area (ha)	Tenement Expiry
M70/1088	Sand	L467	24/08/2010	LIVE	9	23/08/2031
M70/1142	Sand	L467/ L139	24/08/2010	LIVE	64.9	23/08/2031
M70/357	Sand	L140	11/03/1992	LIVE	16.7	10/03/2034

In addition to the mining tenements for quarrying (as described above in Table 4), Lot 4 is part of the previous Midland Brick, and the Boral Brick works facility. Lots 62 to 75 contain special rural residences, and Lot 614 in the south-eastern corner is Banjup Memorial Reserve.

The remainder of the land consists of bushland and cleared areas that are unused. As a result of past land uses, large portions of the Study Area have been extensively disturbed.

3.3.2 Surrounding Land Uses

Residential housing exists to the south-west of the Study Area. Mixed business and light industrial and Service and Light Industry land uses exist west of the Study Area and the Jandakot Industrial Area exists directly to the west (Figure 3). The land to the north, south and west of the Study Area consists of special rural landholdings and areas reserved for Parks and Recreation. Residential housing also exists as close as 445 m east of the Study Area and outside the Jandakot Underground Water Pollution Control Area (UWPCA). An active sand quarry exists to the north of Lot 131.

The site falls outside of the Water Corporation Waste Water Pump Station odour buffers (Figure 3). Review of the City of Cockburn Intramaps identifies that the only buffers that fall within the Study Area are associated with wellhead protection zones in the north-west, south-west and north-east of the Study Area (Figure 3).

The boundary of Jandakot Airport exists as close as 445 m north of the Study Area. Pursuant to the adopted *State Planning Policy 5.3- Land Use Planning in the Vicinity of Jandakot Airport* (SPP 5.3), the Study Area complies with the policy provisions for residential housing as it sits outside the 'Core Area 20 Australian Noise Exposure Forecast (ANEF)' boundary (Figure 3). The Study Area is within the SPP 5.3 'Frame Area' that identifies residential development as being compatible with.

It should be noted that the ANEF zones shown are from the most recent Jandakot Airport Master Plan (JAH 2014).

3.4 Topography, Landforms and Soils

3.4.1 Topography

The topography of the site ranges from 27 m Australian Height Datum (AHD) in the north-western corner and 28 m AHD in the north-eastern corner to 44 m AHD in the south-eastern corner and north-western corner (Figure 4) (DoW 2015). Much of the Study Area has been used for sand extraction. Therefore, the natural landform and elevation has been significantly altered. The mined areas have been levelled out following completion of extraction.

3.4.2 Landforms and Soils

The Department of Agriculture and Food Western Australia (DAFWA) has mapped the entire site as forming part of the Bassendean System (DAFWA 2012). The Bassendean System is described as occurring on the Swan Coastal Plain from Busselton to Jurien and consists of sand dunes and sand plains with pale deep sand, semi-wet and wet soil (Figure 5).

3.4.3 Acid Sulfate Soils

Acid sulfate soil (ASS) mapping undertaken by the DER indicates that the site is within an area mapped as being of "moderate to low risk of ASS" (DER 2016). Areas mapped as being of "high to moderate risk of ASS" occur as close as 50 m south of the site.

3.5 Hydrology

3.5.1 Groundwater

Review of the Department of Water (DoW) groundwater mapping for Perth using historical minima contours found that the depth to groundwater sits at approximately 15 m below ground level (bgl) in the north-western portion of the Study Area, to 16 m bgl in the north-western portion of Lot 140 and ranges to 2 m bgl in the north-eastern portion of the Study Area (DoW 2016a).

3.5.2 Public Water Supply Areas

The Study Area is located in the Jandakot UWPCA and subject to the provisions of the *Statement of Planning Policy No. 2.3- Jandakot Groundwater Protection Policy* (SPP 2.3) and the *Water Quality Protection Note 25: Land use compatibility tables for public drinking water source areas* (WQPN 25).

The UWPCA occupies a total area of 7,400 ha, including more than 4,000 ha within the City of Cockburn. The UWPCA was proclaimed in 1975 under the *Metropolitan Water Supply Sewerage and Drainage Act 1909*. Water from the mound is extracted by the Water Corporation as part of the Perth Metropolitan integrated water supply system (IWSS).

The DoW is the lead agency in protecting catchments for water supply in Western Australia. The DoW supports the Australian Drinking Water Quality Guidelines (ADWQG) barrier approach to water quality protection, with catchment management being the first barrier of protection. Subsequent barriers include water storage, treatment and sterilization. The catchment management measures are also supported by Wellhead Protection Zones (WPZ) around public water supply wells (JDA 2016).

WQPN 25 sets out the groundwater catchment priority system (DoW 2016b):

Priority 1 (P1) areas are defined and managed to ensure there is no degradation of the quality of the drinking water source with the objective of risk avoidance. P1 areas occur within PDWSAs where the existing land uses have low risks to PDWSAs.

Priority 2 (P2) areas are defined and managed to maintain or improve the quality of the drinking water source with the objective of risk minimisation. P2 areas occur within PDWSAs where the land is zoned rural and the risks need to be minimised.

Priority 3 (P3) areas are defined and managed to maintain the quality of the drinking water source for as long as possible with the objective of risk management. P3 areas occur within PDWSAs where the land is zoned for urban and commercial or light industrial uses.

WQPN 25 sets out '**protection zones**' that are defined in the immediate vicinity of drinking water extraction points (DoW 2016). Protection zones can be located within P1, P2 or P3 areas. There are two types of protection zones: WPZs defined for groundwater sources; and reservoir protection zones (RPZs) defined for surface water sources.

Three WPZs exist in the north-west, south-west and north-east of the Study Area and a number of wellhead protection zones surround the site (Figure 3) (DoP 2014a). Of these only two fall within the footprint proposed to be developed for residential housing and the wellhead protection zone in Lot 467 will remain undisturbed in public open space (POS).

3.5.2.1 Reclassification of Priority Areas

The '*Draft State Planning Policy 2.3 Jandakot Groundwater Protection Policy*' states that "proposals to rezone land may be supported where they meet the following criteria:

- Large land holdings that were previously cleared and disturbed;
- Land directly adjacent to already developed areas; and
- Land identified as appropriate for more intensive development through strategic planning instruments such as regional or sub-regional structure plan."(DoP 2014a).

The western portion of the Study Area (Calleya Estate) was originally classified as a P2 area; however the DoW formally endorsed the area to be reclassified to P3 for urban development as it was demonstrated that the drinking water source will be protected. The majority of the Study Area is classified as P2 and the eastern portion of the site is

classified as a P1 area under the UWPCA (Figure 6) (DoP 2014a). The Calleya Estate has since been reclassified from P2 to P3 through the State planning process and reflects the amended draft SPP 2.3 (DoP 2014a).

In relation to Lot 1 (previously Lot 821), the site has recently been rezoned to 'Urban' under the MRS. During the MRS Amendment submission period, the DoW advised that following the WAPCs determination to rezone the site to 'Urban', the DoW would reclassify the site from a P2 to a P3 protection status and may recommend mitigation measures are applied to the development. That is, management measures beyond those normally recommended for P3 areas and which reflect the additional risk posed to the drinking water source by the proposed development. Such measures would be addressed in water management strategies/plans at later stages of the planning process.

Provided the MRS rezoning process concludes that it is acceptable to rezone land to 'Urban' or 'Urban deferred', land proposed to be developed for residential housing can be reclassified from P2 to P3. T, The land presents as an important and likely site for progression to an Urban zoning given (JDA 2016):

- Identification of a Study Area within the Draft South Metropolitan Peel Sub Regional Framework and classification of this land within short to medium term development timeframes;
- The proximity of the site to a high order activity centre, railway station and freeway interchange;
- The site represents a logical extension of development east of the developing Calleya Estate;
- A large portion of the site has been cleared and disturbed for sand quarrying operations;
- Service infrastructure within the area can accommodate the additional development; and
- Compliance with the criteria for urbanisation included within draft State Planning Policy 2.3 – Jandakot Groundwater Protection.

The following initiatives will be applied to ensure any potential groundwater impacts arising from urban development are minimised (JDA 2016):

- Extension of deep sewer to all lots;
- Application of water sensitive urban design principles including at-source stormwater infiltration, rain gardens and water harvesting;
- Appropriate road design and treatments to minimise the risk of high speed car collisions (which might result in oil or petrol spillage);
- Provision of lot types which maximise land use efficiency and reduce excessive garden area and hence fertiliser and pesticide use;

- Encourage home purchasers to use native plants for landscaping (which will also reduce fertiliser and pesticide use);
- Use of promotional information to land purchasers aimed at raising awareness of water issues;
- An on-going monitoring programme; and
- Exclusion of high risk land uses from the development area (e.g. service station).

3.5.3 Surface Water and Drainage

The DoW has not classified any parts of the Study Area as being subject to inundation (Figure 7) (DoW 2012). The DoW has identified a number of earth dams within the site; however the ones within the Calleya Estate no longer exist (Figure 7). The earth dams within Lot 4 Armadale Road were previously used as effluent ponds.

Hydrography mapping undertaken by the DoW indicates that no rivers, creeks or streams intersect the site (DoW 2012).

3.5.4 Wetlands

The Department of Parks and Wildlife (DPaW) geomorphic wetland dataset shows that the Study Area contains three Resource Enhancement Wetlands (REWs) and one Conservation Category Wetland (CCW) (Figure 7) (DPaW 2016a). Details of these wetlands are described below:

Table 5: Information about Geomorphic Wetlands within the Study Area

Wetland UFI	Wetland Management Category	Wetland type	Lot No(s) in site
6881	REW	Sumpland	9016
6781	REW	Dampland	9014
13328	REW	Dampland	4, 62-75,131,467
7169	CCW	Dampland	467

Several Multiple Use Wetlands (MUWs), REWs and CCWs surround the Study Area. The site is not listed as a Ramsar site or listed under the Directory of Important Wetlands (DPaW 2014; DoE 2008).

3.6 Terrestrial Flora and Vegetation

3.6.1 Interim Biogeographical Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia (IBRA) divides Australia into 89 bioregions based on major biological and geographical/ geological attributes (Thackway

& Cresswell 1995). These bioregions are subdivided into 419 subregions, as part of a refinement of the IBRA framework (DSEWPaC 2012).

The site is located in the Perth subregion (SWA02) of the Swan Coastal Plain bioregion (Thackway & Cresswell 1995). The Perth subregion is composed of colluvial and aeolian sands, alluvial river flats and coastal limestone (Mitchell *et al*. 2002). Vegetation can be characterised by heath and/or Tuart woodlands on limestone, Banksia and Jarrah-/ Banksia woodlands on Quaternary marine dunes of various ages and Marri on colluvial and alluvials (Mitchell *et al*. 2002).

3.6.2 Broad Vegetation Types

Mapping of the vegetation of the Perth region of Western Australia was completed on a broad scale by Beard (1981). These vegetation units were re-assessed by Shepherd *et al*. (2001) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units.

There is one Shepherd vegetation mapped within the Study Area. The Shepherd *et al.* (2001) vegetation type is described below, and its representation within the State, Bioregion and subregion is shown in Table 6.

- '**Bassendean_1001**': Medium very sparse woodland; *Eucalyptus marginata* (Jarrah), with low woodland; *Banksia* & *Casuarina* (Shepherd *et al*. 2001).

Table 6: Broad Vegetation Types within the Study Area and its State and Regional Representation (Government of Western Australia 2014)

	Pre-European area (ha)	Current extent (ha)	Remaining (%)	Current extent % in IUCN Class I-IV Reserves
Vegetation Types (Beard 1981/ Shepherd *et al*. 2001) in the state				
1001	57,410.23	13,240.22	23.06	1.14
Vegetation Types (Beard 1981/ Shepherd *et al*. 2001) in the Swan Coastal Bioregion				
1001	57,410.23	13,240.22	23.06	1.14
Vegetation Types (Beard 1981/ Shepherd *et al*. 2001) in the Perth Subregion				
1001	57,410.23	13,240.22	23.06	1.14

Vegetation complexes of the Drummond Botanical Subdistrict, in which the Swan Coastal Plain occurs, have been mapped by Heddle *et al*. (1978). Mapping by Heddle *et al*. (1980) is based on the relationship to the landform-soil units determined by Churchward & McArthur (1980). The Study Area contains two Swan Coastal Plain

vegetation complexes which are associated with the underlying soil profile. These are described below and their representation is shown in Table 7:

- 'Bassendean Complex - Central and South' that covers majority of the Study Area: vegetation ranging from woodland of *Eucalyptus marginata - Allocasuarina fraseriana - Banksia spp*. to low woodland of Melaleuca spp. and sedgelands on the moister sites. This area includes the transition of *Eucalyptus marginata* to *Eucalyptus todtiana* in the vicinity of Perth (Heddle *et al*., 1980); and
- **'Southern River Complex'** that covers the eastern portion of the Study Area: open woodland of *Corymbia calophylla*, *Eucalyptus marginata, Banksia spp.* with fringing woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* along creek beds.

Table 7: Vegetation Complex within the Study Area and its representation in the Swan Coastal Bioregion (LBP 2013)

	Pre-European area (ha)	Current extent (ha)	Remaining (%)	Current extent Secure Tenure Reserves (%)
Bassendean Complex–Central and South	87,392.73	24,206.24	27.70	2.57
Southern River Complex	57,171.55	11,254.99	19.69	2.16

Within constrained areas on the Swan Coastal Plain, the EPA has set a threshold for retention of 10% of the pre-existing extent of native vegetation (EPA 2008). The site is considered to be a constrained area as it is within the Perth metropolitan region and contains, and adjoins, urban areas. There is a reasonable expectation that development will be able to proceed. All the current vegetation extents are greater than the abovementioned 10% threshold.

3.6.3 Vegetation Associations

A number of flora and vegetation surveys have been undertaken over the Study Area. These include the following:

- Targeted Flora and Vegetation Survey for Lots 132, 9002 and 9004 Armadale Road, Banjup by RPS in 2010;
- Flora and Vegetation Survey for Lots 1 and 868 Armadale Road, Banjup in 2010;
- Level 2 Flora and Vegetation Survey of Lot 4 Armadale Road, Banjup by ENV Australia in 2013;
- Level 2 Flora and Vegetation Survey of Lot 131 Jandakot Road, Banjup by 360 Environmental in 2015;

- Level 2 Flora and Vegetation Survey of Lot 467 Jandakot Road, Banjup by Brian Morgan on behalf of RPS in 2011; and
- Level 1 Flora and Vegetation Survey for Lot 821 Armadale Road, Banjup by PGV Environmental in 2012.

Based on a number of surveys, figure 8 shows the vegetation associations identified within the site. A number of Lots within the Study Area have not been surveyed, however these form part of the regional POS areas that will be retained as well as areas not currently proposed for residential development under the draft DSP. Table 8 describes the vegetation associations within each of the Lots surveyed.

Table 8: Vegetation Associations within the Study Area

Map Reference Vegetation Code	Vegetation Association
Lot 4 Armadale Road, Banjup (ENV Australia 2013)	
Ba	*Baumea articulata* population
BaBmEf	Low woodland of *Banksia menziesii* and *B. attenuata* over *Stirlingia latifolia*, *Eremaea fimbriata*, *Allocasuarina humilis*, *Patersonia occidentalis* and *Lyginia imberbis*
BaBm	Low open woodland of *Banksia menziesii* and *B. attenuata* over *Eremaea pauciflora* var. *pauciflora*, *Scholtzia involucrata*, *Stirlingia latifolia* and *Astroloma ciliatum*
Rehab	Planted mixed shrubs of *Kunzea glabrescens*, *Acacia pulchella*, *Adenanthos cygnorum*, *Bossiaea eriocarpa*, *Gompholobium tomentosum* and *Stirlingia latifolia*
MpBi	Low open forest of *Melaleuca preissiana* and *Banksia ilicifolia* over *Dasypogon bromeliifolius*, *Astartea scoparia*, *Lepidosperma squamatum*, *Xanthorrhoea preissii* and *Phlebocarya ciliata*
Lot 131 Jandakot Road, Banjup (360 Environmental 2015)	
BaEt	Low woodland of *Banksia attenuata*, *Eucalyptus todtiana* and *Allocasuarina fraseriana* over *Xanthorrhoea preissii*, *Macrozamia riedlei*, *Hibbertia hypericoides*, *Hibbertia racemosa*, *Patersonia occidentalis* and *Desmocladus flexuosus*.

Map Reference Vegetation Code	Vegetation Association
KgMp	Tall Closed Shrub of *Kunzea glabrescens* with *Melaleuca preissiana* and *Banksia ilicifolia* over open understorey.
Ri	Closed heath of *Regelia inops* with occasional *Melaleuca preissiana* and/or *Banksia ilicifolia* over *Hypocalymma angustifolium*, *Euchilopsis linearis*, *Kunzea glabrescens* and *Lyginia imberbis*.
BaRi	Low Open Woodland of *Banksia attenuata and Banksia Ilicifolia over Regelia inops, Xanthorrhoea preissii, Patersonia occidentalis, Schoenus caespititius and Platysace compressa.*
MpHa	Low Woodland of *Melaleuca preissiana* over Closed Heath of *Hypocalymma angustifolium*, *Astartea scoparia, Pericalymma ellipticum* var. *ellipticum, Hypolaena exsulca* and *Lyginia imberbis.*
BaMp	Low Woodland of *Banksia attenuata, Banksia ilicifolia, Banksia menziesii* and *Melaleuca preissiana* over *Kunzea glabrescens, Hypocalymma angustifolium, Patersonia occidentalis, Dasypogon bromeliifolius* and *Bossiaea eriocarpa*.
Rehab	Tall Open Shrubland of *Adenanthos cygnorum, Kunzea glabrescens, Acacia rostellifera, Calothamnus quadrifidus* and *Lyginia imberbis*.
Lot 1 (Previously Lot 821) Armadale Road, Banjup (PGV Environmental 2012)	
BaBmEmLOW	*Banksia attenuata/Banksia menziesii/Eucalyptus marginata* (Jarrah) Low Open Woodland over *Adenanthos cygnorum* (Woolly Bush) Open Shrubland over *Hibbertia* *hypericoides/Lyginia barbata/ Conostylis aculeata* Closed Low Heath.
BmAfLOW	Banksia menziesii/Allocasuarina fraseriana Low Open Woodland over Adenanthos cygnorum (Woolly Bush) Open Shrubland over Eremaea pauciflora Low Open Heath.

Map Reference Vegetation Code	Vegetation Association
Calleya Estate LSP Area (RPS 2011)	
RR	**Remnant Trees and Rehabilitation Works** There are some remnant native trees within the cleared sand areas as well as some rehabilitation plantings. These include planted *Eucalyptus spp.* including *Eucalyptus conferruminata*, *Eucalyptus camaldulensis*, *Eucalyptus todtiana* and *Callitris preissii* with *Kunzea micrantha*, *Adenanthos cygnorum*, *Melaleuca nesophila*, *Agonis flexuosa*, *Acacia iteaphylla*, *Leschenaultia floribunda* and *Scholtzia involucrata.*
EtEmBaBm	***Eucalyptus todtiana*, *E.marginata* with *Banksia attenuata*, *B. menziesii* and *B. ilicfolia* Open Woodland to Woodland** Open Woodland to Woodland of *Eucaluptus todtiana* and *E. marginata* with *Banksia attenuata*, *B. menziesii* and *B. ilicifolia* over Open Shrubland of *Adenanthos cygnorum*, *Allocasuarina humilis*, *Melaleuca sp.*, *Hibberia hypericoides*, *Calytrix sp.*, Phlebocarya ciliata, and *Xanthorrhoea preissii* over Open Low Shrubland and Exotic Grassland of *Dasypogon bromeliifolius*, *Patersonia occidentalis* and *Ehrharta calycina.*
Mp	**Scattered *Melaleuca preissiana* over Astartea and Hypocalymma** Dampland with Scattered *Melaleuca preissiana* over Closed Shrubland of *Astartea affinis* and *Hypocalymma angustifolium* over an Open Sedgeland of *Lepidosperma longitudinale*.
Lot 467 Jandakot Road, Banjup (Morgan 2011)	
***Banksia attenuata-Banksia menziesii* low woodlands on dune slopes**	
BaBM	*Banksia attenuata*, *Banksia menziesii*, (*Allocasuarina fraserina*) low woodland over *Allocasuarina humilis* shrubland over *Hibbertia hypericoides*, *Astroloma xerophyllum* low shrubland over *Desmocladus flexuosus*, *Amphipogon turbinatus* open sedgeland/grassland.
***Melaleuca preissiana* mixed woodlands on gentle slopes and flats around the base of the dune.**	
MpAa	*Melaleuca preissiana*, (*Allocasuarina fraseriana*) low open forest over *Xanthorrhoea preissii*, *Astartea affinis* open shrubland over *Hypocalymma angustifolium* scattered low shrubs over *Dasypogon bromeliifolius* open

Map Reference Vegetation Code	Vegetation Association
	herbland to herbland.
MpBmBa	*Melaleuca preissiana*, *Banksia menziesii*, *Banksia attenuata*, (*Nuytsia floribunda*, *Eucalyptus todtiana*) low woodland over *Xanthorrhoea preissii*, *Adenanthos cygnorum* subsp. *cygnorum* shrubland over *Hibbertia subvaginata* low open shrubland with *Dasypogon bromeliifolius* herbland.
Pericalymma heaths and sedgelands on flats (dampland/palusplain).	
Pe	*Pericalymma ellipticum* closed heath over *Daviesia incrassata* subsp. *incrassata*, *Euchilopsis linearis* scattered low shrubs (*Hypocalymma angustifolium* low shrubland in parts) over *Lyginia imberbis*, *Hypolaena exsulca* very open sedgeland.
Ss	*Acacia pulchella* var. *goadbyi* scattered shrubs over *Hypocalymma angustifolium*, *Pericalymma ellipticum* scattered low shrubs over *Schoenus subfascicularis* closed sedgeland.
AcHa	*Kunzea glabrescens* scattered tall shrubs over *Adenanthos cygnorum* shrubland over *Hypocalymma angustifolium* low open shrubland over *Hypolaena exsulca* very open sedgeland with *Dasypogon bromeliifolius*, *Phlebocarya ciliata* herbland.

3.6.4 Vegetation Condition

The condition of vegetation in the Study Area ranged from 'Completely Degraded' to 'Excellent' as shown on Figure 9. Historical sand extraction has been the main the cause of disturbance within the Study Area, some of which has since been rehabilitated. However, the rehabilitation has not been very successful given the low diversity and density of native species. For these reasons the majority of the rehabilitation across the site is considered to be in a 'Degraded' to 'Completely Degraded' condition.

3.6.5 Threatened and Priority Flora

A 5km radial DPaW NatureMap flora search and DotE Protected Matters Search Tool (PMST) was undertaken from the centre of the Study Area (Appendix C) (DPaW 2016b; DotE 2016). A DPaW Threatened and Priority Flora Database search using a 5 km buffer was also undertaken in 2013 that is shown on Figure 10 (DPaW 2013).

The NatureMap database identified 15 conservation significant flora species as potentially occurring in the vicinity of the site. Of these, four are classed as Threatened, one as Priority 2, six as Priority 3 and four as Priority 4. The PMST identified eight

Threatened fauna species occurring within 5 km of the site. An assessment of the likelihood of each conservation significant flora species occurring within the site can be found in Appendix D.

One conservation significant flora species has been found on site, *Caladenia huegelii*, which is Threatened under the *Wildlife Conservation Act 1950* (WC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Caladenia huegelii is known to have a significant population within the site due to many individuals being identified over numerous surveys. Figure 10 shows known individuals identified in surveys over the Study Area, however the GPS coordinates are not known for all of the specific *Caladenia huegelii* sightings and are therefore not all shown on the Figure.

The following are known locations of *Caladenia huegelii* within the Study Area (Morgan 2011; PGV Environmental 2012; ENV Australia 2013; 360 Environmental 2015):

- Within the pocket of vegetation along the eastern boundary of the Calleya Estate LSP area;
- Along the western boundary of Lot 1 (previously Lot 821);
- Throughout Bush Forever Site 390 in Lot 820 and Lot 4; and
- Within the southern portion of Bush Forever Site 390 in Lot 131.

PGV Environmental (2012) stated that (then) DEC undertook a survey in 2004 and 2005 which identified a substantial population of *Caladenia huegelii* in Bush Forever No. 390 within Lot 820.

Six conservation significant species are considered 'likely' to occur within the Study Area based on suitable habitat being present and records of the species being less than 5 km from the site:

Likely to occur on site

- *Drakaea micrantha* (Threatened under the WC Act and EPBC Act);
- *Cyathochaeta teretifolia* (Priority 3);
- *Phlebocarya pilosissima* subsp. *pilosissmia* (Priority 3);
- *Stylidium paludicola* (Priority 3);
- *Jacksonia sericea* (Priority 4); and
- *Verticordia lindleyi subsp. lindleyi* (Priority 4).

Seven conservation significant species are considered 'unlikely', three are considered 'possible' and two species are considered as 'unknown', with regards to occurring within the site based on suitable habitat being present and records of the species being 5 km from the site.

3.6.6 Threatened Ecological Communities and Priority Ecological Communities

A search of the DPaW Threatened Ecological Community (TEC) and Priority Ecological Community (PEC) identified three State listed TECs, which are also listed under the EPBC Act, and three State listed PECs as occurring within 5 km of the Study Area. The database search determined that no TECs exist within the site (DPaW 2013). The closest TEC to the site is SCP10a that is 3.18 km to the east of the Study Area.

The TEC and PEC communities are:

- FCT SCP08 – Herb rich shrublands in clay pans (Vulnerable [WC Act], Critically Endangered [EPBC Act]);
- FCT SCP10a – Shrublands on dry clay flats (Endangered [WC Act], Critically Endangered [EPBC Act]);
- FCT SCP21c - Low lying *Banksia attenuata* woodlands or shrublands (Priority 3 [DPaW]);
- FCT SCP22 - *Banksia ilicifolia* woodlands (Priority 3[DPaW]);
- FCT SCP24 - Northern Spearwood shrublands and woodlands (Priority 3[DPaW]); and
- Muchea Limestone – Shrubland and woodlands on Muchea Limestone (Endangered [WC Act], Endangered [EPBC Act]).

One PEC buffer was recorded within the north-western portion of the Study Area (Figure 10):

- SCP22: *Banksia ilicifolia* woodlands (Priority 2).

Statistical analysis would need to be undertaken to determine if SCP22 exists within the north-western portion of the site.

Although the database search did not identify "*Banksia* dominated woodlands of the Swan Coastal Plain IBRA region", Banksia woodlands are now all listed as Priority 3 ecological communities and have been nominated to become a federally listed TEC under the EPBC Act. The nomination is currently being assessed by the Department of the Environment (DotE) and the threatened species scientific committee. The key feature of these *Banksia* woodlands is the presence of *Banksia attenuata* and/or *B. menziesii* occurring on deep sands. A number of vegetation associations within the Study Area are likely to be considered Priority 3 based on the presence of *Banksia spp*. (for example BaEt and BaRi within Lot 131 Jandakot Road have recently been considered Priority 3).

None of the flora and vegetation assessments undertaken over the Study Area identified the presence of any TECs or PECs within any vegetation associations, except for the newly listed "*Banksia* dominated woodlands of the Swan Coastal Plain IBRA region".

3.7 Terrestrial Fauna

A number of fauna surveys have been undertaken over the Study Area. These include the following:

- Level 1 Fauna Survey for Lot 821 Armadale Road, Banjup by PGV Environmental in 2012;
- Targeted Carnaby's Black Cockatoo and Graceful Sun Moth Fauna Surveys for Lots 1 and 86; and
- 8 and Lots 132, 9002 and 9004 Armadale Road, Banjup by RPS in 2010.

The fauna survey undertaken for Lot 1(previously Lot 821) identified that the Southern Brown Bandicoot has been spotted in Bush Forever Site No. 390 (PGV Environmental 2012). No conservation significant fauna species were identified during the site visit for this Lot. The fauna survey for the Calleya Estate identified that the site is likely to offer foraging habitat for the Carnaby's Black Cockatoo, however no evidence of their nesting or foraging was noted during the survey (RPS 2011).

3.7.1 Threatened and Priority Fauna

A 5km radial DPaW NatureMap Fauna Search and DotE PMST was undertaken from the centre of the Study Area (Appendix C) (DPaW 2016b; DotE 2016). The NatureMap Report identified four Threatened fauna species, one fauna species listed as Other Specially Protected fauna and one Priority 1 fauna species, one Priority 3 fauna species, three Priority 4 fauna species and two Priority 5 fauna species. It also identified 13 fauna species protected under international agreement as occurring within 5 km of the site.

The PMST identified nine Threatened fauna species and 18 Migratory species as occurring within 5 km of the site.

The DPaW NatureMap database search results are based on recorded occurrences of individuals and are considered more site specific and more accurate than the PMST that often returns modelled distributions of species.

The likelihood of each of the fauna species occurring within the site is shown in Appendix E. The likelihood assessment found that the site is likely to offer suitable habitat for the following fauna species:

- Forest Red-tailed Black Cockatoo (Threatened under the WC Act and EPBC Act);
- Baudin's Black Cockatoo (Threatened under the WC Act and EPBC Act);
- Carnaby's Cockatoo (Threatened under the WC Act and EPBC Act);
- Rainbow Bee-eater (Migratory and Marine under the EPBC Act);
- Perth Slider (Listed as Priority 3 by DPaW); and
- Southern Brown Bandicoot (Listed as Priority 3 by DPaW).

All wetland and marine species have not been considered in the likelihood assessment as the proposed development will not impact on any marine or wetland habitat. The Study Area contains a number of wetlands, however these will be retained with appropriate buffers.

3.8 Conservation Areas and Linkages

3.8.1 Bush Forever Site 390

Remnant native vegetation within Lots 131 and 467 Jandakot Road and Lots 4, 140 and 820 Armadale Road is mapped as being part of Bush Forever Site 390, also known as Fraser Road Bushland, Banjup (Figure 11) (DoP 2014b).

In accordance with SPP 2.8, Bush Forever Site 390 falls under the 'Bush Forever Area (BFA) - Urban, industrial and resource development' site implementation category. The policy recognises that regionally significant bushland in this category is constrained by existing commitments, approvals and policies. Therefore, development proposals should seek to achieve a reasonable balance between conservation and development or resource extraction through a negotiated outcome which has regard for the specific conservation values involved. (WAPC 2010)

3.8.2 Jandakot Regional Park

A DPaW conservation estate 'Jandakot Regional Park' is located within Lot 140 Jandakot Road of the Study Area (Figure 11). Jandakot Regional Park comprises a mosaic of land from the southern end of Jandakot Airport to south of Casuarina Prison. Beeliar Regional Park exists as close as 2.6 km east of the Study Area. A DPaW managed land 'Forestdale Lake Nature Reserve' exists 3.6 km south east of the Study Area (Figure 11).

3.8.3 Regional Ecological Linkages

Remnant native vegetation within the site is part of two regional ecological linkages (No. 46 and 47) which connects Bush Forever Site 389 to the north with Bush Forever Site 344 to the south and Bush Forever Site 344 to the south east. The retention of native vegetation and fauna habitat within the regional ecological linkages aims to reduce the loss of biodiversity and key ecological functions across the South West (Molly *et al*. 2009).

3.9 Cultural Heritage

3.9.1 Aboriginal Heritage

A search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Information System (AHIS) identified three 'Other Heritage Places' and no 'Registered Sites' within the Study Area (DAA 2016) (Figure 12). Information about each of the Aboriginal Heritage Places within the Study Area is described below:

- '**Banjup Calsil**': Place ID. 3301 associated with artefacts/scatter. The status of the place is 'Stored Data/Not a Site', which means it has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972*;
- '**Readymix Sandpit 1**': Place ID. 4108 associated with artefacts/scatter. The status of the place is 'Lodged Site', which means it has not been determined whether or not it meets Section 5 of the *Aboriginal Heritage Act 1972*; and
- '**Camp Site**': Place ID. 18752 associated with artefacts/scatter. The status of the place is 'Lodged Site', which means it has not been determined whether or not it meets Section 5 of the *Aboriginal Heritage Act 1972*.

The closest 'Registered Site' is Kraemer Reserve (Place ID: 21811), which is approximately 1.1 km to the south of the Study Area. This site is registered due to its mythological significance. A number of other 'Registered Sites' surround the Study Area as shown on Figure 12.

3.9.2 Non-Aboriginal Heritage

A search of the State Heritage Office database identified the presence of one State Heritage Place in the south-eastern corner of the Study Area (SHO 2016) (Figure 12):

- '**Banjup Memorial Park**': Place No. 10162 listed under the Municipal Inventory. The significance of Banjup Memorial Park is associated with the men from the district who enlisted in World War I. It has social significance for the Returned and Services League (RSL) and the descendants of those men commemorated. Banjup Memorial Park has aesthetic value as a designed small park set within a natural bush area (SHO 2016).

Another State Heritage Place exists directly to the south of the Study Area (Figure 12):

- '**Armadale/Fremantle Rail Armadale Road to Cockburn**': Place No. 24582 listed under the Municipal Inventory. The place has historic value due to the opening of the railway from Perth to Armadale. The selection of Armadale as the point to join the line to Fremantle further opened the district to the transport of its agricultural and timber products and the movement of passengers along the Armadale-Fremantle route (SHO 2016). The place has scientific value as an archaeological research and teaching site due to its potential to expose wider information about railway works associated with the construction of railways in Western Australia at the start of the 20th Century (SHO 2016).

3.10 Potential Contamination

A search of the DER's Contaminated Sites Database did not identify any contaminated sites present within the site (DER 2016). It must be noted that the DER contaminated sites database only shows three of the seven classifications that may be placed on a site. Sites that have been decontaminated; were found not to be contaminated; are possibly

contaminated; and 'reports not substantiated' are not shown on the database. However contaminated sites that require remediation; have a restricted use; or have been remediated for a restricted use are shown on the database.

The closest contaminated site is directly to the east of Warton Road outside of the Study Area (843 Warton Rd, Piara Waters). This contaminated site is listed as 'Contamination-remediation required' due to unauthorised disposal of asbestos wastes (DER 2016).

Another contaminated site occurs approximately 575 m to the west of the Study Area (1001 Prinsep Road, Jandakot). This contaminated site is listed as 'Remediated for restricted use' due to Zinc in the soil exceeding Ecological Investigation Levels and hydrocarbons in the soil exceeding Health-based Investigation Levels for commercial and industrial sites (DER 2016).

The lots within the Study Area that have undergone sand extraction activities have the potential to be contaminated as a result of chemical and hydrocarbon storage and spills. The parts of the Study Area that have undergone contamination investigations are discussed below:

3.10.1 Lot 4 Armadale Road

A Detailed Site Investigation (DSI) was undertaken on Lot 4 by Engtech Risk Consultants (ERC) in 2014. An intensive soil and groundwater investigation was undertaken at the site which concluded that the majority of the site appears to be un-impacted by historical site operations (ERC 2014).

However, the DSI found a number of generally isolated areas of soil contamination, or "hotspots", were found to exist across the southern half of the site extending from near surface impacts to deeper impacts closer to the groundwater (ERC 2014). These impacts are primarily attributed to:

- Former fuel storage infrastructure to the south of the former plant buildings;
- Isolated surface hydrocarbon spills or other minor surface contamination events at random locations across the site; and
- Demolition of the plant itself (residual asbestos containing material) or the presence of historical fill materials that came into contact with asbestos or hydrocarbon contamination during the historical operations of the site.

In addition the two artificial water bodies that exist on site and have previously been used as effluent ponds act as a potential pathway for groundwater contamination.

The previous operator of the site (Boral Pty Ltd) is currently undertaking remediation in consultation with a contaminated sites auditor and the DER. This issue will be managed in consultation with the DER in accordance with the requirements of the *Contaminated Sites Act 2003*. Once the remediation work has been completed by Boral and the site is appropriately classified under the *Contaminated Sites Act 2003* the site will be transferred to Perron.

3.10.2 Calleya Estate LSP Area

RPS undertook a Preliminary Site Investigation (PSI) in 2010 to assess the contamination status of the site. The investigation found the following potential sources of contamination and associated contaminants of concern (RPS 2011):

- Mining and extractive industry- trace metals, hydrocarbons, acids, alkalis and organise flocculants;
- Asbestos Containing Material (ACM)- asbestos;
- Electrical buildings- Polychlorinated biphenyls (PCBs);
- Unknown fill material at sediment pond location- ACM, trace metals, hydrocarbons and pesticides;
- Spent drum- trace metals and hydrocarbon;
- Demolished buildings- ACM and organochlorine pesticides used for termite treatment;
- Demolished waste bund at Washing Plant- trace metals;
- Fertiliser use- trace metals and nutrients; and
- Demolished fuel storage area- hydrocarbons and trace metals.

4 Potential Impacts and Management Measures

4.1 Conservation Areas and Ecological Linkages

4.1.1 Potential Impacts

Based on 360 Environmental's review of the conservation areas and ecological linkages within and adjacent to the Study Area, the following conclusions are provided:

- Remnant native vegetation within Lots 131 and 467 Jandakot Road and Lots 4, 140 and 820 Armadale Road is mapped as being part of Bush Forever Site 390, also known as Fraser Road Bushland, Banjup (Figure 13) (DoP 2014). Bush Forever Site No. 390 is approximately 171.8 ha in area. Of this, the DSP proposes to retain 162. 9 ha (approximately 95%) as POS;
- Approximately 10.5 ha within Lot 131 is proposed to be developed for residential purposes, of which approximately 40% (4.2 ha) is comprised of vegetation condition that is mapped as 'Completely Degraded'. It should be noted that approximately 47% of the Bush forever area proposed to be developed has been previously cleared as a result of past sand quarrying activities and poorly rehabilitated (4.9 ha). Remnant native vegetation within the site forms part of two ecological linkages (No. 46 and 47) which connects Bush Forever Site 389 to the north with Bush Forever Site 344 to the south and Bush Forever Site 344 to the south east; and
- A DPaW conservation estate 'Jandakot Regional Park' is located within Lot 140 Jandakot Road of the Study Area (Figure 11).

In light of the above conclusions, the potential environmental impacts on conservation areas and ecological linkages from future development of the Study Area include:

- Clearing of terrestrial vegetation within Bush Forever Site No. 390;
- Introduction and distribution of weed species;
- Habitat fragmentation;
- Uncontrolled access;
- Bushfire risk as a result of increased human activity within the Study Area; and
- Hydrological changes.

4.1.2 Management Response

4.1.2.1 Public Open Space Allocation and Design

In order to achieve a balance between environmental and planning outcomes for the DSP, the proposed POS areas were derived as a result of the following key considerations:

1. The current Bush Forever mapping includes land that has been historically cleared of native vegetation and quarried for sand and therefore, does not belong in Bush Forever.
2. Application of the current Bush Forever boundary will result in an area that is impractical to manage from a conservation perspective and present a significant risk in terms of bushfire management.
3. From a planning perspective, the current Bush Forever boundary within Lot 131 will also result in a highly compromised urban development form that will undermine some of the benefits of master planned development and integration of landuse, environmental and transport planning in this location.
4. Consolidation of POS with the key objective being to conserve remnant vegetation and conservation significant flora (*Caladenia huegelii*) within the Calleya Estate, Lot 82 and Lot 131 will result in a consolidated and manageable conservation reserve. This establishes not only a highly manageable and substantially sized reserve area, but also creates a rational boundary which allows the integration of development between the Calleya Estate and future development east of the estate. The integration will allow coordinated road connections, joint access to shops and schools and the establishment of a functional neighbourhood district.
5. Linear east-west open space along the south of Lot 131 and north of Lot 4 will connect with the state-owned 98 ha Bush Forever reserve located in the western portion of the site.
6. Retention of the 17.5 ha of wetland and Bush Forever landholding in the eastern portion of Lot 131 provides a north-south connection in addition to the east-west connection established along the southern boundary.
7. Following preliminary consultation with the Department of Planning, the Office of the EPA and the DPaW the proposed POS area within Lot 131 was increased to include an additional 1.8 ha (that is not within Bush Forever), of which approximately 90% (1.6 ha) is comprised of vegetation that is mapped as being in 'Excellent' condition.

4.1.2.2 Bush Forever Impact Assessment Process

In accordance with SPP 2.8, Bush Forever Site No. 390 falls under the 'Bush Forever Area (BFA) - Urban, industrial and resource development' site implementation category. The policy recognises that regionally significant bushland in this category is constrained by existing commitments, approvals and policies. Therefore, development proposals

should seek to achieve a reasonable balance between conservation and development or resource extraction through a negotiated outcome which has regard for the specific conservation values involved (WAPC 2010).

Given the above any proposed MRS rezoning of areas within the DSP that may result in unavoidable impacts on regionally significant bushland within Bush Forever Site No. 390 will result in an impact assessment being undertaken. The impact assessment will be done in accordance with the process outlined in Appendix 1 of SPP 2.8 and the framework outlined in Figure A.

The primary purpose of this impact assessment will be to inform

- The development of a statement of environment effect (guided by Appendix 1 of SPP 2.8);
- The development of a Bush Forever offsets package that will provide a net environmental outcome; and
- Assist in any future negotiated outcome over the final boundary for Bush Forever Site No. 390.

Provision of a Bush Forever offsets package will lead to a positive net environmental outcome. There are opportunities to provide an offset package through the addition of remnant vegetation (outside of Bush Forever) on site, purchase of vegetated land and the rehabilitation of land in the immediate vicinity to achieve an appropriate offset ratio, which will be determined through the application of Appendix 4 of SPP 2.8 and in consultation with the Department of Planning and Office of the EPA.

Please refer to the following sections regarding the proposed management responses specific to terrestrial flora, vegetation, fauna and wetlands, but relevant to the conservation areas and ecological linkages within the Study Area.

4.2 Terrestrial Flora and Vegetation

4.2.1 Potential Impacts

Based on the terrestrial flora and vegetation review, the following conclusions are provided:

- One conservation significant flora species has been found to occur within the Study Area, *Caladenia huegelii,* that is Threatened under the *Wildlife Conservation Act 1950* (WC Act) and *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). The majority of the known population will be retained in Bush Forever, POS and road reserves. The individuals located in the remnant vegetation along Fraser Road will be retained in the future road reserve for Lot 1 (Previously Lot 821). The individuals in Lot 131 will be retained in POS and thus there are no *Caladenia huegelii* within Lot 131 that are proposed to be cleared. All known *Caladenia huegelii* within Bush Forever Site 390 are to be retained. The individuals in

the Calleya Estate (identified by the DPaW database search) appear to be retained in POS along the eastern boundary of the LSP area.

It is likely that only three currently known individuals of *Caladenia huegelii* will be cleared within Lot 4 as a result of developing the DSP area. Three locations of *C. huegelii* occur outside of the Bush Forever site in a small (0.8 ha) patch of remnant vegetation in Lot 4 (Figure 13). The patch of remnant vegetation is approximately five metres above the surrounding landscape due to the extraction of sand around it and is considered to be isolated from other remnant vegetation on a local scale. Given these factors, retaining the patch of remnant vegetation as part of the development is considered to be impractical; and

- None of the Flora and Vegetation assessments undertaken over the Study Area identified the presence of any TECs or PECs within any vegetation associations except for the newly listed Priority 3 "*Banksia* dominated woodlands of the Swan Coastal Plain IBRA region".

Therefore, in light of the above conclusions the key potential environmental impacts on terrestrial flora and vegetation from future development of the Study Area include:

- Clearing of terrestrial vegetation within Bush Forever Site No. 390;
- Impacts on *Caledenia heueglii*;
- Introduction and distribution of weed species;
- Unnecessary clearing;
- Uncontrolled access;
- Bushfire risk as a result of increased human activity within the Study Area; and
- Hydrological changes.

4.2.2 Management Response

Potential environmental impacts to flora and vegetation will be addressed at subsequent stages of planning using the mitigation sequence (i.e. avoidance, minimised, rectify, reduce, offset) and through the implementation of the following environmental management measures:

- Retention of remnant vegetation by placing a substantial portion of Bush Forever Site No.390 within regional and local POS across the DSP area (approximately 95% of Bush Forever 390 is proposed to be retained). However, approximately 10.5 ha within Lot 131 is proposed to be developed for residential purposes, of which approximately 40% (4.2 ha) is comprised of vegetation condition that is mapped as being 'Completely Degraded'. Additionally, approximately 47% (4.9 ha) of the Bush Forever area that is

proposed to be developed has been previously cleared as a result of past sand quarrying activities and poorly rehabilitated;

- Within Lot 131, approximately 1.8 ha (that is not currently within Bush Forever) is proposed to be included within the POS, of which approximately 90% (1.6 ha) is comprised of vegetation that is mapped as being in 'Excellent' condition;
- The proposed POS areas will be fenced off and contain appropriate fire breaks and emergency vehicle access and gates;
- Consideration will be given to ceding the POS areas (for conservation purposes) to the DPaW for conservation in perpetuity. These areas may be added to the Jandakot Regional Park conservation system;
- Establishment of POS areas will maintain an east west ecological link through the Study Area;
- Relocation of individual *Caladenia huegelii* to Jandakot Regional Park or to the POS proposed within the DSP. Advice will be sought from orchid cultivation experts within the WA Botanic Gardens and Parks Authority to determine the most appropriate approach to relocating the orchids;
- Overarching Open Space Masterplan, which will guide and co-ordinate the future management requirements and vesting of regional and local POS areas within the Study Area;
- Vegetation Management Plan;
- Bushfire Management Plan;
- Local Water Management Strategy; and
- Urban Water Management Plan.

It should be noted that a referral of the proposed development was made under the EPBC Act to the Department of the Environment (DotE) in November 2013 due to the proposal to clear three locations of *C. huegelii* within Lot 4, and in relation to the potential for the clearing to impact on black cockatoos. On the 16 December 2013, the proponent received notification from the DotE referral decision received on the referral was 'not a controlled action'. A copy of this correspondence has been provided in Appendix B.

4.3 Terrestrial Fauna

4.3.1 Potential Impacts

Based on the terrestrial fauna review, the following conclusions are summarised:

- One conservation significant fauna, the Southern Brown Bandicoot, has been identified in Bush Forever Site No. 390;

- The fauna survey for the Calleya Estate identified that the site is likely to offer foraging habitat for the Carnaby's Black Cockatoo, however no evidence of their nesting or foraging was noted during the survey;
- The likelihood assessment undertaken as part of the terrestrial fauna review found that the site is likely to offer suitable habitat for the following fauna species:
    - Forest Red-tailed Black Cockatoo (Threatened under the WC Act and EPBC Act);
    - Baudin's Black Cockatoo (Threatened under the WC Act and EPBC Act);
    - Carnaby's Cockatoo (Threatened under the WC Act and EPBC Act);
    - Rainbow Bee-eater (Migratory and Marine under the EPBC Act);
    - Perth Slider (Listed as Priority 3 by DPaW); and
    - Southern Brown Bandicoot (Listed as Priority 3 by DPaW).

The remainder of species identified on site or potentially occurring on site were not considered likely to be impacted due to their ability to move away from disturbances.

Therefore, in light of the above conclusions the key potential environmental impacts on terrestrial fauna from future development of the Study Area include:

- Animal deaths during the clearing process and the destruction of burrows and retreat sites;
- Habitat removal;
- Habitat fragmentation;
- Bushfire risk as a result of increased human activity within the Study Area;
- An increased abundance of introduced species (cats and wild dogs); and
- Road fauna deaths.

4.3.2 Management Response

Potential environmental impacts to terrestrial fauna will be addressed at subsequent stages of planning using the mitigation sequence (i.e. avoidance, minimised, rectify, reduce, offset) and through the implementation of the following environmental management measures:

- Retention of remnant vegetation and fauna habitats by placing a substantial portion of Bush Forever Site No.390 within regional and local POS across the DSP area (approximately 95% of Bush Forever 390 is proposed to be retained). However, approximately 10.5 ha within Lot 131 is proposed to be developed for residential purposes, of which approximately 40% (4.2 ha) is comprised of vegetation condition that is mapped as being 'Completely

Degraded'. It should be noted that approximately 47% (4.9 ha) of the Bush Forever area that is proposed to be developed has been previously cleared as a result of past sand quarrying activities and poorly rehabilitated;

- Within Lot 131, approximately 1.8 ha (that is not currently within Bush Forever) is proposed to be included within the POS, of which approximately 90% (1.6 ha) is comprised of vegetation that is mapped as being in 'Excellent' condition;
- Establishment of POS areas will maintain an east west corridor of connected habitat for fauna;
- Potential impacts to the black cockatoos as a result of clearing within the DSP area will be mitigated by placing a large portion of habitat on site in POS, as well as on-site retention and planting and provision of an offset, if deemed necessary;. It is anticipated that following finalisation of the Green Growth Plan there may be the application of a new approach for environmental offsets. The Green Growth Plan proposes to implement a Conservation Program which will assist the Western Australian Government in meeting the overall conservation outcomes, objectives and commitments for MNES and State environmental values by implementing a range of conservation actions, and establishing environmental offset requirements;
- Overarching Open Space Masterplan, which will guide and co-ordinate the future management requirements and vesting of regional and local POS areas within the Study Area;
- Vegetation Management Plan;
- Undertake Terrestrial Fauna Survey (if required i.e. within areas proposed to be cleared and outside of the existing biological survey areas);
- Terrestrial Conservation Significant Fauna Management Plan (if required); and
- Bushfire Management Plan.

As previously stated, a referral of the proposed development within Lot 4 was made under the EPBC Act to the DotE in November 2013 due to the potential impact to the black cockatoos. On the 16 December 2013, the proponent received notification from the DotE referral decision received on the referral was 'not a controlled action'. A copy of this correspondence has been provided in Appendix B.

4.4 Hydrological Processes

4.4.1 Potential Impacts

Based on the hydrology review, the following conclusions are summarised (JDA 2016):

- The Study Area is hydrologically unconstrained with free draining sandy soils, clearance to groundwater, moderate to low risk of ASS and no regional surface water features;
- The primary constraint to future development is the P1 and P2 water protection zone which covers a portion of the Study Area. Urban development is not a compatible land use within P1 or P2 areas; and
- Should any future MRS amendment process conclude that it is acceptable to rezone the land to 'Urban' or 'Urban deferred' under the MRS, the P2 water protection zone will be reclassified to P3. With certain controls in place, development is compatible with a P3 classification.

The Calleya Estate has been reclassified to P3 and Lot 1 (previously Lot 821) has been recently rezoned to 'Urban' under the MRS and will subsequently be reclassified to P3.W

Potential impacts to hydrology within the Study Area include:

- Groundwater level changes that occur as a result of a change in landuse. Residential development in the site will potentially increase recharge of rainfall into groundwater through increased surface area of residential roofs, driveways, car parks, and roads; and
- The creation of residential gardens and POS areas may lead to a minor increase in the amount of nitrates and phosphates being discharged into the groundwater.

4.4.2 Management Response

Within the Study Area, a number of water management documents have been prepared in accordance with the Better Urban Water Management Guidelines (WAPC 2008). These include:

- DWMS for the Calleya Estate LSP Area by Emerson Stewart Consulting in 2011;
- LWMS for the Calleya Estate LSP Area by Emerson Stewart Consulting in 2013;
- DWMS for Lot 821 Armadale Road, Banjup by Hyd2o in 2013; and
- DWMS for Lots 2 and 4 Armadale Road, Banjup by JDA Hydrology Consultants in 2015.

4.4.2.1 Strategic District Water Management Strategy

A Strategic District Water Management Strategy (SDWMS) has been prepared by JDA Consultant Hydrologists for the DSP area. The SDWMS has been prepared to provide a coordinating framework and guide the key requirements for water sensitive urban design. The SDWMS demonstrates that the Study Area can support urban development and best practice urban water management. (JDA 2016)

To limit any potential impacts associated with urban development the SWDMS lists the following initiatives that will be applied (JDA 2016):

- Extension of deep sewer to all lots;
- Application of water sensitive urban design principles including at-source stormwater infiltration, rain gardens and water harvesting;
- Appropriate road design and treatments to minimise the risk of high speed car collisions (which might result in oil or petrol spillage);
- Provision of lot types which maximise land use efficiency and reduce excessive garden area and hence fertiliser and pesticide use;
- Encourage home purchasers to use native plants for landscaping (which will also reduce fertiliser and pesticide use);
- Use of promotional information to land purchasers aimed at raising awareness of water issues;
- An on-going monitoring programme; and
- Exclusion of high risk land uses from the development area (e.g. service station).

4.4.2.2 Local Water Management Strategy

Furthermore, the above potential impacts to surface water and groundwater will be addressed in further detail through the preparation of a LWMS for each LSP area.

The LWMS will be prepared to meet the following objectives:

- Interpretation of the local geology and hydrogeology to provide the foundation for the above-ground design constraints and opportunities;
- Define the water balance for pre- and post-development scenarios to demonstrate maintenance of rainfall recharge to the Jandakot Mound superficial aquifer;
- Identify groundwater contamination source and pathway risks, and mitigate those risks through planning and engineered design;
- Conceptually design stormwater treatment to prevent impact at stormwater infiltration to groundwater or flood water discharge to Forrestdale Lake;
- Report modelling of contamination risk pathways through surface water and hydrogeology model 'particle tracking' based on the site investigation results, urban development scenarios and stormwater design;
- Outline regional scale water demand conservation strategies;
- Engineering design of contamination controls to operate a 50 year asset life; and

- Promote the utilisation of Water Sensitive Urban Design (WSUD) at or beyond best practice where possible at every stage of the total water cycle management system, recognising that this is a benchmark project.

4.4.2.3 Urban Water Management Plan

An Urban Water Management Plan will be prepared and submitted to support the lodgement of the Subdivision Applications within the DSP area with consultation with the City of Cockburn and DoW in accordance with the Better Urban Water Management Guidelines (WAPC, 2008). The UWMP will include landscaping plans, engineering drawings, the final layout plan and any additional environmental and geotechnical information that is available.

4.5 Wetlands

4.5.1 Potential Impacts

The Study Area contains three REWs and one CCW (Figure 7). Potential impacts to wetlands within the Study Area include:

- Introduction and distribution of weed species;
- Uncontrolled access;
- Changes to wetland hydrology;
- Increase in level of nutrients and pollutants entering wetlands through surface water Runoff from driveways, carparks and roads; and
- Bushfire risk as a result of increased human activity within the Study Area.

4.5.2 Management Response

Potential environmental impacts to terrestrial fauna will be addressed at subsequent stages of planning using the mitigation sequence (i.e. avoidance, minimised, rectify, reduce, offset) and through the implementation of the following environmental management measures:

- Retention of wetlands within regional and local POS areas within the DSP;
- Provision of appropriately sized buffers for the wetlands. These will be defined at Local Structure Planning stage through consultation with the City of Cockburn and the DPaW;
- Overarching Open Space Masterplan;
- Wetland Management Plan;
- Bushfire Management Plan;
- Local Water Management Strategy; and
- Urban Water Management Plan.

It should be noted that the artificial water bodies within the site are not natural wetlands and will be in-filled during the development. Infilling the water bodies would ideally be undertaken in summer when water levels tend to be at their lowest.

4.6 Acid Sulfate Soils

4.6.1 Potential Impacts

The Study Area is mapped by the DER as being of "moderate to low risk of ASS". It is understood that the areas proposed for development will require fill and therefore, it is not anticipated that ASS will be disturbed as part of the proposed construction works.

4.6.2 Management Response

If ASS soil is identified as occurring on site, a Preliminary Site Assessment will be undertaken to determine the presence and extent of ASS in accordance with the DER guidelines. Depending upon the results of the preliminary assessment, an ASS Assessment and Dewatering Management Plan will be prepared. This plan will be approved for implementation by the DER prior to any ground disturbing works continuing.

4.7 Contamination

4.7.1 Potential Impacts

The lots within the Study Area that have undergone sand extraction activities have the potential to be contaminated as a result of chemical and hydrocarbon storage and spills. Contamination studies over parts of the Study Area (Lot 4 and Calleya Estate) have identified contamination relating primarily to fuel, asbestos containing material and trace metals.

4.7.2 Management Response

Boral Pty Ltd is responsible for the ongoing testing and remediation of the isolated hydrocarbon spill on Lot 4 within the Study Area. The previous operator of the site (Boral Pty Ltd) is currently undertaking testing and remediation in consultation with a contaminated sites auditor and the DER and it is considered that this issue will be dealt with in a manner consistent with the requirements of the *Contaminated sites Act 2003*.

It is unknown whether further contamination investigations were undertaken within the Calleya Estate since the PSI in 2010. However, the PSI undertaken within the LSP area recommended that further investigations should be considered to assess the nature, extent and magnitude of contamination (if present) in the soil and groundwater.

It is recommended that a PSI be undertaken at Lot 131 and Lot 1 (previously Lot 821) prior to development to assess the contamination status of the site. Historical land uses may have resulted in contamination of the land.

4.8 Aboriginal Heritage

4.8.1 Potential Impacts

The Study Area does not contain any 'Registered Sites' that are listed under Section 5 of the *Aboriginal Heritage Act 1972*. Aboriginal Place ID: 3301 that covers a substantial portion of the south-eastern part of the site is classified as 'Stored Data/Not a Site' which means it has been assessed as not meeting Section 5 of the *Aboriginal Heritage Act 1972*. The two other Aboriginal Places within the Study Area (ID: 4108 and ID: 3300) area classified as 'Lodged Sites' which means it has not been determined whether or not they meet Section 5 of the *Aboriginal Heritage Act 1972*.

4.8.2 Management Response

The client will liaise with the DAA prior to development to determine any responsibilities under the *Aboriginal Heritage Act 1972*.

In the event that any future planning approval involves activities that will result in the disturbance of sites, then consent for these activities (and prior to any ground disturbing activities being undertaken) will be sought through Section 18 of the *Aboriginal Heritage Act 1972*.

4.9 Non-Aboriginal Heritage

4.9.1 Potential Impacts

The State Heritage Place 'Banjup Memorial Park' within the south-eastern portion of the site will not be disturbed as part of the future development as it will be retained within POS.

4.10 Construction Impacts and Management

Construction activities will require management in order to minimise the potential impacts to adjacent residents, retained vegetation, fauna and wetlands.

Potential impacts can include the following:

- Nuisance dust generation during bulk earthworks;
- Potential disturbance of ASS during earthworks and/or installation of services;
- Silt and sediment run-off from uncontrolled run-off during site works;
- Inadvertent damage to trees and other vegetation earmarked for retention;
- Injury and/or death to native fauna; and
- Inappropriate disposal of waste building material and poor housekeeping on building sites leading to windblown litter.

All of these potential impacts are considered to be manageable through appropriate engineering design and appropriate site management practices. Furthermore, management of these potential impacts will be detailed in the Vegetation Management Plan/s and Wetland Management Plan/s for the protection of existing vegetation and wetland areas during construction, and through the provision of standard subdivision approval conditions.

4.11 Surrounding Land Uses and Buffers

4.11.1 Sand Quarry

The site contains three active mining tenements for sand quarries within Lot 467 Jandakot Road and Lot 140 Armadale Road. An active sand quarry also exists to the north of Lot 131. The Draft EPA *Environmental Assessment Guideline for Separation distances between industrial and sensitive land uses* recommends a separation distance of between 300-500 m for sand extraction industries and sensitive land uses based on noise and dust impacts (EPA 2015). As the Study Area is at the early district structure planning stage it is expected that the sand quarries will be closed by the time residential development commences. However, if the sand quarries are still active when this occurs, then appropriate noise and dust studies will be undertaken to ensure future development within the recommended separation distances is environmentally acceptable.

4.11.2 Jandakot Airport

The boundary of Jandakot Airport exists as close as 445 m north of the Study Area (Jandakot Airport Holdings Pty Ltd 2014).

For the purpose of assessing land use planning implication on land surrounding airports, the following types of noise chart indicators are used (Jandakot Airport Holdings Pty Ltd 2014):

- **Australian Noise Exposure Forecast (ANEF)** – It is the official land use planning reference and only one ANEF can be in force at a particular time. Under the Airports Act 1996, the Jandakot Airport's ANEF is required to be updated at least every five years, in conjunction with the Master Plan update;
- **Noise Above Contour (N60/65/70) charts** – These charts calculate the average daily noise events above 60,65 or 70 decibels (dBA). The contours represent the frequency of the expected aircraft noise impact. For the general public, it provides a more readily understood measure of noise exposure.

The ANEF and Noise Above Contour for the Jandakot Airport are shown in the most recent Master Plan (Jandakot Airport Holdings Pty Ltd 2014).

Pursuant to the adopted *State Planning Policy 5.3: Land Use Planning in the Vicinity of Jandakot Airport* (SPP 5.3), the DSP area complies with policy provisions for residential housing as it sits outside the 20 ANEF contour (Figure 13), which is identified as being

'Acceptable' for all building types. Furthermore, the Study Area is within the SPP 5.3 'Frame Area' that residential development is compatible with.

5 Conclusions

Based on the high-level review undertaken, the following key environmental issues are identified:

- Terrestrial flora and vegetation;
- Terrestrial fauna; and
- Hydrological process.

Future development, in accordance with the DSP, will deliver the following key environmental outcomes:

- Provision of regional and local POS areas will result in establishing a consolidated, highly manageable and substantially sized reserve within the Study Area;
- Provision of a Bush Forever offsets package, which will lead to a positive net environmental outcome;
- Linear east-west open space along the south of Lot 131 and north of Lot 4 will connect with the state-owned 98 ha Bush Forever reserve located in the western portion of the site;
- Retention of the 17.5 ha of wetland and Bush Forever landholding in the eastern portion of Lot 131 provides a north-south connection in addition to the east-west connection established along the southern boundary;
- Development and implementation of an Open Space Masterplan and subsequent environmental management plans (i.e. Vegetation Management Plan, Wetland Management and Bushfire Management Plan) will ensure the long-term management and viability of the proposed conservation areas; and
- Application of water management initiatives and a framework to the guide future development of the site to ensure water sensitive urban design is achieved (i.e. LWMS and UWMP).

Other environmental issues (such as wetlands, acid sulfate soils, potential contamination, etc) are capable of being resolved (i.e. avoided or managed) through site-specific investigations and detailed engineering drainage design. Therefore, a key conclusion of this environmental assessment report is that, based on the review undertaken and the environmental outcomes proposed by the DSP and future land use planning, none of the key environmental issues pose a significant constraint to future residential development of the Study Area.

6 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

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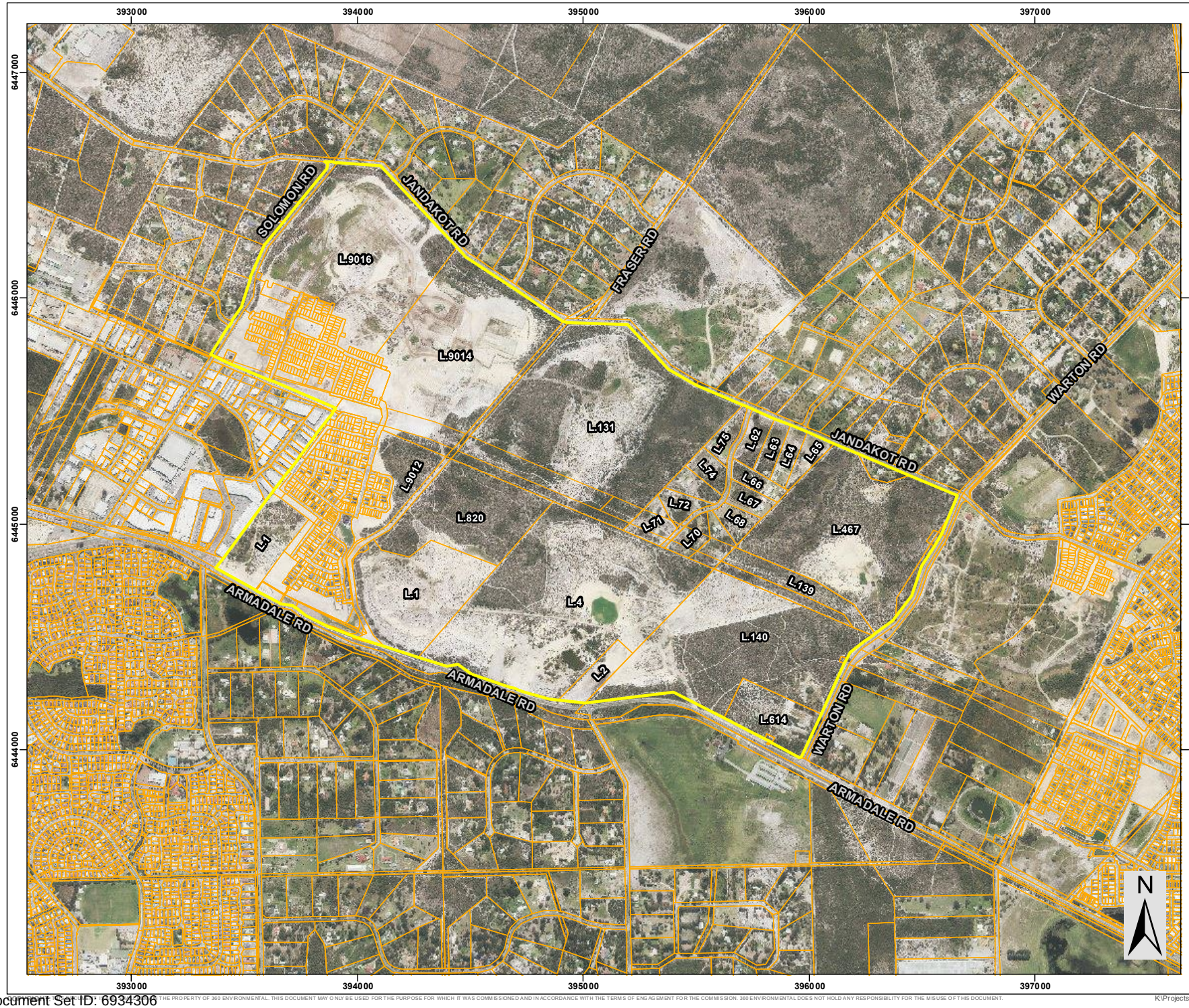
FIGURES



Legend

- District Structure Plan Boundary (461.54 ha)
- Cadastre

NOTE:
L. indicates 'Lot'

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- CADASTRE SOURCED LANDGATE VIA SLIP 6 APRIL 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE SEPT 2015
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360 environmental
a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
w www.360environmental.com.au

0 200 400 600 800
Meters
1:22,500 @ A4

LOCALITY MAP

PROJECT ID	DATE
1405	06-Apr-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

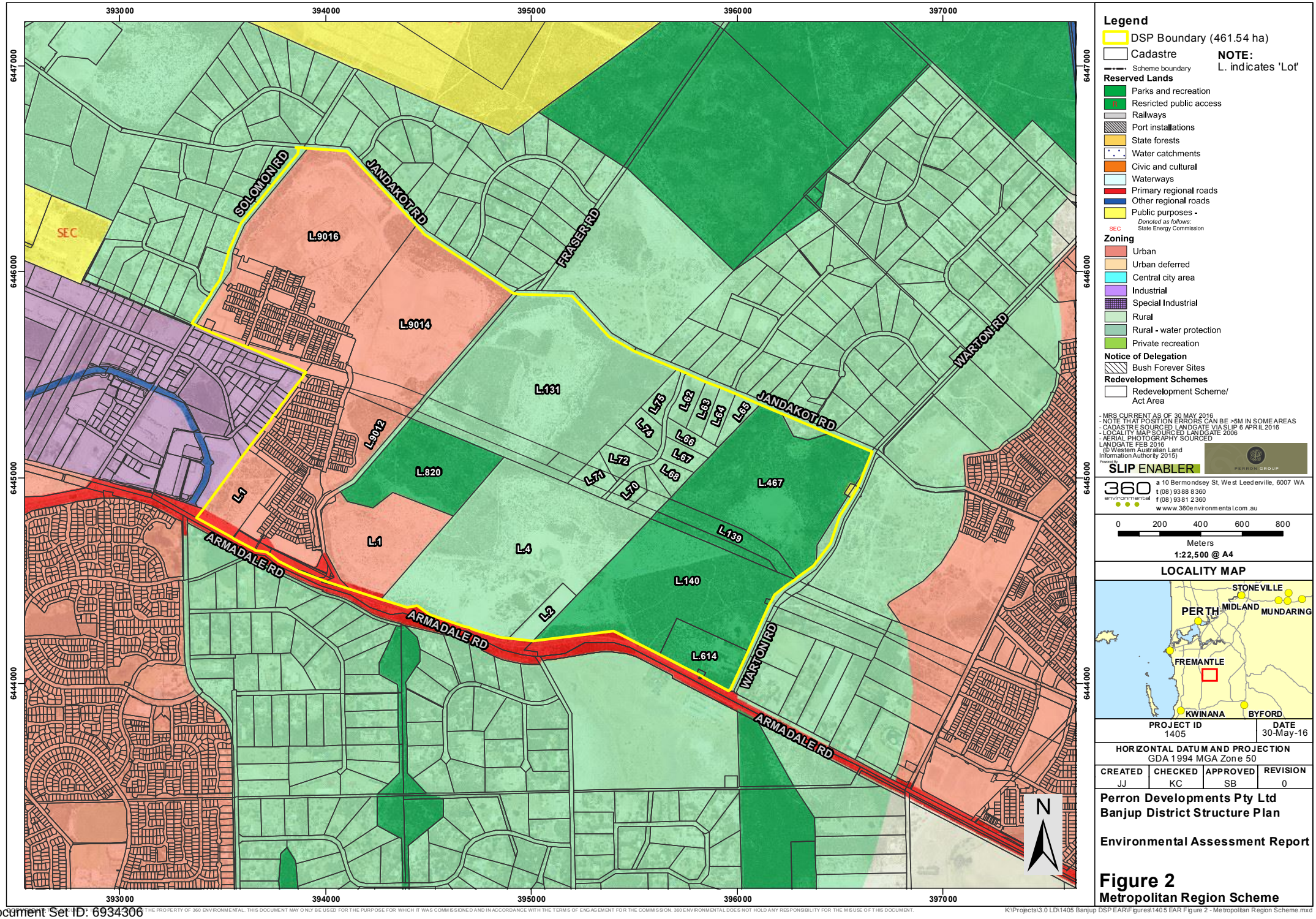
CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

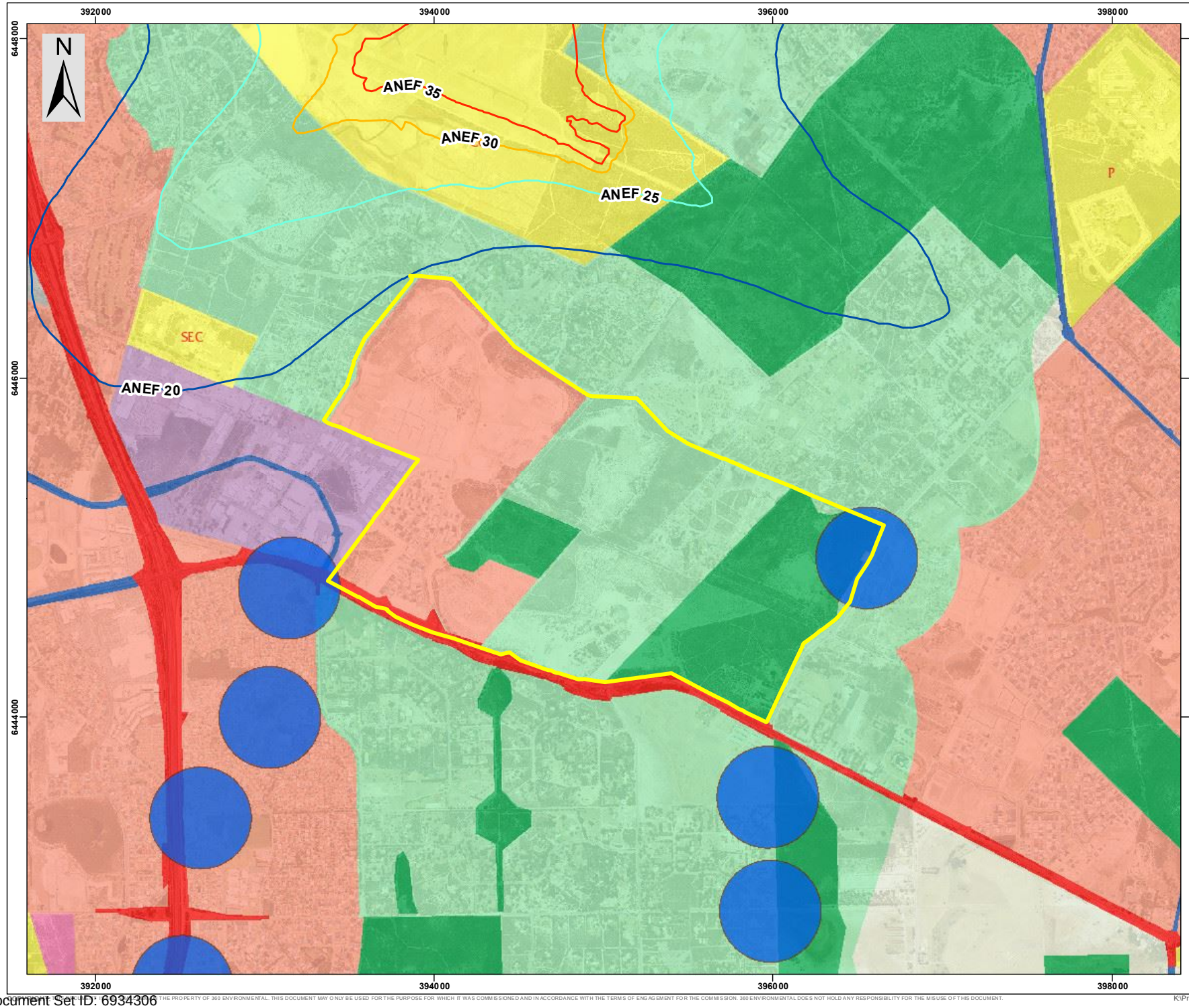
Environmental Assessment Report

Figure 1
Site Location

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 1 - Site Location.mxd



K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 2 - Metropolitan Region Scheme.mxd



Legend

- DSP Boundary (461.54 ha)
- Wellhead Protection Buffer

Jandakot Airport Ultimate Capacity ANEF[1]

- 20 ANEF
- 25 ANEF
- 30 ANEF
- 35 ANEF

MRS Zones and Reserves

- Industrial
- Other regional roads
- Parks and recreation
- Primary regional roads
- Public purposes[2]
- Railways
- Rural
- Rural - water protection
- Urban
- Urban deferred

NOTE:

1. ANEF: Australian Noise Exposure Forecast
2. CG - Commonwealth Government, P - Prison, SEC - State Energy Commission, WSD - Water Authority of WA

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- JANDAKOT ANEF SOURCED FROM JANDAKOT AIRPORT (AIR SERVICES 2014), MRS SOURCED 2015
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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LOCALITY MAP

PROJECT ID	DATE
1405	30-May-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC/RH	SB	0

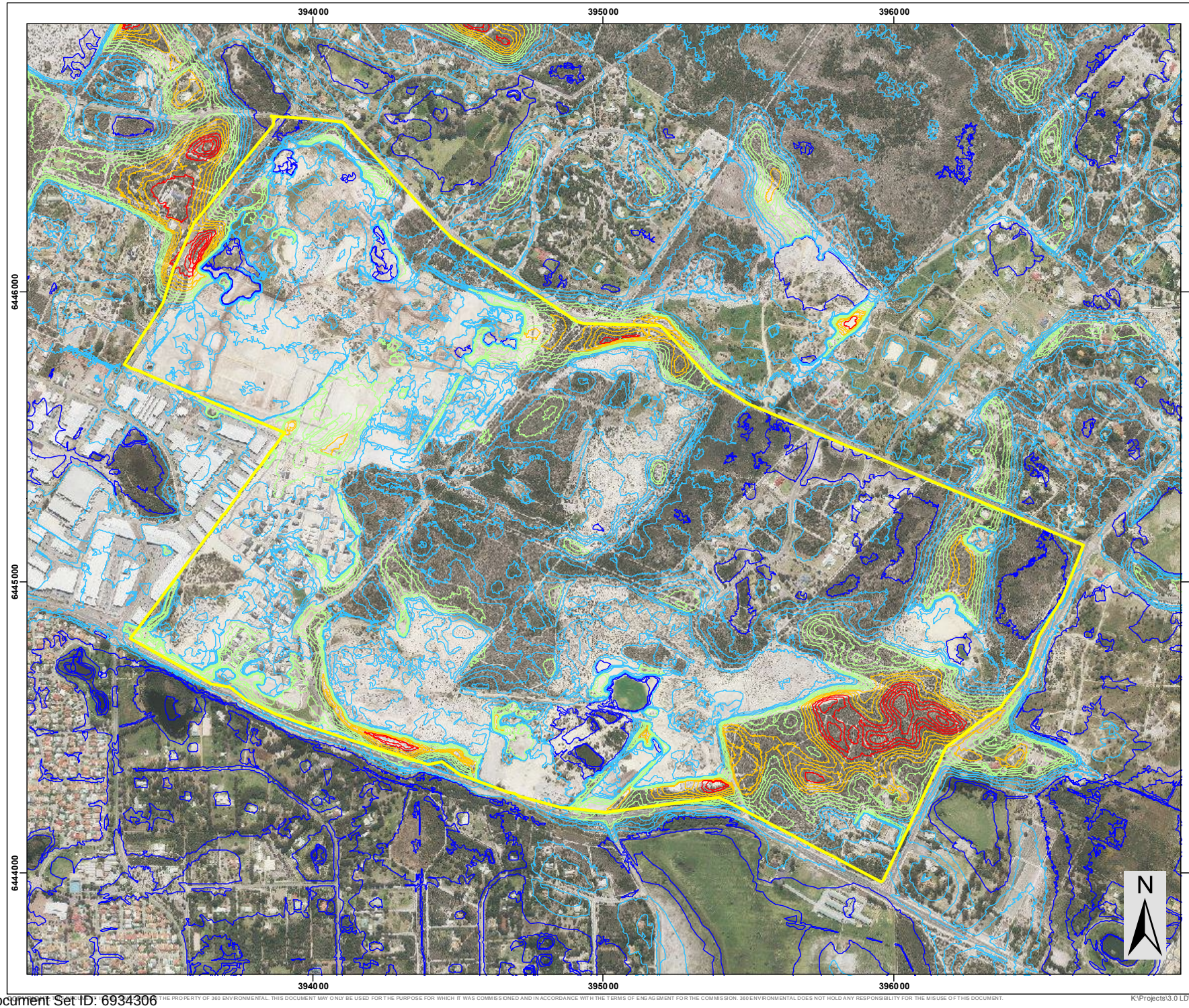
Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 3

Surrounding Land Uses and Buffers

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 3 - Buffers.mxd



Legend

District Structure Plan Boundary (461.54 ha)

Elevation Contours (mAHD)

- 24 - 28
- 28 - 32
- 32 - 36
- 36 - 40
- 40 - 45

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ELEVATION SOURCED DOW 2015
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE SEPT 2015

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LOCALITY MAP

PROJECT ID	DATE
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HORIZONTAL DATUM AND PROJECTION
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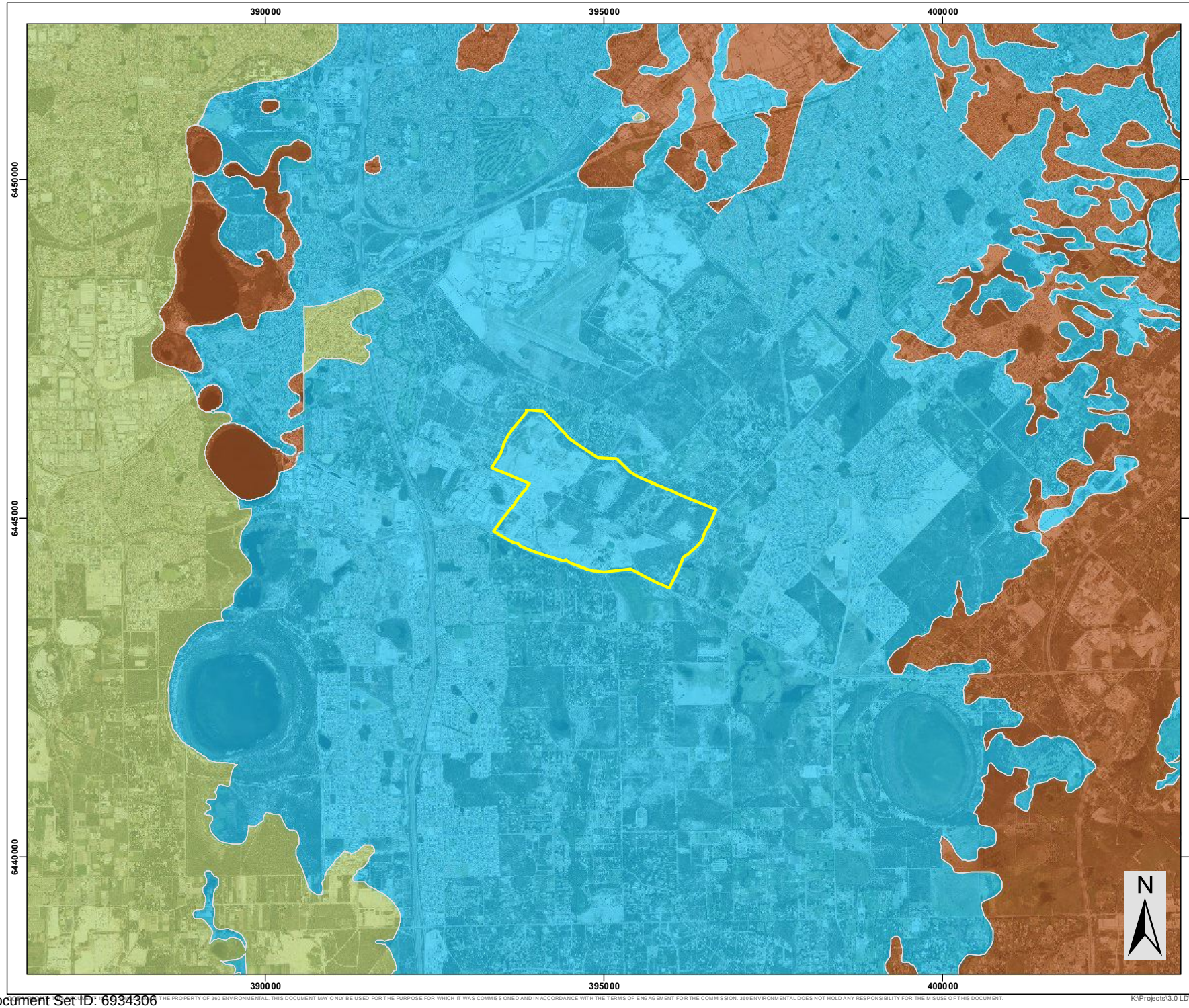
Figure 4
Topography

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 5 - Landforms and Soils.mxd



Legend

District Structure Plan Boundary (461.54 ha)

Soil Landscapes

Bassendean System: Swan Coastal Plain from Busselton to Jurien. Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths.

Pinjarra System: Swan Coastal Plain from Perth to Capel. Poorly drained coastal plain with variable alluvial and aeolian soils. Variable vegetation includes Jarrah, marri, wandoo, paperbark sheoaks and rudis.

Spearwood System: Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/brown shallow sands.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SOIL LANDSCAPES SOURCED DAFWA 2012
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE SEPT 2015

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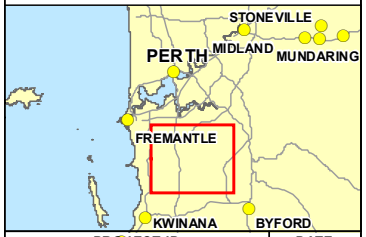
LOCALITY MAP



PROJECT ID	DATE
1405	06-Apr-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

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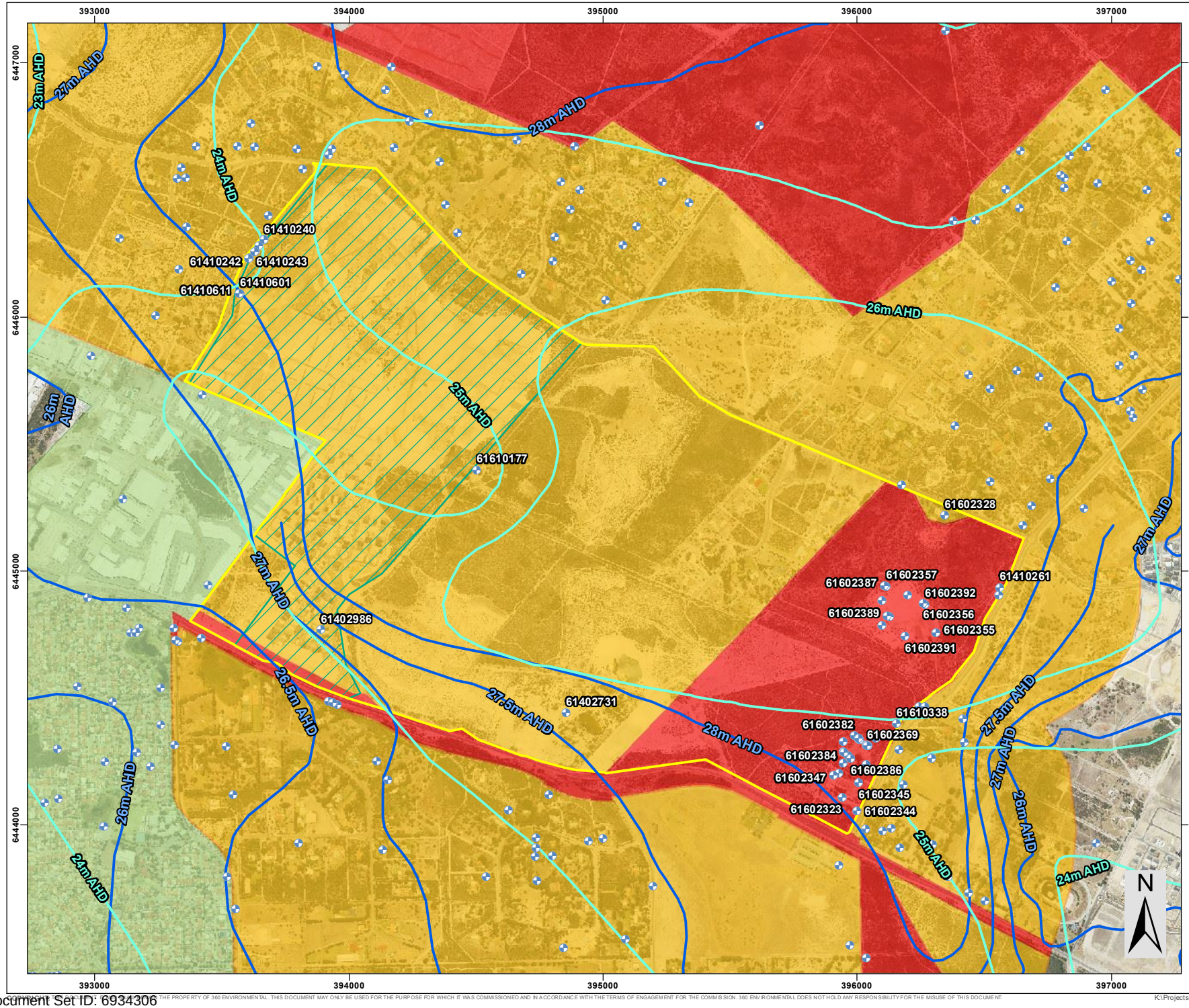
Figure 5
Landforms and Soils

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 5 - Landforms and Soils.mxd



Legend

- District Structure Plan Boundary (461.54 ha)
- Groundwater WIN Bore
- Groundwater Contour (Hist. Max)
- Groundwater Contour (Hist. Min)

Public Drinking Water Source Areas (PDWSA)

- P1 symbology
- P2 symbology
- P3 symbology
- Downgraded to P3 under Draft SPP2.3

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- PDWSA, GW CONTOURS AND WIN BORES SOURCED DOW 2012
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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LOCALITY MAP

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Environmental Assessment Report

Figure 6
Groundwater

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 5 - Groundwater.mxd

Legend

- District Structure Plan Boundary (461.54 ha)
- Directory of Important Wetlands

Surface Water Features

- Area Subject to Inundation
- Drain - major
- Earth Dam
- Swamp - perennial

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- DIWA SOURCED DOTE 2016
- SURFACE WATER FEATURES SOURCED DOW 2012
- GEOMORPHIC WETLANDS SOURCED DPAW JAN 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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LOCALITY MAP

PROJECT ID	DATE
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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
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Banjup District Structure Plan

Environmental Assessment Report

Figure 7
Hydrology and Wetlands

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 6 - Hydrology and Wetlands.mxd

393500 394000 394500 395000 395500 396000 396500

6446500 6446000 6445500 6445000 6444500 6444000

Mp EtEmBaBm EtEmBaBm EtEmBaBm Mp RR RR RR RR RR RR RR RR Cleared EtEmBaBm CD BaEt BaEt BaRi BaEt BaRi BaEt CD EtEmBaBm Ri BaEt Ri Rehab EtEmBaBm RR RR Mp Mp CD KgMp BaMp BaEt Ri MpHa BaEt EtEmBaBm RR RR RR BaBm BaBm BaBm Rehab BaBm Rehab BaBm Cleared MpBi BmBaEmLOW EtEmBaBm BmBaEmLOW Cleared BaBm BaBm BaEmEf BaEmEf Cleared OW Rehab Ba NN Cleared BmAfLOW BmAfLOW BaBm BaBm NN OW Pe MpBmBa CD BaBm Pe/Ss MpAa Ss CD BaBm AcHa CD MpBmBa

Legend

District Structure Plan Boundary

Survey Areas

- Lot 4 Armadale Road, Banjup
- Lot 467 Jandakot Road, Banjup
- Lot 1 (Previously Lot 821) Armadale Road, Banjup
- Lot 131 Jandakot Road, Banjup
- Calleya Estate LSP Area

Lot 4 Armadale Road
- Ba
- BaBm
- BaBmEf
- MpBi
- NN
- OW
- Rehab
- Cleared

Lot 467 Jandakot Road
- AcHa
- BaBm
- MpAa
- MpBmBa
- Pe
- Pe/Ss
- Ss
- CD

Lot 1 (Previously Lot 821) Armadale Road
- BmAfLOW
- BmBaEmLOW
- Cleared

Lot 131 Jandakot Road
- BaEt
- BaMp
- BaRi
- KgMp
- MpHa
- Ri
- Rehab
- CD

Calleya Estate LSP Area
- EtEmBaBm
- Mp
- RR
- Cleared

- VEGETATION ASSOCIATION SOURCED RPS 2011, RPS 2013, ENV 2013, PGV ENVIRONMENTAL 2013 AND 360 ENVIRONMENTAL 2015, SUPPLEMENTED WITH CURRENT CLEARED EXTENTS (AERIAL IMAGERY FEB 2016)
- LOCALITY MAP SOURCED FROM LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

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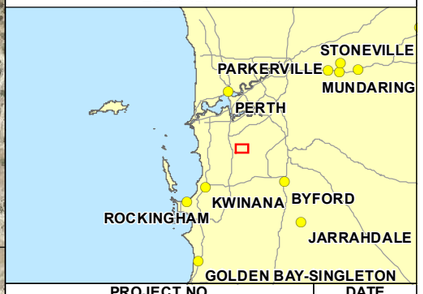
LOCALITY MAP



PROJECT NO	DATE
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GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	RH	SB	0

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Banjup District Structure Plan

Environmental Assessment Report

Figure 8
Consolidated Vegetation Units

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 7 - Vegetation Units.mxd

393500 394000 394500 395000 395500 396000 396500

6446500 6446000 6445500 6445000 6444500 6444000

Legend

District Structure Plan Boundary

Survey Areas

- Lot 1 (Previously Lot 821) Armadale Road, Banjup
- Lot 131 Jandakot Road, Banjup
- Lot 4 (ENV 2013)
- Lot 467 Jandakot Road, Banjup
- Calleya Estate LSP Area

Consolidated Vegetation Condition

- E: Excellent
- VG-E: Very Good to Excellent
- VG: Very Good
- G-VG: Good to Very Good
- G: Good
- G-D: Good to Degraded
- D and D/R: Degraded and/or Degraded/Rehab
- CD-D: Completely Degraded to Degraded
- CD: Completely Degraded
- N/A: Open Water

- VEGETATION ASSOCIATION SOURCED RPS 2011, RPS 2013, ENV 2013, PGV ENVIRONMENTAL 2013 AND 360 ENVIRONMENTAL 2015, SUPPLEMENTED WITH CURRENT CLEARED EXTENTS (AERIAL IMAGERY FEB 2016)
- LOCALITY MAP SOURCED FROM LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

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- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

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LOCALITY MAP

PROJECT NO	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

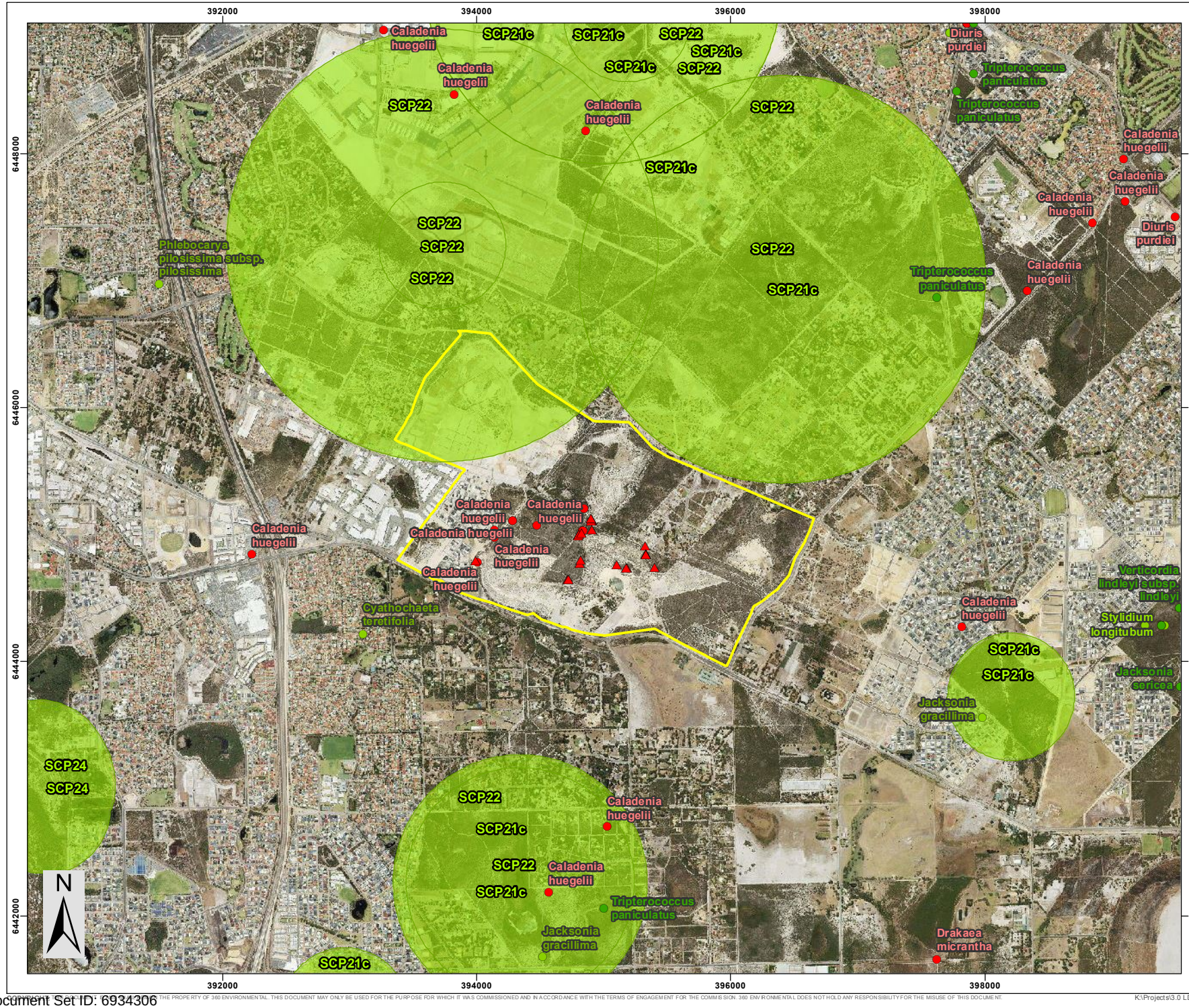
CREATED	CHECKED	APPROVED	REVISION
JJ	RH	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 9
Consolidated Vegetation Condition

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 8 - Vegetation Condition.mxd



Legend

District Structure Plan Boundary (461.54 ha)

Rare and Priority Flora

- Priority 4
- Priority 3
- Priority 2
- Priority 1
- Declared Rare
- *Caladenia huegelii* records (Surveyed)

TECs and PECs

- Priority 4
- Priority 3
- Priority 2
- Priority 1
- Vulnerable
- Endangered
- Critically Endangered

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SURVEYED FLORA LOCATIONS SOURCED ENV 2013, 360 ENVIRONMENTAL 2015 AND PGV ENVIRONMENTAL 2013
- FLORA RECORDS PURCHASED FROM DPAW 20 DEC 2013 (REF 36-1213FL)
- TEC AND PEC DATA PURCHASED FROM DPAW 23 DEC 2013
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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Meters

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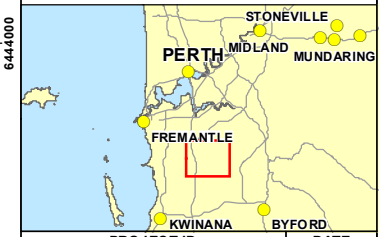
LOCALITY MAP



PROJECT ID	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

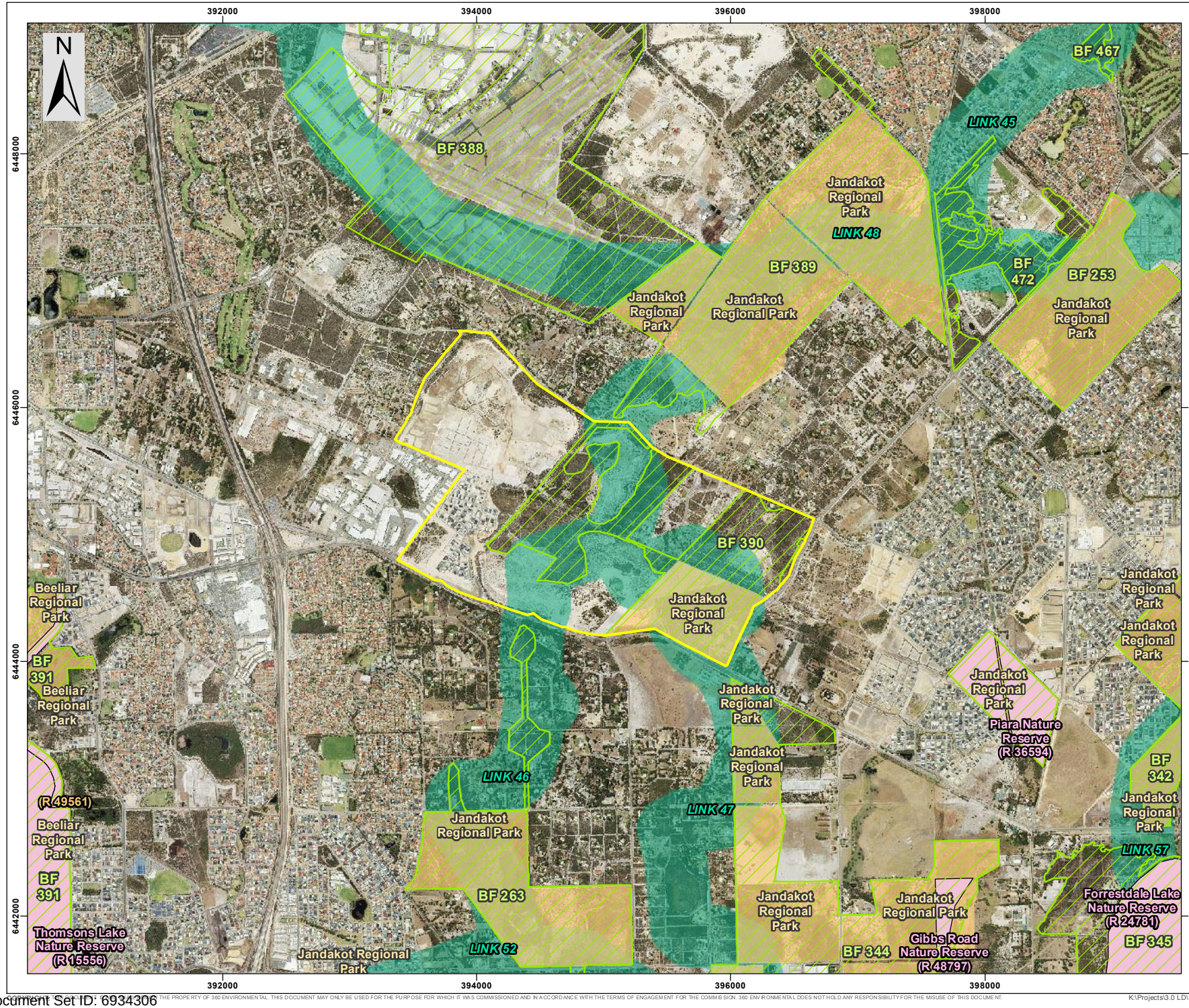
Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 10

Threatened and Priority Flora and Ecological Communities

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 9 - TECPEC and Flora.mxd



Legend

- District Structure Plan Boundary (461.54 ha)
- Bush Forever Sites
- Regional Parks
- Perth Regional Ecological Linkages

DPaW Managed Lands

- Conservation Park
- Nature Reserve

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- BUSH FOREVER SOURCED DOP 2014
- REGIONAL PARKS SOURCED LANDGATE 2015
- ECOLOGICAL LINKAGES SOURCED PBP 2008 (WALGA)
- DPAW LANDS SOURCED DPAW 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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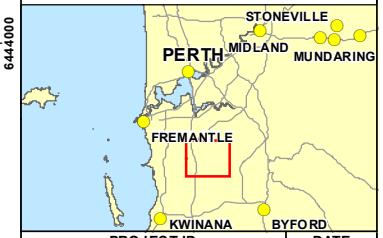
LOCALITY MAP



PROJECT ID	DATE
1405	18-May-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

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Banjup District Structure Plan

Environmental Assessment Report

Figure 11
Conservation Areas

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 10 - Conservation Areas.mxd

Legend

- District Structure Plan Boundary (461.54 ha)
- Municipal Heritage List

Aboriginal Heritage Sites

- Registered Site
- Lodged Site
- Stored Data / Not a Site

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ABORIGINAL HERITAGE SITES SOURCED DAA 2016
- MUNICIPAL LISTING SOURCED INHERIT (SHO) 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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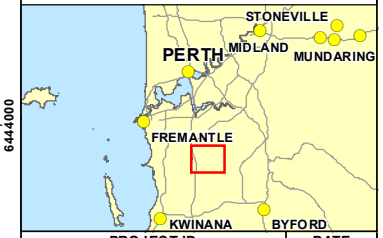
LOCALITY MAP



PROJECT ID	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

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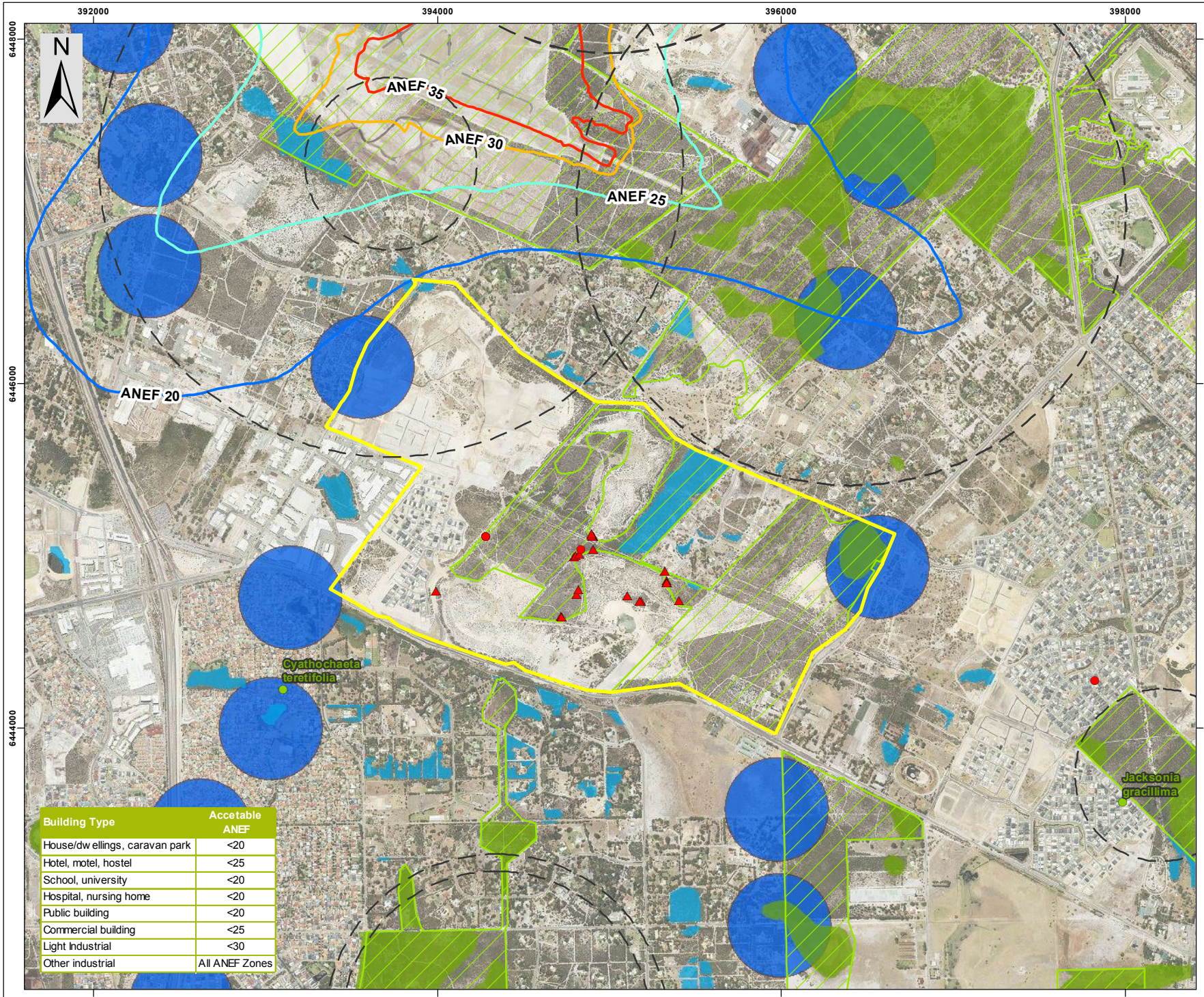
Environmental Assessment Report

Figure 12
Heritage

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 11 - Heritage.mxd



Building Type	Accetable ANEF
House/dw ellings, caravan park	<20
Hotel, motel, hostel	<25
School, university	<20
Hospital, nursing home	<20
Public building	<20
Commercial building	<25
Light Industrial	<30
Other industrial	All ANEF Zones

Legend

- DSP Boundary (461.54 ha)
- CCW
- REW (With Remant Vegetation)
- PEC Buffers
- Bush Forever Sites
- Wellhead Protection Buffer

Jandakot Airport Ultimate Capacity ANEF [1]

- 20 ANEF
- 25 ANEF
- 30 ANEF
- 35 ANEF

Rare and Priority Flora

- Priority 4
- Priority 3
- Priority 2
- Priority 1
- Declared Rare (*C. huegelii*)
- Known *Caladenia huegelii* records (Surveyed)

NOTE:

1. ANEF: Australian Noise Exposure Forecast

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- JANDAKOT ANEF SOURCED FROM JANDAKOT AIRPORT (AIR SERVICES 2014)
- WETLANDS SOURCED DPAW 2016
- PEC BUFFERS AND FLORA SOURCED DPAW 2013 & SURVEYS (SEE FIGURE 7/8)
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

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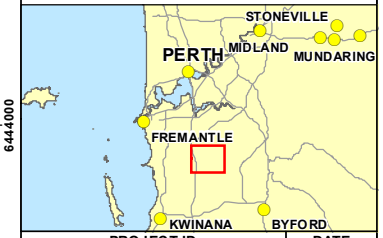
LOCALITY MAP



PROJECT ID	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
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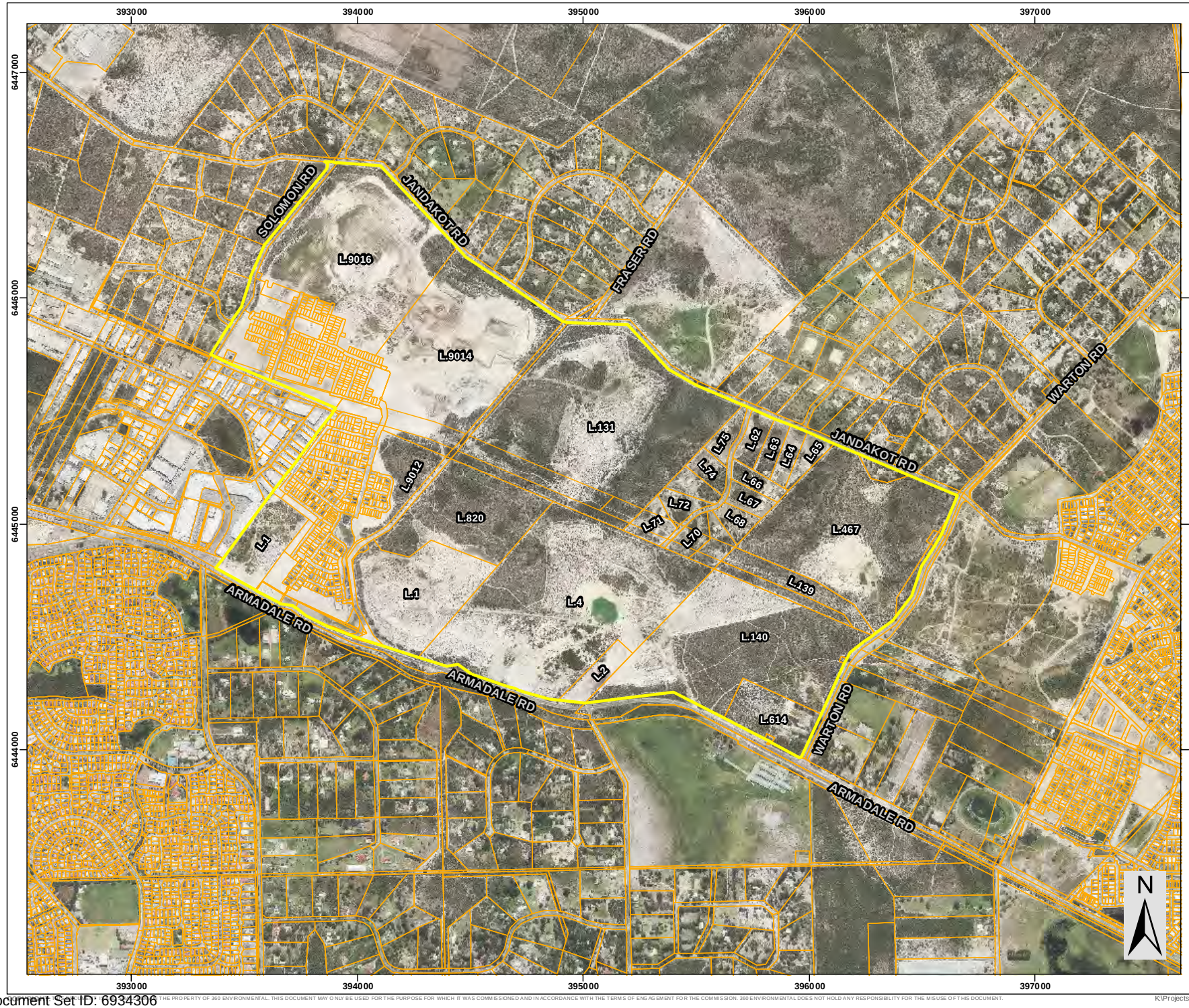
Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 13

Environmental Opportunities and Constraints

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 12 - Opportunities and Constraints.mxd



Legend

- District Structure Plan Boundary (461.54 ha)
- Cadastre

NOTE:
L. indicates 'Lot'

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- CADASTRE SOURCED LANDGATE VIA SLIP 6 APRIL 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE SEPT 2015
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LOCALITY MAP

PROJECT ID	DATE
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HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
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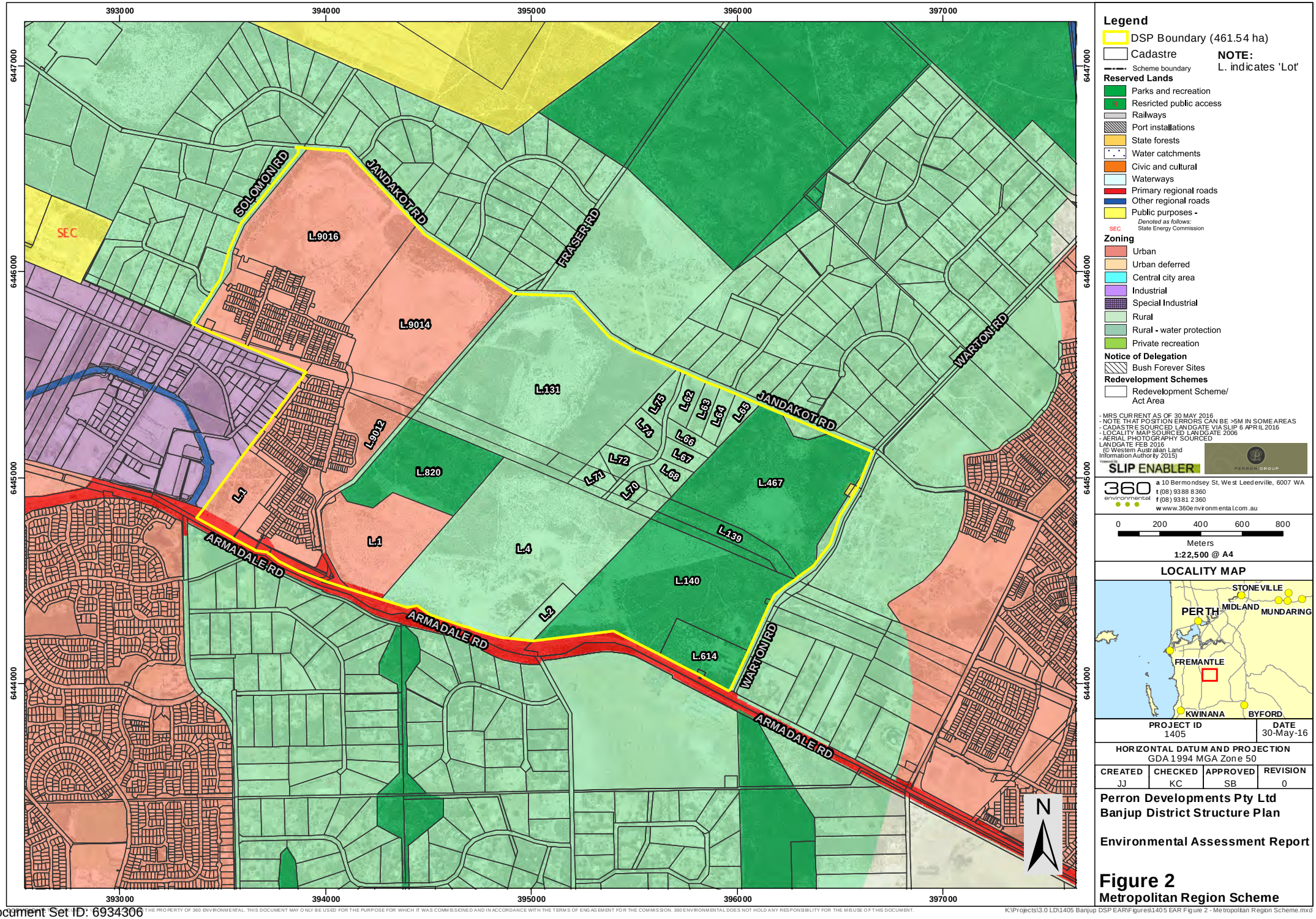
Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 1
Site Location

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 1 - Site Location.mxd



Legend

DSP Boundary (461.54 ha)

Cadastre

Scheme boundary

NOTE: L. indicates 'Lot'

Reserved Lands

- Parks and recreation
- Resricted public access
- Railways
- Port installations
- State forests
- Water catchments
- Civic and cultural
- Waterways
- Primary regional roads
- Other regional roads
- Public purposes -
  Denoted as follows:
  SEC State Energy Commission

Zoning

- Urban
- Urban deferred
- Central city area
- Industrial
- Special Industrial
- Rural
- Rural - water protection
- Private recreation

Notice of Delegation

- Bush Forever Sites

Redevelopment Schemes

- Redevelopment Scheme/ Act Area

- MRS CURRENT AS OF 30 MAY 2016
- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- CADASTRE SOURCED LANDGATE VIA SLIP 6 APRIL 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016 (© Western Australian Land Information Authority 2015)

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LOCALITY MAP

PROJECT ID	DATE
1405	30-May-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

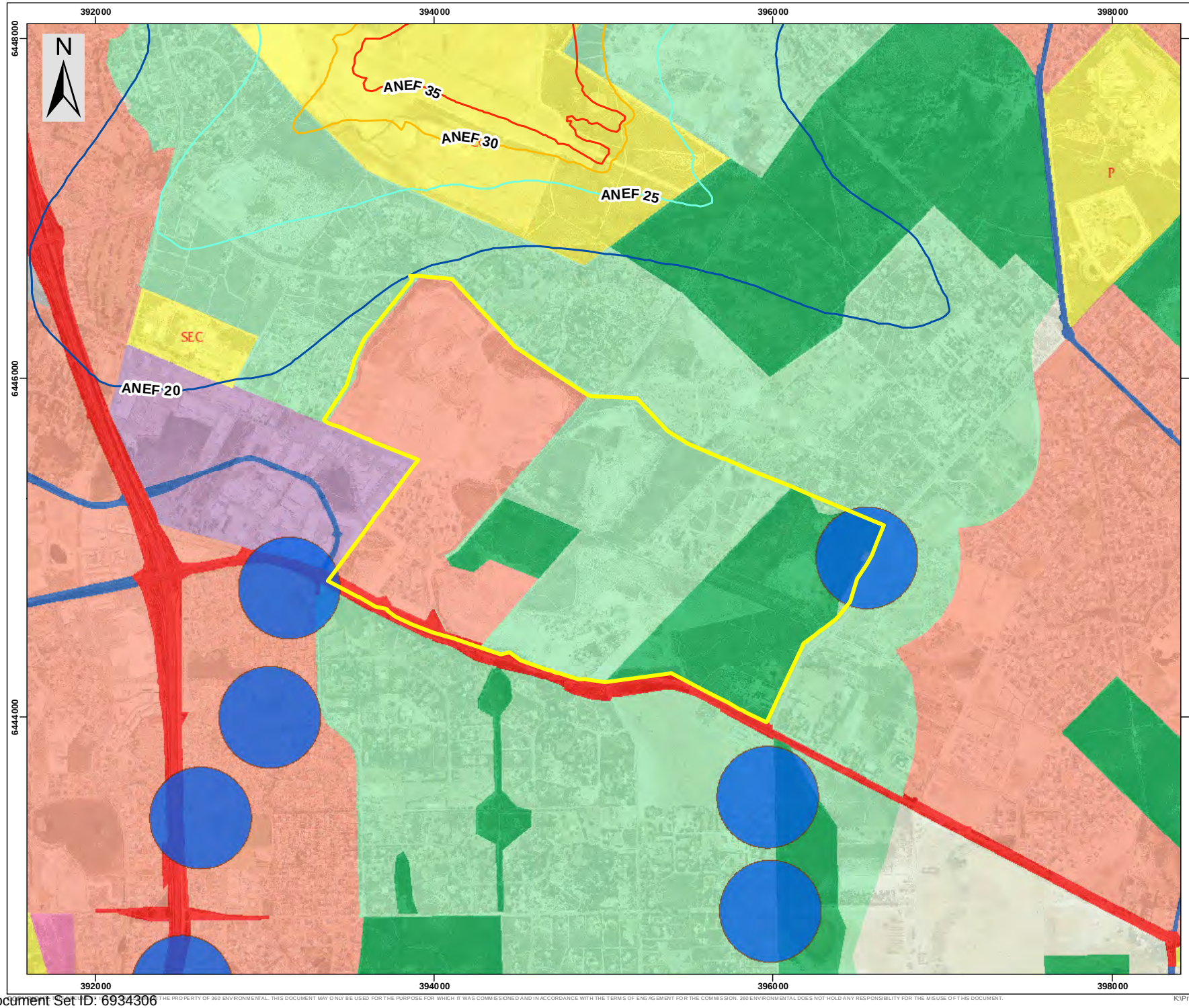
CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 2
Metropolitan Region Scheme

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 2 - Metropolitan Region Scheme.mxd



Legend

- DSP Boundary (461.54 ha)
- Wellhead Protection Buffer

Jandakot Airport Ultimate Capacity ANEF[1]

- 20 ANEF
- 25 ANEF
- 30 ANEF
- 35 ANEF

MRS Zones and Reserves

- Industrial
- Other regional roads
- Parks and recreation
- Primary regional roads
- Public purposes[2]
- Railways
- Rural
- Rural - water protection
- Urban
- Urban deferred

NOTE:

1. ANEF: Australian Noise Exposure Forecast
2. CG - Commonwealth Government, P - Prison, SEC - State Energy Commission, WSD - Water Authority of WA

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- JANDAKOT ANEF SOURCED FROM JANDAKOT AIRPORT (AIR SERVICES 2014). MRS SOURCED 2015
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016
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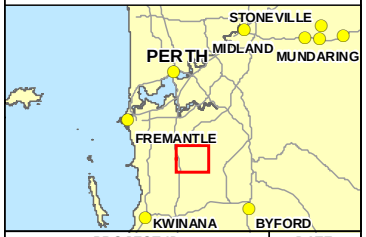
0 200 400 600 800 1,000 1,200
Meters
1:30,000 @ A4

LOCALITY MAP



PROJECT ID	DATE
1405	30-May-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

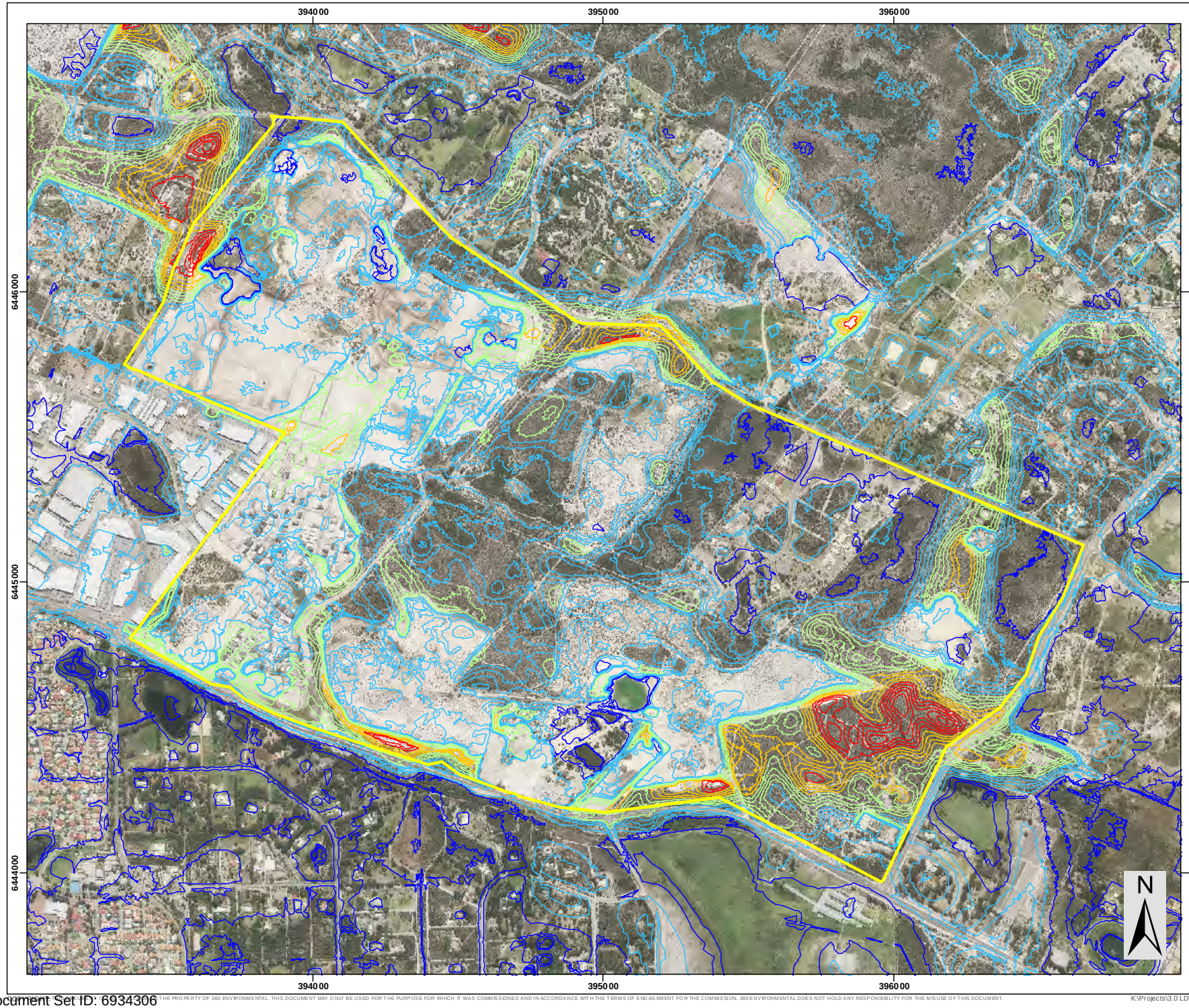
CREATED	CHECKED	APPROVED	REVISION
JJ	KC/RH	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 3
Surrounding Land Uses and Buffers

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 3 - Buffers.mxd



Legend

District Structure Plan Boundary (461.54 ha)

Elevation Contours (mAHD)

- 24 - 28
- 28 - 32
- 32 - 36
- 36 - 40
- 40 - 45

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ELEVATION SOURCED DOW 2015
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE SEPT 2015

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Meters

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LOCALITY MAP

PROJECT ID	DATE
1405	06-Apr-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

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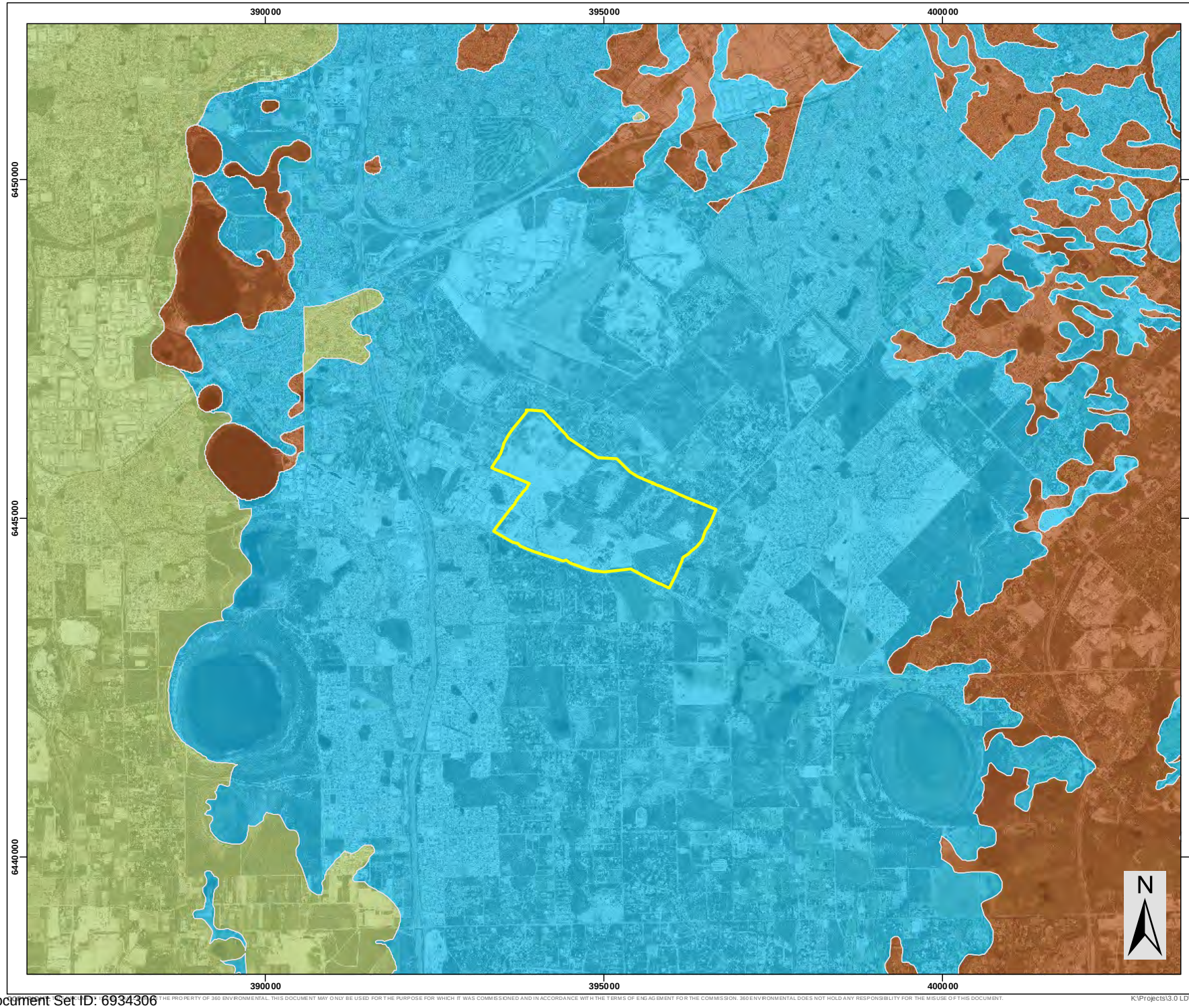
Environmental Assessment Report

Figure 4
Topography

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 5 - Landforms and Soils.mxd



Legend

District Structure Plan Boundary (461.54 ha)

Soil Landscapes

Bassendean System: Swan Coastal Plain from Busselton to Jurien. Sand dunes and sandplains with pale deep sand, semi-wet and wet soil. Banksia-paperbark woodlands and mixed heaths.

Pinjarra System: Swan Coastal Plain from Perth to Capel. Poorly drained coastal plain with variable alluvial and aeolian soils. Variable vegetation includes Jarrah, marri, wandoo, paperbark sheoaks and rudis.

Spearwood System: Sand dunes and plains. Yellow deep sands, pale deep sands and yellow/brown shallow sands.

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SOIL LANDSCAPES SOURCED DAFWA 2012
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE SEPT 2015

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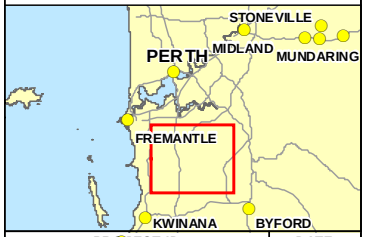
LOCALITY MAP



PROJECT ID	DATE
1405	06-Apr-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

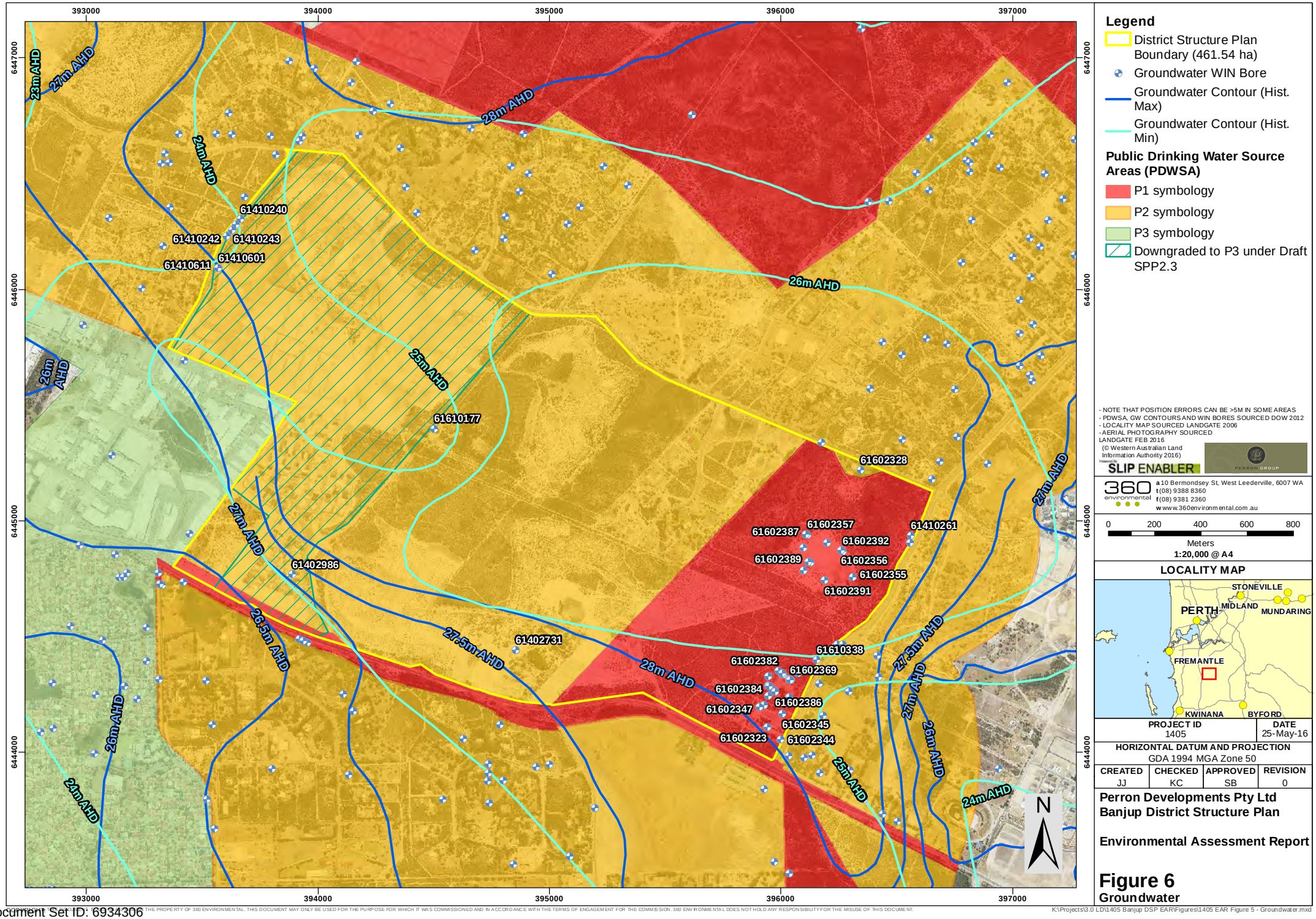
CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 5
Landforms and Soils

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 5 - Landforms and Soils.mxd



Legend

- District Structure Plan Boundary (461.54 ha)
- Groundwater WIN Bore
- Groundwater Contour (Hist. Max)
- Groundwater Contour (Hist. Min)

Public Drinking Water Source Areas (PDWSA)

- P1 symbology
- P2 symbology
- P3 symbology
- Downgraded to P3 under Draft SPP2.3

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- PDWSA, GW CONTOURS AND WIN BORES SOURCED DOW 2012
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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LOCALITY MAP

PROJECT ID	DATE
1405	25-May-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 6
Groundwater

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 5 - Groundwater.mxd

Legend

- District Structure Plan Boundary (461.54 ha)
- Directory of Important Wetlands

Surface Water Features

- Area Subject to Inundation
- Drain - major
- Earth Dam
- Swamp - perennial

Geomorphic Wetlands

- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- DIWA SOURCED DOTE 2016
- SURFACE WATER FEATURES SOURCED DOW 2012
- GEOMORPHIC WETLANDS SOURCED DPAW JAN 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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Meters
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LOCALITY MAP

PROJECT ID	DATE
1405	17-May-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 7
Hydrology and Wetlands

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 6 - Hydrology and Wetlands.mxd

393500 394000 394500 395000 395500 396000 396500

6446500 6446000 6445500 6445000 6444500 6444000

Mp EtEmBaBm EtEmBaBm EtEmBaBm Mp RR RR RR RR RR RR RR RR Cleared EtEmBaBm

CD BaEt BaEt BaRi BaEt BaRi BaEt CD EtEmBaBm BaEt Ri BaEt Ri Rehab KgMp CD BaMp BaEt Ri MpHa

EtEmBaBm RR Mp RR Mp EtEmBaBm

Pe MpBmBa CD BaBm Pe/Ss MpAa BaBm Ss CD AcHa CD MpBmBa

RR RR RR RR BmBaEmLOW EtEmBaBm BmBaEmLOW Cleared

BaBm BaBm BaBm Rehab Rehab BaBm BaBm Cleared MpBi BaBm BaBmEf BaBmEf Cleared OW BaBm NN Ba Rehab Cleared NN OW

BmAfLOW BmAfLOW BaBm BaBm

Legend

District Structure Plan Boundary

Survey Areas

- Lot 4 Armadale Road, Banjup
- Lot 467 Jandakot Road, Banjup
- Lot 1 (Previously Lot 821) Armadale Road, Banjup
- Lot 131 Jandakot Road, Banjup
- Calleya Estate LSP Area

Lot 4 Armadale Road
- Ba
- BaBm
- BaBmEf
- MpBi
- NN
- OW
- Rehab
- Cleared

Lot 467 Jandakot Road
- AcHa
- BaBm
- MpAa
- MpBmBa
- Pe
- Pe/Ss
- Ss
- CD

Lot 1 (Previously Lot 821) Armadale Road
- BmAfLOW
- BmBaEmLOW
- Cleared

Lot 131 Jandakot Road
- BaEt
- BaMp
- BaRi
- KgMp
- MpHa
- Ri
- Rehab
- CD

Calleya Estate LSP Area
- EtEmBaBm
- Mp
- RR
- Cleared

- VEGETATION ASSOCIATION SOURCED RPS 2011, RPS 2013, ENV 2013, PGV ENVIRONMENTAL 2013 AND 360 ENVIRONMENTAL 2015, SUPPLEMENTED WITH CURRENT CLEARED EXTENTS (AERIAL IMAGERY FEB 2016)
- LOCALITY MAP SOURCED FROM LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

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PERRON GROUP

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

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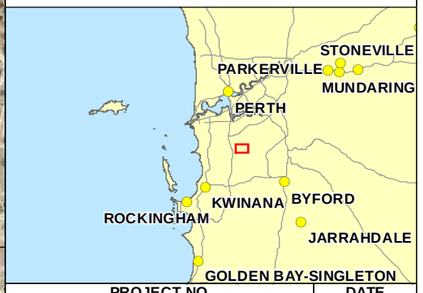
0 100 200 300 400 500

Meters

1:10,000 @ A3

LOCALITY MAP



PROJECT NO	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	RH	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 8
Consolidated Vegetation Units

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 7 - Vegetation Units.mxd

393500 394000 394500 395000 395500 396000 396500

6446500 6446000 6445500 6445000 6444500 6444000

Legend

District Structure Plan Boundary

Survey Areas

- Lot 1 (Previously Lot 821) Armadale Road, Banjup
- Lot 131 Jandakot Road, Banjup
- Lot 4 (ENV 2013)
- Lot 467 Jandakot Road, Banjup
- Calleya Estate LSP Area

Consolidated Vegetation Condition

- E: Excellent
- VG-E: Very Good to Excellent
- VG: Very Good
- G-VG: Good to Very Good
- G: Good
- G-D: Good to Degraded
- D and D/R: Degraded and/or Degraded/Rehab
- CD-D: Completely Degraded to Degraded
- CD: Completely Degraded
- N/A: Open Water

- VEGETATION ASSOCIATION SOURCED RPS 2011, RPS 2013, ENV 2013, PGV ENVIRONMENTAL 2013 AND 360 ENVIRONMENTAL 2015, SUPPLEMENTED WITH CURRENT CLEARED EXTENTS (AERIAL IMAGERY FEB 2016)
- LOCALITY MAP SOURCED FROM LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

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PERRON GROUP

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS

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Meters

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LOCALITY MAP

PROJECT NO	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

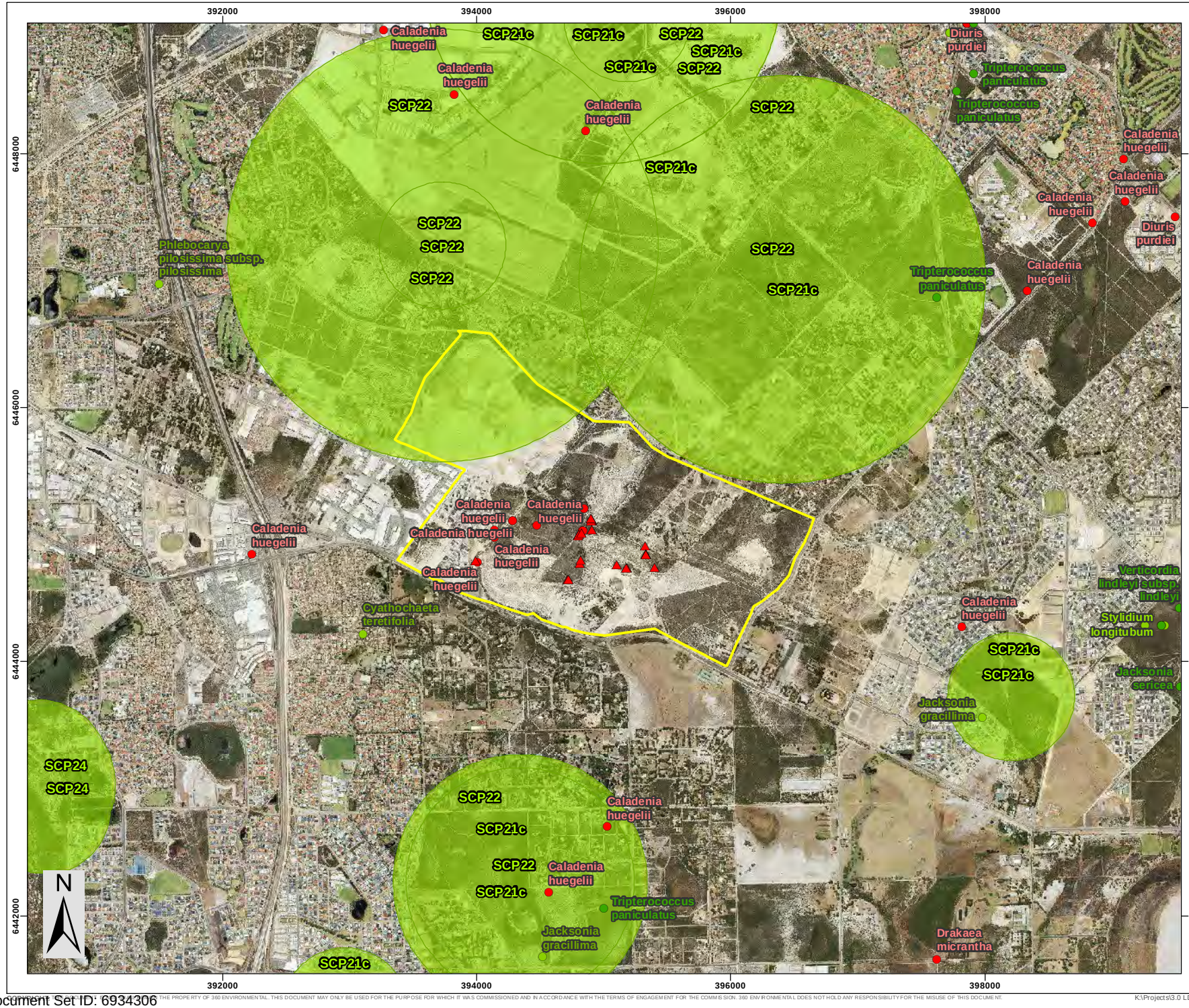
CREATED	CHECKED	APPROVED	REVISION
JJ	RH	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 9
Consolidated Vegetation Condition

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 8 - Vegetation Condition.mxd



Legend

District Structure Plan Boundary (461.54 ha)

Rare and Priority Flora

- Priority 4
- Priority 3
- Priority 2
- Priority 1
- Declared Rare
- *Caladenia huegelii* records (Surveyed)

TECs and PECs

- Priority 4
- Priority 3
- Priority 2
- Priority 1
- Vulnerable
- Endangered
- Critically Endangered

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- SURVEYED FLORA LOCATIONS SOURCED ENV 2013, 360 ENVIRONMENTAL 2015 AND PGV ENVIRONMENTAL 2013
- FLORA RECORDS PURCHASED FROM DPAW 20 DEC 2013 (REF 36-1213FL)
- TEC AND PEC DATA PURCHASED FROM DPAW 23 DEC 2013
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

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Meters
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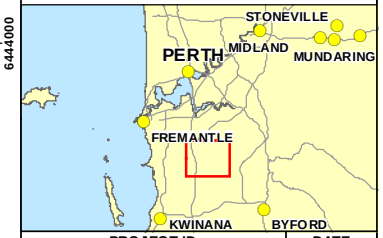
LOCALITY MAP



PROJECT ID	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

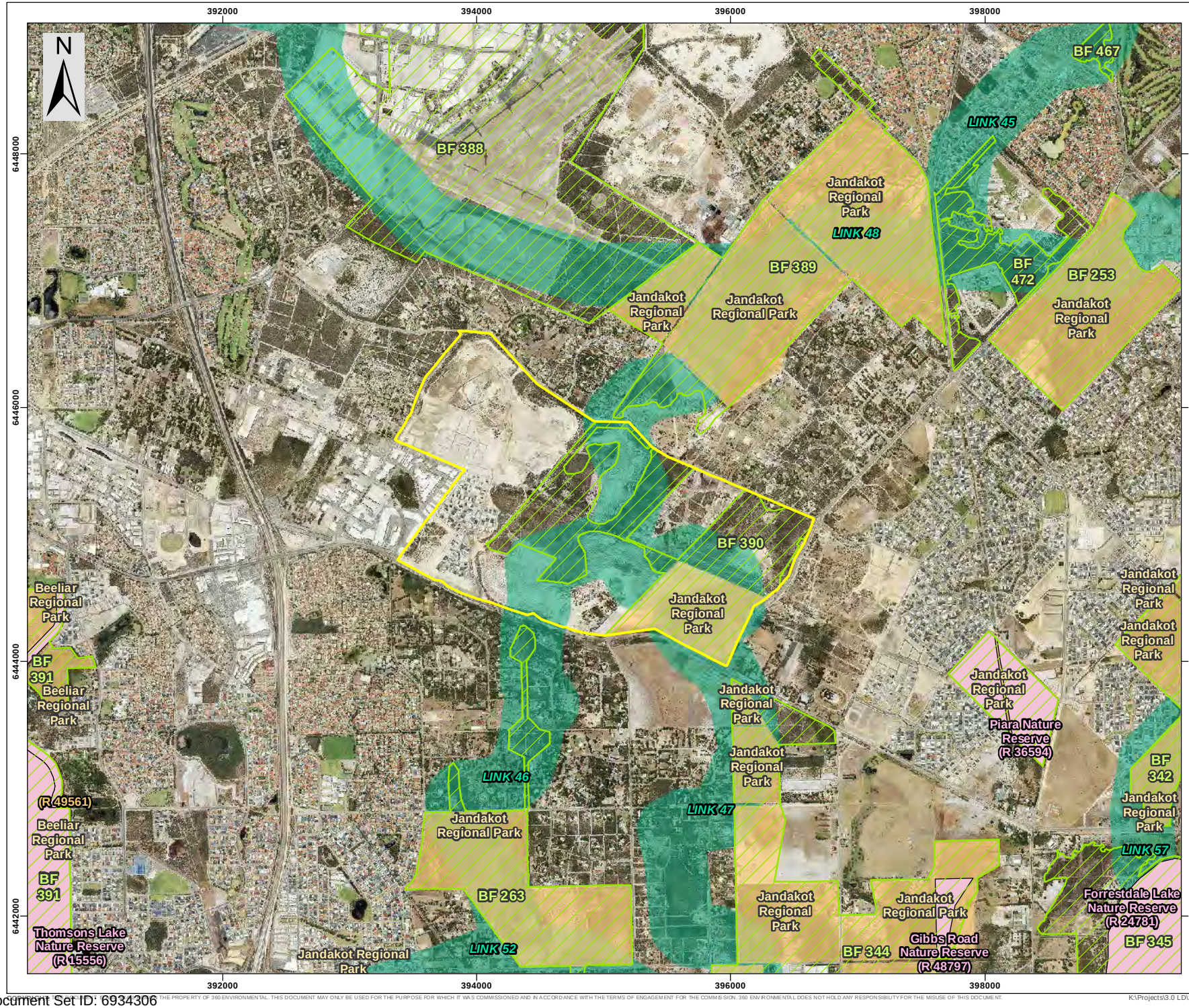
Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 10

Threatened and Priority Flora and Ecological Communities

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 9 - TECPEC and Flora.mxd



Legend

- District Structure Plan Boundary (461.54 ha)
- Bush Forever Sites
- Regional Parks
- Perth Regional Ecological Linkages

DPaW Managed Lands

- Conservation Park
- Nature Reserve

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- BUSH FOREVER SOURCED DOP 2014
- REGIONAL PARKS SOURCED LANDGATE 2015
- ECOLOGICAL LINKAGES SOURCED PBP 2008 (WALGA)
- DPAW LANDS SOURCED DPAW 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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Meters
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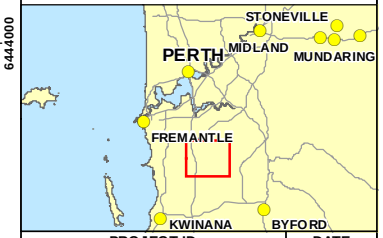
LOCALITY MAP



PROJECT ID	DATE
1405	18-May-16

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 11
Conservation Areas

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 10 - Conservation Areas.mxd

Legend

- District Structure Plan Boundary (461.54 ha)
- Municipal Heritage List

Aboriginal Heritage Sites

- Registered Site
- Lodged Site
- Stored Data / Not a Site

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- ABORIGINAL HERITAGE SITES SOURCED DAA 2016
- MUNICIPAL LISTING SOURCED INHERIT (SHO) 2016
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016

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LOCALITY MAP

PROJECT ID	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

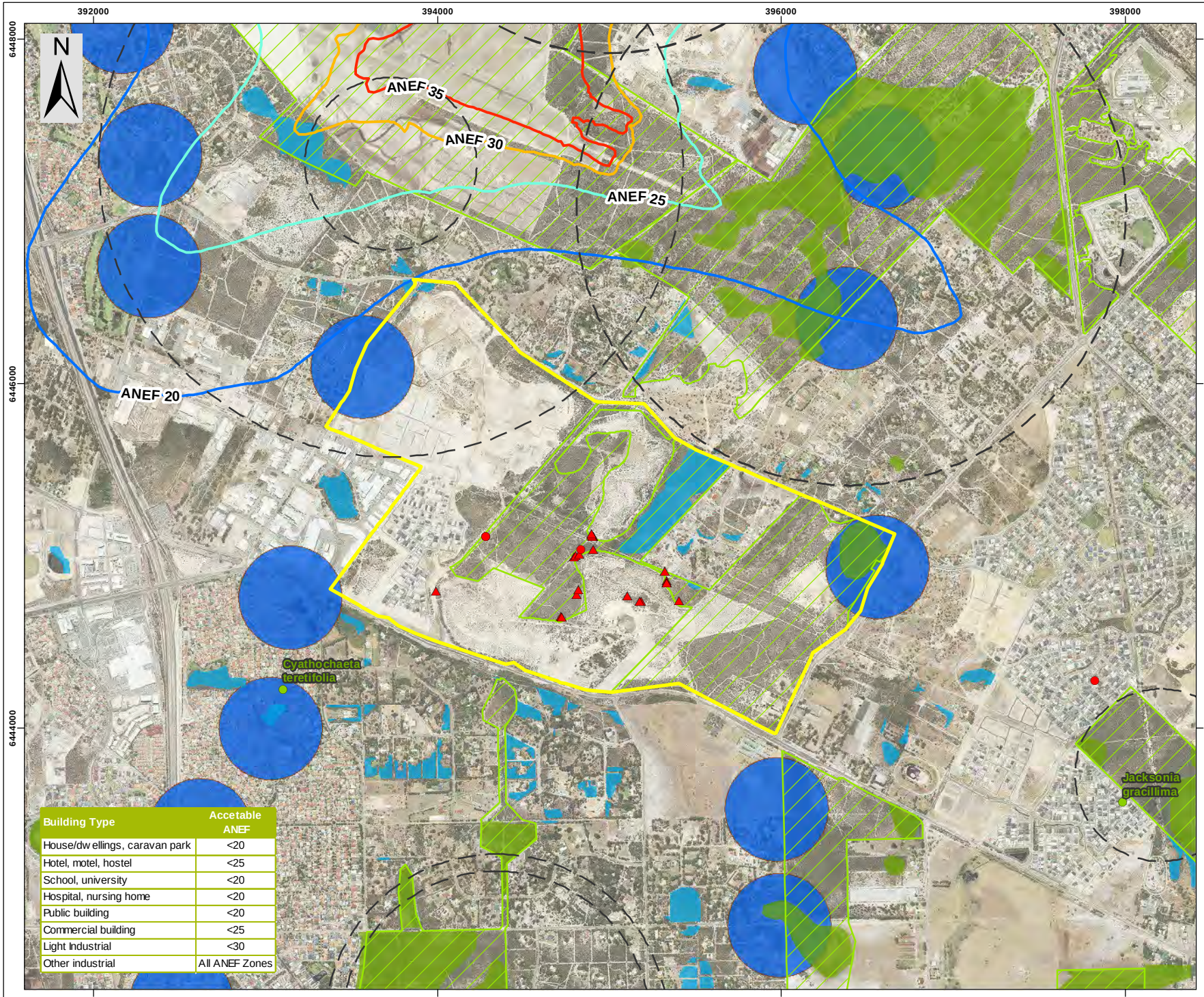
CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 12
Heritage

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 11 - Heritage.mxd



Building Type	Accetable ANEF
House/dwellings, caravan park	<20
Hotel, motel, hostel	<25
School, university	<20
Hospital, nursing home	<20
Public building	<20
Commercial building	<25
Light Industrial	<30
Other industrial	All ANEF Zones

Legend

- DSP Boundary (461.54 ha)
- CCW
- REW (With Remant Vegetation)
- PEC Buffers
- Bush Forever Sites
- Wellhead Protection Buffer

Jandakot Airport Ultimate Capacity ANEF [1]

- 20 ANEF
- 25 ANEF
- 30 ANEF
- 35 ANEF

Rare and Priority Flora

- Priority 4
- Priority 3
- Priority 2
- Priority 1
- Declared Rare (*C. huegelii*)
- Known *Caladenia huegelii* records (Surveyed)

NOTE:

1. ANEF: Australian Noise Exposure Forecast

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- JANDAKOT ANEF SOURCED FROM JANDAKOT AIRPORT (AIR SERVICES 2014)
- WETLANDS SOURCED DPAW 2016
- PEC BUFFERS AND FLORA SOURCED DPAW 2013 & SURVEYS (SEE FIGURE 7/8)
- LOCALITY MAP SOURCED LANDGATE 2006
- AERIAL PHOTOGRAPHY SOURCED LANDGATE FEB 2016 (© Western Australian Land Information Authority 2016)

Prepared by SLIP ENABLER

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Meters

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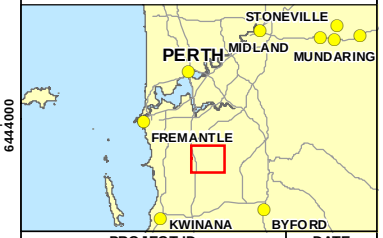
LOCALITY MAP



PROJECT ID	DATE
1405	24/05/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	KC	SB	0

Perron Developments Pty Ltd
Banjup District Structure Plan

Environmental Assessment Report

Figure 13

Environmental Opportunities and Constraints

K:\Projects\3.0 LD\1405 Banjup DSP EAR\Figures\1405 EAR Figure 12 - Opportunities and Constraints.mxd

APPENDIX A

Draft Treeby (Banjup) District Structure Plan

This plan has no formal approval status and has been prepared by CLE to demonstrate one potential land use scenario for the land which could be investigated further by the Client. Implementation in any form would be subject to the receipt of all appropriate approvals. The plan may be changed without notice and should not be relied upon. This plan remains the property of CLE.

Jandakot Airport & Business Park

BOUNDARIES SUBJECT TO FORMAL ASSESSMENT AND APPROVAL.

POSSIBLE REALIGNMENT OF JANDAKOT ROAD

POSSIBLE INTERSECTION (SUBJECT TO LEVELS & DESIGN REVIEW)

EXISTING RESOURCE ZONED LOTS

COCKBURN CENTRAL TRAIN STATION

PLANNING CONTROL AREA (REALIGNED NORTH LAKE ROAD CONNECTION)

COCKBURN CENTRAL ACTIVITY CENTRE

EXISTING SIGNALISED INTERSECTION

PROPOSED LEFT IN/OUT INTERSECTION

EXISTING SIGNALISED INTERSECTION. SUBJECT TO REVIEW BY MAIN ROADS WA.

POSSIBLE ADDITIONAL LEFT IN / LEFT OUT INTERSECTION SUBJECT TO FURTHER CONSIDERATION AND APPROVAL AS PART OF LSP PROCESS.

PROPOSED SIGNALISED INTERSECTION OR ROUNDABOUT

EXISTING SIGNALISED INTERSECTION

Approved Banjup Quarry Cell 4 Final Structure Plan

LEGEND

- Treeby (Banjup) DSP
- Residential
- Public Open Space (District level)
- POS (including areas with Regional Conservation Values)
- Public Purposes - School / Civic
- Neighbourhood / Local Centre
- Mixed Business and/or Residential
- Resource
- Powerline Easement
- Green Linkage
- Primary Regional Road
- District Distributor Road
- Connector Road
- Major Dual Use Path / Cycle path
- distance to Train Station
- distance to Amenities
- X Signalised intersection
- Left IN / OUT Only
- Roundabout with access at grade. Subject to current design review by MRWA.

DRAFT

TREEBY (BANJUP) DISTRICT STRUCTURE PLAN

Banjup
City of Cockburn

0 100 200 300 400 500 750m 1km

nearmap 12.07.2015

plan no: 2310-122D-01
scale: 1:12,500@A3, 1:6,250@A1
date: 23.08.2016

CLE TOWN PLANNING + DESIGN

APPENDIX B

EPBC Referral Decision for Lot 4 Armadale Road, Banjup

Australian Government
Department of the Environment

Notification of

REFERRAL DECISION – not controlled action
Urban development and associated infrastructure, Lot 4 Armadale Road, Banjup, WA

This decision is made under Section 75 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Proposed action

person named in the referral	Perron Developments Pty Ltd ACN: 000230446
proposed action	To undertake an urban development and associated infrastructure, Lot 4, Armadale Road, Banjup, Western Australia; as described in the referral received by the department on 7 November 2013 and additional information received on the 6 December 2013 (See EPBC Act referral 2013/7049).

Referral decision: not a controlled action

status of proposed action	The proposed action is not a controlled action.

Person authorised to make decision

name and position	Victoria Press A/g Assistant Secretary North, West and Offshore Assessment Branch

signature

date of decision 16 December 2013

APPENDIX C

NatureMap and EPBC Protected Matters Search Results

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 28/04/2016

Kingdom Plantae
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115° 53' 09" E,32° 07' 31" S
Buffer 5km
Group By Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	403	809
Priority 2	1	1
Priority 3	6	13
Priority 4	4	14
Rare or likely to become extinct	4	45
TOTAL	**418**	**882**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
2.	1637	*Diuris purdiei (Purdie's Donkey Orchid)*		T	
3.	1639	*Drakaea elastica (Glossy-leaved Hammer Orchid)*		T	
4.	13635	*Drakaea micrantha*		T	
Priority 2					
5.	18564	*Stylidium aceratum*		P2	
Priority 3					
6.	3178	*Byblis gigantea (Rainbow Plant)*		P3	
7.	16245	*Cyathochaeta teretifolia*		P3	
8.	20462	*Jacksonia gracillima*		P3	
9.	11557	*Phlebocarya pilosissima subsp. pilosissima*		P3	
10.	1008	*Schoenus pennisetis*		P3	
11.	25800	*Stylidium paludicola*		P3	
Priority 4					
12.	4027	*Jacksonia sericea (Waldjumi)*		P4	
13.	7756	*Stylidium longitubum (Jumping Jacks)*		P4	
14.	44444	*Tripterococcus sp. Brachylobus (A.S. George 14234)*		P4	
15.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
Non-conservation taxon					
16.	3374	*Acacia huegelii*			
17.	3502	*Acacia pulchella (Prickly Moses)*			
18.	30032	*Acacia saligna subsp. saligna*			
19.	1775	*Adenanthos cygnorum (Common Woollybush)*			
20.	1791	*Adenanthos obovatus (Basket Flower)*			
21.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
22.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
23.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
24.	20184	*Amphipogon laguroides subsp. laguroides*			
25.	199	*Amphipogon strictus (Greybeard Grass)*			
26.	200	*Amphipogon turbinatus*			
27.	7833	*Angianthus preissianus*			
28.	1409	*Anigozanthos humilis (Catspaw)*			
29.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
30.	11566	*Anigozanthos viridis subsp. viridis*			
31.	3686	*Aotus cordifolia*			
32.	3692	*Aotus procumbens*			
33.	207	*Aristida contorta (Bunched Kerosene Grass)*			
34.	1264	*Arnocrinum preissii*			
35.	8779	*Asparagus asparagoides (Bridal Creeper)*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
36.	20350	*Astartea affinis*			
37.	20283	*Astartea scoparia*			
38.	7851	*Asteridea pulverulenta (Common Bristle Daisy)*			
39.	6334	*Astroloma pallidum (Kick Bush)*			
40.	6339	*Astroloma xerophyllum*			
41.	2471	*Atriplex prostrata (Hastate Orache)*	Y		
42.	17234	*Austrostipa compressa*			
43.	17245	*Austrostipa mollis*			
44.	233	*Avena barbata (Bearded Oat)*	Y		
45.	17737	*Azolla pinnata*			
46.	42902	*Azolla rubra*			
47.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
48.	32580	*Banksia dallanneyi var. dallanneyi*			
49.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
50.	1834	*Banksia menziesii (Firewood Banksia)*			
51.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
52.	741	*Baumea articulata (Jointed Rush)*			
53.	744	*Baumea laxa*			
54.	5393	*Beaufortia squarrosa (Sand Bottlebrush, Puno)*			
55.	1417	*Blancoa canescens (Winter Bell)*			
56.	749	*Bolboschoenus caldwellii (Marsh Club-rush)*			
57.	4413	*Boronia crenulata (Aniseed Boronia)*			
58.	16636	*Boronia crenulata subsp. viminea*			
59.	4417	*Boronia dichotoma*			
60.	11381	*Boronia ramosa subsp. anethifolia*			
61.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
62.	30142	*Brachyloma preissii subsp. obtusifolium*			
63.	30136	*Brachyloma preissii subsp. preissii*			
64.	7867	*Brachyscome bellidioides*			
65.	7878	*Brachyscome iberidifolia*			
66.	244	*Briza maxima (Blowfly Grass)*	Y		
67.	245	*Briza minor (Shivery Grass)*	Y		
68.	249	*Bromus diandrus (Great Brome)*	Y		
69.	12770	*Burchardia congesta*			
70.	1277	*Caesia occidentalis*			
71.	1592	*Caladenia flava (Cowslip Orchid)*			
72.	15348	*Caladenia flava subsp. flava*			
73.	1599	*Caladenia latifolia (Pink Fairy Orchid)*			
74.	15361	*Caladenia longicauda subsp. calcigena*			
75.	1605	*Caladenia marginata (White Fairy Orchid)*			
76.	15503	*Caladenia paludosa*			
77.	15398	*Caladenia xantha*			
78.	16365	*Calandrinia sp. Kenwick (G.J. Keighery 10905)*			
79.	19309	*Calectasia narragara*			
80.	36600	*Callitris pyramidalis (Swamp Cypress)*			
81.	5411	*Calothamnus hirsutus*			
82.	5415	*Calothamnus lateralis*			
83.	5439	*Calytrix angulata (Yellow Starflower)*			
84.	5458	*Calytrix flavescens (Summer Starflower)*			
85.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
86.		*Calytrix sp.*			
87.	32338	*Campylopus introflexus*	Y		
88.	2794	*Carpobrotus aequilaterus (Angular Pigface)*	Y		
89.	2795	*Carpobrotus edulis (Hottentot Fig)*	Y		
90.	1162	*Cartonema philydroides*			
91.	2957	*Cassytha racemosa (Dodder Laurel)*			
92.	6542	*Centaurium tenuiflorum*	Y		
93.	6214	*Centella asiatica*			
94.	1125	*Centrolepis drummondiana*			
95.	1134	*Centrolepis polygyna (Wiry Centrolepis)*			
96.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
97.	17685	*Chaetanthus aristatus*			
98.	17687	*Chaetanthus tenellus*			
99.	18156	*Chamaecytisus palmensis (Tagasaste)*	Y		
100.	1280	*Chamaescilla corymbosa (Blue Squill)*			
101.	2483	*Chenopodium album (Fat Hen)*	Y		
102.	2490	*Chenopodium glaucum (Glaucous Goosefoot)*	Y		
103.		*Chiloscyphus semiteres var. semiteres*			
104.	7937	*Cirsium vulgare (Spear Thistle, Scotch Thistle)*	Y		
105.	4550	*Comesperma calymega (Blue-spike Milkwort)*			

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106.	4554	*Comesperma flavum*			
107.	1858	*Conospermum amoenum (Blue Smokebush)*			
108.	6348	*Conostephium pendulum (Pearl Flower)*			
109.	6349	*Conostephium preissii*			
110.	1418	*Conostylis aculeata (Prickly Conostylis)*			
111.	11826	*Conostylis aculeata subsp. aculeata*			
112.	11695	*Conostylis festucacea subsp. festucacea*			
113.	1436	*Conostylis juncea*			
114.	7939	*Conyza bonariensis (Flaxleaf Fleabane)*	Y		
115.	20074	*Conyza sumatrensis*	Y		
116.	1285	*Corynotheca micrantha (Sand Lily)*			
117.	7945	*Cotula coronopifolia (Waterbuttons)*	Y		
118.	3137	*Crassula colorata (Dense Stonecrop)*			
119.	3139	*Crassula exserta*			
120.	13527	*Croninia kingiana*			
121.	6663	*Cuscuta epithymum (Lesser Dodder, Greater Dodder)*	Y		
122.	40660	*Cycnogeton huegelii*			
123.	783	*Cyperus congestus (Dense Flat-sedge)*	Y		
124.	10916	*Cyrtostylis huegelii*			
125.	10942	*Cyrtostylis tenuissima*			
126.	17692	*Cytogonidium leptocarpoides*			
127.	7451	*Dampiera lavandulacea*			
128.	7454	*Dampiera linearis (Common Dampiera)*			
129.	5508	*Darwinia citriodora (Lemon-scented Darwinia)*			
130.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
131.	3832	*Daviesia physodes*			
132.	3845	*Daviesia triflora*			
133.	16595	*Desmocladus flexuosus*			
134.	1259	*Dianella revoluta (Blueberry Lily)*			
135.	1287	*Dichopogon capillipes*			
136.	32344	*Dicranoloma diaphanoneuron*			
137.	32345	*Didymodon australasiae*			
138.	17838	*Dielsia stenostachya*			
139.	11049	*Diuris corymbosa*			
140.	1634	*Diuris laxiflora (Bee Orchid)*			
141.	1635	*Diuris longifolia (Common Donkey Orchid)*			
142.	1636	*Diuris pauciflora*			
143.	1640	*Drakaea glyptodon (King-in-his-carriage)*			
144.	13217	*Drosera erythrorhiza subsp. erythrorhiza*			
145.	3106	*Drosera macrantha (Bridal Rainbow)*			
146.	14298	*Drosera macrantha subsp. macrantha*			
147.	3109	*Drosera menziesii (Pink Rainbow)*			
148.	13216	*Drosera menziesii subsp. penicillaris*			
149.	11768	*Drosera neesii subsp. neesii*			
150.	8911	*Drosera rosulata*			
151.	3131	*Drosera stolonifera (Leafy Sundew)*			
152.	33500	*Dysphania ambrosioides (Mexican Tea)*	Y		
153.	2501	*Dysphania glomulifera*			
154.	11368	*Dysphania glomulifera subsp. glomulifera*			
155.	11105	*Echinochloa crus-galli*	Y		
156.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
157.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
158.	5187	*Elatine gratioloides (Waterwort)*			
159.	822	*Eleocharis acuta (Common Spikerush)*			
160.	1644	*Elythranthera emarginata (Pink Enamel Orchid)*			
161.	1645	*Epiblema grandiflorum (Babe-in-a-cradle)*			
162.	6133	*Epilobium hirtigerum (Hairy Willow Herb)*			
163.		*Eragrostis sp.*			
164.	13950	*Eremaea asterocarpa subsp. asterocarpa*			
165.	13962	*Eremaea atala*			
166.	13951	*Eremaea hadra*			
167.	5543	*Eremaea violacea (Violet Eremaea)*			
168.	15412	*Eriochilus dilatatus subsp. multiflorus*			
169.	15414	*Eriochilus helonomos*			
170.	1647	*Eriochilus scaber (Pink Bunny Orchid)*			
171.	15415	*Eriochilus scaber subsp. scaber*			
172.	5659	*Eucalyptus gomphocephala (Tuart, Duart)*			
173.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
174.	13511	*Eucalyptus rudis subsp. rudis*			
175.	5790	*Eucalyptus todtiana (Coastal Blackbutt)*			

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176.	3872	*Euchilopsis linearis (Swamp Pea)*			
177.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
178.	3880	*Eutaxia virgata*			
179.	835	*Evandra pauciflora*			
180.	1747	*Ficus carica (Common Fig)*	Y		
181.	11571	*Galenia pubescens var. pubescens*	Y		
182.	20475	*Gastrolobium capitatum*			
183.	20483	*Gastrolobium linearifolium*			
184.	20482	*Gastrolobium nervosum*			
185.	3921	*Gastrolobium reticulatum*			
186.	3924	*Gastrolobium spinosum (Prickly Poison)*			
187.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
188.	17043	*Glyceria declinata*	Y		
189.	12624	*Gnephosis angianthoides*			
190.	6587	*Gomphocarpus fruticosus (Narrowleaf Cottonbush)*	Y		
191.	10909	*Gompholobium confertum*			
192.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
193.	6160	*Gonocarpus paniculatus*			
194.	6161	*Gonocarpus pithyoides*			
195.	19628	*Grevillea bipinnatifida subsp. bipinnatifida*			
196.	2032	*Grevillea leucopteris (White Plume Grevillea)*			
197.	1475	*Haemodorum spicatum (Mardja)*			
198.	2197	*Hakea prostrata (Harsh Hakea)*			
199.	2216	*Hakea varia (Variable-leaved Hakea)*			
200.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
201.	29594	*Helichrysum luteoalbum (Jersey Cudweed)*			
202.	6710	*Heliotropium europaeum (Common Heliotrope)*	Y		
203.	6839	*Hemiandra pungens (Snakebush)*			
204.	1293	*Hensmania turbinata*			
205.	5134	*Hibbertia huegelii*			
206.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
207.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
208.	43280	*Hibbertia sericosepala*			
209.		*Hibbertia sp. Bankstown (R.T.Miller & C.P.Gibson s.n. 18/10/06)*			
210.	5173	*Hibbertia subvaginata*			
211.	5176	*Hibbertia vaginata*			
212.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
213.	6222	*Homalosciadium homalocarpum*			
214.	3968	*Hovea trisperma (Common Hovea)*			
215.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
216.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
217.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
218.	9352	*Hypochaeris radicata (Flat Weed)*	Y		
219.	17841	*Hypolaena pubescens*			
220.	20200	*Isolepis cernua var. setiformis*			
221.	917	*Isolepis marginata (Coarse Club-rush)*			
222.	921	*Isolepis producta*			
223.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
224.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
225.	1178	*Juncus bufonius (Toad Rush)*	Y		
226.	1186	*Juncus microcephalus*	Y		
227.	1188	*Juncus pallidus (Pale Rush)*			
228.	1190	*Juncus planifolius (Broadleaf Rush)*			
229.	4044	*Kennedia prostrata (Scarlet Runner)*			
230.	17506	*Kunzea ericifolia subsp. ericifolia*			
231.	15498	*Kunzea glabrescens (Spearwood)*			
232.	13562	*Lachenalia aloides*	Y		
233.	20019	*Lachnagrostis filiformis*			
234.	19955	*Lachnagrostis plebeia*			
235.	6777	*Lachnostachys albicans*			
236.	8095	*Lactuca saligna (Wild Lettuce)*	Y		
237.	18585	*Lagenophora huegelii*			
238.	4052	*Latrobea tenella*			
239.	1307	*Laxmannia ramosa (Branching Lily)*			
240.	11911	*Laxmannia ramosa subsp. ramosa*			
241.	11464	*Laxmannia sessiliflora subsp. australis*			
242.	1309	*Laxmannia squarrosa*			
243.	7572	*Lechenaultia expansa*			
244.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
245.	44490	*Leontodon rhagadioloides*	Y		

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246.	8099	*Leontodon saxatilis (Hairy Hawkbit)*	Y		
247.	925	*Lepidosperma angustatum*			
248.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
249.	41649	*Lepidosperma rigidulum*			
250.		*Lepidosperma sp.*			
251.	19833	*Leptocarpus laxus*			
252.	2344	*Leptomeria empetriformis*			
253.	2350	*Leptomeria pauciflora (Sparse-flowered Currant Bush)*			
254.	6374	*Leucopogon conostephioides*			
255.	6425	*Leucopogon oxycedrus*			
256.	6434	*Leucopogon polymorphus*			
257.	6439	*Leucopogon pulchellus (Beard-heath)*			
258.	19579	*Leucopogon sp. Murdoch (M. Hislop 1037)*			
259.	6445	*Leucopogon squarrosus*			
260.	40803	*Leucopogon squarrosus subsp. squarrosus*			
261.	6451	*Leucopogon tenuis*			
262.	9289	*Lobelia anceps (Angled Lobelia)*			
263.	7408	*Lobelia tenuior (Slender Lobelia)*			
264.	10957	*Lolium perenne x rigidum*	Y		
265.	478	*Lolium rigidum (Wimmera Ryegrass)*	Y		
266.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
267.	1228	*Lomandra hermaphrodita*			
268.	1236	*Lomandra odora (Tiered Matrush)*			
269.	1239	*Lomandra preissii*			
270.	1243	*Lomandra sericea (Silky Mat Rush)*			
271.		*Lomandra sp.*			
272.	4059	*Lotus angustissimus (Narrowleaf Trefoil)*	Y		
273.	8564	*Lotus subbiflorus*	Y		
274.	4065	*Lupinus angustifolius (Narrowleaf Lupin)*	Y		
275.	1097	*Lyginia barbata*			
276.	18049	*Lyginia imberbis*			
277.	6456	*Lysinema ciliatum (Curry Flower)*			
278.	6458	*Lysinema elegans*			
279.	34736	*Lysinema pentapetalum*			
280.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
281.	2838	*Macarthuria apetala*			
282.	2839	*Macarthuria australis*			
283.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
284.		*Marchantia berteroana*			
285.	4079	*Medicago polymorpha (Burr Medic)*	Y		
286.	17683	*Meeboldina cana*			
287.		*Meeboldina roycei MS*			
288.	34676	*Meionectes brownii (Swamp Raspwort)*			
289.	37580	*Melaleuca acutifolia*			
290.	5900	*Melaleuca cuticularis (Saltwater Paperbark)*			
291.	5917	*Melaleuca hamulosa*			
292.	13273	*Melaleuca incana subsp. incana*			
293.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
294.	18394	*Melaleuca parviceps*			
295.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
296.	5964	*Melaleuca seriata*			
297.	5978	*Melaleuca teretifolia (Banbar)*			
298.	5980	*Melaleuca thymoides*			
299.	5987	*Melaleuca viminea (Mohan)*			
300.	4085	*Melilotus indicus*	Y		
301.	953	*Mesomelaena graciliceps*			
302.	15419	*Microtis media subsp. media*			
303.		*Microtis sp.*			
304.	8106	*Millotia tenuifolia (Soft Millotia)*			
305.	16693	*Minuartia mediterranea*	Y		
306.	4666	*Monotaxis occidentalis*			
307.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
308.	14293	*Oenothera indecora subsp. bonariensis*	Y		
309.	16347	*Oenothera laciniata*	Y		
310.	6140	*Oenothera mollissima*	Y		
311.	7090	*Parentucellia viscosa (Sticky Bartsia)*	Y		
312.	527	*Paspalum dilatatum*	Y		
313.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			
314.	4343	*Pelargonium capitatum (Rose Pelargonium)*	Y		
315.	6006	*Pericalymma ellipticum (Swamp Teatree)*			

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316.	16477	*Pericalymma ellipticum var. ellipticum*			
317.	16478	*Pericalymma ellipticum var. floridum*			
318.	11052	*Persicaria prostrata*			
319.	2273	*Persoonia saccata (Snottygobble)*			
320.	2299	*Petrophile linearis (Pixie Mops)*			
321.	20460	*Pheladenia deformis*			
322.	18529	*Philotheca spicata (Pepper and Salt)*			
323.	1478	*Phlebocarya ciliata*			
324.	1479	*Phlebocarya filifolia*			
325.	4	*Phylloglossum drummondii (Pigmy Clubmoss)*			
326.	4141	*Phyllota gracilis*			
327.	2793	*Phytolacca octandra (Red Ink Plant)*	Y		
328.	5252	*Pimelea lanata*			
329.	18353	*Pithocarpa pulchella var. pulchella*			
330.	6249	*Platysace compressa (Tapeworm Plant)*			
331.	4524	*Platytheca galioides*			
332.	578	*Poa porphyroclados*			
333.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
334.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
335.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
336.	1672	*Prasophyllum fimbria (Fringed Leek Orchid)*			
337.	1673	*Prasophyllum gibbosum (Humped Leek Orchid)*			
338.	1674	*Prasophyllum giganteum (Bronze Leek Orchid)*			
339.	1676	*Prasophyllum hians (Yawning Leek Orchid)*			
340.	1680	*Prasophyllum parvifolium (Autumn Leek Orchid)*			
341.	1681	*Prasophyllum regium (King Leek Orchid)*			
342.	17267	*Pterostylis brevisepala*			
343.	44723	*Pterostylis glebosa*			
344.	1693	*Pterostylis recurva (Jug Orchid)*			
345.	12217	*Pterostylis sanguinea*			
346.		*Pterostylis sp.*			
347.	18648	*Pterostylis sp. cauline leaves (N. Gibson & M.N. Lyons 1490)*			
348.	18655	*Pterostylis sp. crinkled leaf (G.J. Keighery 13426)*			
349.	1698	*Pterostylis vittata (Banded Greenhood)*			
350.	2718	*Ptilotus drummondii (Narrowleaf Mulla Mulla)*			
351.	4177	*Pultenaea ochreata*			
352.	4181	*Pultenaea reticulata*			
353.	6012	*Regelia ciliata*			
354.	4822	*Rhamnus alaternus (Buckthorn)*	Y		
355.	14485	*Romulea flava var. minor*	Y		
356.	14924	*Romulea rosea var. communis*	Y		
357.	44608	*Rosulabryum billarderii*			
358.	6263	*Schoenolaena juncea*			
359.	973	*Schoenus asperocarpus (Poison Sedge)*			
360.	978	*Schoenus brevisetis*			
361.	979	*Schoenus caespititius*			
362.	984	*Schoenus curvifolius*			
363.	986	*Schoenus efoliatus*			
364.	992	*Schoenus grandiflorus (Large Flowered Bogrush)*			
365.	1011	*Schoenus rigens*			
366.	1017	*Schoenus subbulbosus*			
367.	1018	*Schoenus subfascicularis*			
368.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
369.	8203	*Senecio diaschides*			
370.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
371.	7020	*Solanum linnaeanum (Apple of Sodom)*	Y		
372.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
373.	45036	*Solidago chilensis*	Y		
374.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
375.	4211	*Sphaerolobium vimineum (Leafless Globe Pea)*			
376.	2316	*Stirlingia latifolia (Blueboy)*			
377.	25831	*Stylidium araeophyllum (Stilt Walker)*			
378.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
379.	7696	*Stylidium calcaratum (Book Triggerplant)*			
380.	7717	*Stylidium divaricatum (Daddy-long-legs)*			
381.	7734	*Stylidium guttatum (Dotted Triggerplant)*			
382.	25829	*Stylidium neurophyllum (Coastal Plain Triggerplant)*			
383.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
384.	7777	*Stylidium preissii (Lizard Triggerplant)*			
385.	7785	*Stylidium repens (Matted Triggerplant)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
386.	25806	*Stylidium scariosum*			
387.	7798	*Stylidium schoenoides (Cow Kicks)*			
388.	7806	*Stylidium utricularioides (Pink Fan Triggerplant)*			
389.	1260	*Stypandra glauca (Blind Grass)*			
390.	1716	*Thelymitra tigrina (Tiger Orchid)*			
391.	1318	*Thysanotus arbuscula*			
392.	1338	*Thysanotus manglesianus (Fringed Lily)*			
393.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
394.	1343	*Thysanotus patersonii*			
395.	1358	*Thysanotus triandrus*			
396.	6280	*Trachymene pilosa (Native Parsnip)*			
397.	4383	*Tribulus terrestris (Caltrop)*	Y		
398.	1363	*Tricoryne tenella*			
399.	1038	*Tricostularia neesii*			
400.	4289	*Trifolium angustifolium (Narrowleaf Clover)*	Y		
401.	17145	*Trifolium angustifolium var. angustifolium*	Y		
402.	14738	*Trifolium resupinatum var. resupinatum*	Y		
403.	4309	*Trifolium scabrum (Rough Clover)*	Y		
404.	150	*Triglochin stowardii*			
405.	4360	*Tropaeolum majus (Garden Nasturtium)*	Y		
406.	98	*Typha domingensis (Bulrush, Djandjid)*			
407.	8255	*Ursinia anthemoides (Ursinia)*	Y		
408.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
409.	15432	*Verticordia densiflora var. densiflora*			
410.	6077	*Verticordia drummondii (Drummond's Featherflower)*			
411.	11474	*Vicia sativa subsp. nigra*	Y		
412.	4325	*Viminaria juncea (Swishbush, Koweda)*			
413.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
414.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
415.	7389	*Wahlenbergia preissii*			
416.	8282	*Waitzia suaveolens (Fragrant Waitzia)*			
417.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
418.	6289	*Xanthosia huegelii*			

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
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[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 28/04/2016

Kingdom	Animalia
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 53' 09" E,32° 07' 31" S
Buffer	5km
Group By	Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	235	4626
Other specially protected fauna	1	2
Priority 1	1	4
Priority 3	1	11
Priority 4	3	54
Priority 5	2	212
Protected under international agreement	13	82
Rare or likely to become extinct	4	352
TOTAL	**260**	**5343**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	24784	*Calidris ferruginea (Curlew Sandpiper)*		T	
2.	24731	*Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black-Cockatoo)*		T	
3.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)*		T	
4.	24146	*Myrmecobius fasciatus (Numbat, Walpurti)*		T	
Protected under international agreement					
5.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
6.	41324	*Ardea modesta (Eastern Great Egret)*		IA	
7.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*		IA	
8.	24786	*Calidris melanotos (Pectoral Sandpiper)*		IA	
9.	24788	*Calidris ruficollis (Red-necked Stint)*		IA	
10.	24789	*Calidris subminuta (Long-toed Stint)*		IA	
11.	25574	*Charadrius dubius (Little Ringed Plover)*		IA	
12.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*		IA	
13.	25741	*Limosa limosa (Black-tailed Godwit)*		IA	
14.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
15.	24843	*Plegadis falcinellus (Glossy Ibis)*		IA	
16.	24806	*Tringa glareola (Wood Sandpiper)*		IA	
17.	24808	*Tringa nebularia (Common Greenshank)*		IA	
Other specially protected fauna					
18.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
Priority 1					
19.	33994	*Throscodectes xiphos (cricket)*		P1	Y
Priority 3					
20.	25147	*Lerista lineata (Perth Slider, Lined Skink)*		P3	
Priority 4					
21.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
22.	24328	*Oxyura australis (Blue-billed Duck)*		P4	
23.	33992	*Synemon gratiosa (Graceful Sunmoth)*		P4	
Priority 5					
24.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*		P5	
25.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
Non-conservation taxon					
26.	24260	*Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)*			
27.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
28.	24262	*Acanthiza inornata (Western Thornbill)*			
29.		*Acantholophus hypoleucus*			
30.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
31.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
32.	25536	*Accipiter fasciatus (Brown Goshawk)*			
33.	24282	*Accipiter fasciatus subsp. fasciatus (Brown Goshawk)*			
34.	42368	*Acritoscincus trilineatus (Western Three-lined Skink)*			
35.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
36.		*Aname mainae*			
37.		*Aname tepperi*			
38.	24312	*Anas gracilis (Grey Teal)*			
39.	24315	*Anas rhynchotis (Australasian Shoveler)*			
40.	24316	*Anas superciliosa (Pacific Black Duck)*			
41.	25553	*Anhinga melanogaster (Darter)*			
42.		*Anhinga novaehollandiae*			
43.	44629	*Anilios australis*			
44.		*Anser anser*			
45.		*Anser sp.*			
46.	24561	*Anthochaera carunculata (Red Wattlebird)*			
47.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
48.	24991	*Aprasia repens (Sand-plain Worm-lizard)*			
49.	24285	*Aquila audax (Wedge-tailed Eagle)*			
50.		*Archiargiolestes parvulus*			
51.		*Archiargiolestes pusillus*			
52.	24340	*Ardea novaehollandiae (White-faced Heron)*			
53.	24341	*Ardea pacifica (White-necked Heron)*			
54.		*Arenopsaltria fullo*			
55.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
56.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
57.		*Artoria flavimana*			
58.		*Artoria linnaei*			
59.		*Artoria taeniifera*			
60.	24318	*Aythya australis (Hardhead)*			
61.		*Ballarra longipalpus*			
62.		*Barnardius zonarius*			
63.	24319	*Biziura lobata (Musk Duck)*			
64.	42381	*Brachyurophis semifasciatus (Southern Shovel-nosed Snake)*			
65.	25714	*Cacatua pastinator (Western Long-billed Corella)*			
66.	25716	*Cacatua sanguinea (Little Corella)*			
67.		*Cacatua sp.*			
68.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
69.	42307	*Cacomantis pallidus (Pallid Cuckoo)*			
70.		*Cairina moschata*			
71.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
72.		*Calyptorhynchus sp.*			
73.		*Castiarina crenata*			
74.		*Castiarina rufipennis*			
75.	24373	*Charadrius melanops (Black-fronted Dotterel)*			
76.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
77.	43380	*Chelodina colliei (Oblong Turtle)*			
78.	24321	*Chenonetta jubata (Australian Wood Duck, Wood Duck)*			
79.	24980	*Christinus marmoratus (Marbled Gecko)*			
80.		*Chroicocephalus novaehollandiae*			
81.	24834	*Cincloramphus mathewsi (Rufous Songlark)*			
82.	24288	*Circus approximans (Swamp Harrier)*			
83.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
84.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
85.	24399	*Columba livia (Domestic Pigeon)*	Y		
86.		*Coptotermes michaelseni*			
87.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
88.	24363	*Coracina novaehollandiae subsp. subpallida (Black-faced Cuckoo-shrike)*			
89.		*Cormocephalus aurantiipes*			
90.		*Cormocephalus rubriceps*			
91.	25592	*Corvus coronoides (Australian Raven)*			
92.	24417	*Corvus coronoides subsp. perplexus (Australian Raven)*			
93.	25595	*Cracticus tibicen (Australian Magpie)*			
94.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
95.	25596	*Cracticus torquatus (Grey Butcherbird)*			
96.	25399	*Crinia glauerti (Clicking Frog)*			
97.	25400	*Crinia insignifera (Squelching Froglet)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
98.	30893	*Cryptoblepharus buchananii*			
99.		*Cryptoerithus quobba*			
100.	30899	*Ctenophorus adelaidensis (Southern Heath Dragon, Western Heath Dragon)*			
101.	25027	*Ctenotus australis*			
102.	25040	*Ctenotus gemmula (Jewelled South-west Ctenotus (Swan Coastal Plain pop P3), skink)*			
103.	25047	*Ctenotus impar*			
104.		*Cubicorhynchus crenicollis*			
105.	24322	*Cygnus atratus (Black Swan)*			
106.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*	Y		
107.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
108.	25766	*Delma fraseri (Fraser's Legless Lizard)*			
109.	24999	*Delma grayii*			
110.	25296	*Demansia psammophis subsp. reticulata (Yellow-faced Whipsnake)*			
111.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
112.		*Dingosa serrata*			
113.		*Dysmicoccus macrozamiae*			
114.	25100	*Egernia napoleonis*			
115.		*Egretta garzetta*			
116.		*Egretta novaehollandiae*			
117.		*Elanus axillaris*			
118.	25250	*Elapognathus coronatus (Crowned Snake)*			
119.		*Elseyornis melanops*			
120.		*Eodelena convexa*			
121.		*Eolophus roseicapillus*			
122.	24567	*Epthianura albifrons (White-fronted Chat)*			
123.		*Erythracarus decoris*			
124.	24379	*Erythrogonys cinctus (Red-kneed Dotterel)*			
125.	25621	*Falco berigora (Brown Falcon)*			
126.	25622	*Falco cenchroides (Australian Kestrel)*			
127.	25623	*Falco longipennis (Australian Hobby)*			
128.	25727	*Fulica atra (Eurasian Coot)*			
129.	24761	*Fulica atra subsp. australis (Eurasian Coot)*			
130.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
131.	24763	*Gallinula tenebrosa subsp. tenebrosa (Dusky Moorhen)*			
132.	24764	*Gallinula ventralis (Black-tailed Native-hen)*			
133.	25730	*Gallirallus philippensis (Buff-banded Rail)*			
134.	24959	*Gehyra variegata*			
135.		*Geitoneura minyas*			
136.	25530	*Gerygone fusca (Western Gerygone)*			
137.	24271	*Gerygone fusca subsp. fusca (Western Gerygone)*			
138.	24443	*Grallina cyanoleuca (Magpie-lark)*			
139.	24295	*Haliastur sphenurus (Whistling Kite)*			
140.	25410	*Heleioporus eyrei (Moaning Frog)*			
141.		*Helicoverpa punctigera*			
142.	25119	*Hemiergis quadrilineata*			
143.		*Heteronympha merope subsp. duboulayi*			
144.	25734	*Himantopus himantopus (Black-winged Stilt)*			
145.	24491	*Hirundo neoxena (Welcome Swallow)*			
146.		*Isopeda leishmanni*			
147.		*Lampona cylindrata*			
148.		*Latrobiella guttatus*			
149.		*Latrodectus hasseltii*			
150.	25131	*Lerista distinguenda*			
151.	25133	*Lerista elegans*			
152.	25005	*Lialis burtonis*			
153.	25661	*Lichmera indistincta (Brown Honeyeater)*			
154.	24582	*Lichmera indistincta subsp. indistincta (Brown Honeyeater)*			
155.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
156.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
157.	25388	*Litoria moorei (Motorbike Frog)*			
158.		*Longepi woodman*			
159.		*Lophoictinia isura*			
160.		*Lycosa gilberta*			
161.	24132	*Macropus fuliginosus (Western Grey Kangaroo)*			
162.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
163.	25654	*Malurus splendens (Splendid Fairy-wren)*			
164.	24583	*Manorina flavigula (Yellow-throated Miner)*			
165.		*Maratus pavonis*			
166.	25758	*Megalurus gramineus (Little Grassbird)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
167.	25663	*Melithreptus brevirostris (Brown-headed Honeyeater)*			
168.	24587	*Melithreptus chloropsis (Western White-naped Honeyeater)*			
169.	25184	*Menetia greyii*			
170.		*Metaballus litus*			
171.		*Microcarbo melanoleucos*			
172.		*Missulena granulosa*			
173.		*Mituliodon tarantulinus*			
174.		*Mitzoruga insularis*			
175.	25192	*Morethia obscura*			
176.	24223	*Mus musculus (House Mouse)*	Y		
177.	25420	*Myobatrachus gouldii (Turtle Frog)*			
178.		*Myrmecia chasei*			
179.		*Myrmecia infima*			
180.	24738	*Neophema elegans (Elegant Parrot)*			
181.	25748	*Ninox novaeseelandiae (Boobook Owl)*			
182.	25252	*Notechis scutatus (Tiger Snake)*			
183.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
184.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
185.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
186.	24624	*Pachycephala rufiventris subsp. rufiventris (Rufous Whistler)*			
187.		*Paramphisopus sp.*			
188.	25253	*Parasuta gouldii*			
189.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
190.	25682	*Pardalotus striatus (Striated Pardalote)*			
191.	24628	*Pardalotus striatus subsp. murchisoni (Striated Pardalote)*			
192.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
193.		*Peripsocus maoricus*			
194.	24659	*Petroica goodenovii (Red-capped Robin)*			
195.	25697	*Phalacrocorax carbo (Great Cormorant)*			
196.	25698	*Phalacrocorax melanoleucos (Little Pied Cormorant)*			
197.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
198.	24409	*Phaps chalcoptera (Common Bronzewing)*			
199.		*Phenasteron longiconductor*			
200.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
201.		*Pinkfloydia harveii*			
202.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
203.	25720	*Platycercus icterotis (Western Rosella)*			
204.	25007	*Pletholax gracilis subsp. gracilis (Keeled Legless Lizard)*			
205.	25704	*Podiceps cristatus (Great Crested Grebe)*			
206.	25510	*Pogona minor (Dwarf Bearded Dragon)*			
207.	24907	*Pogona minor subsp. minor (Dwarf Bearded Dragon)*			
208.		*Pogona sp.*			
209.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
210.	25722	*Polytelis anthopeplus (Regent Parrot)*			
211.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
212.	24767	*Porphyrio porphyrio subsp. bellus (Purple Swamphen)*			
213.	24769	*Porzana fluminea (Australian Spotted Crake)*			
214.	25732	*Porzana pusilla (Baillon's Crake)*			
215.	24771	*Porzana tabuensis (Spotless Crake)*			
216.		*Prionosternum scutatum*			
217.	25511	*Pseudonaja affinis (Dugite)*			
218.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
219.	25433	*Pseudophryne guentheri (Crawling Toadlet)*			
220.		*Ptycta cornigera*			Y
221.		*Ptycta emarginata*			Y
222.		*Pulvinaria sp.*			
223.		*Purpureicephalus spurius*			
224.	25008	*Pygopus lepidopodus (Common Scaly Foot)*			
225.	24245	*Rattus rattus (Black Rat)*	Y		
226.		*Raveniella cirrata*			
227.		*Raveniella peckorum*			
228.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
229.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
230.	24454	*Rhipidura leucophrys subsp. leucophrys (Willie Wagtail)*			
231.		*Sclerorrhinella crawshawi*			
232.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
233.	30948	*Smicrornis brevirostris (Weebill)*			
234.	24329	*Stictonetta naevosa (Freckled Duck)*			
235.	25597	*Strepera versicolor (Grey Currawong)*			
236.	24426	*Strepera versicolor subsp. plumbea (Grey Currawong)*			

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237.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*	Y		
238.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*	Y		
239.		*Supunna funerea*			
240.		*Supunna picta*			
241.	25705	*Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
242.	24682	*Tachybaptus novaehollandiae subsp. novaehollandiae (Australasian Grebe, Black-throated Grebe)*			
243.	24331	*Tadorna tadornoides (Australian Shelduck, Mountain Duck)*			
244.		*Talaurinus carbonarius*			
245.		*Talaurinus sp.*			
246.	24167	*Tarsipes rostratus (Honey Possum, Noolbenger)*			
247.	24844	*Threskiornis molucca (Australian White Ibis)*			
248.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
249.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
250.	25519	*Tiliqua rugosa*			
251.	25204	*Tiliqua rugosa subsp. aspera*			
252.	25207	*Tiliqua rugosa subsp. rugosa*			
253.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
254.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
255.		*Urodacus novaehollandiae*			
256.	24386	*Vanellus tricolor (Banded Lapwing)*			
257.	25218	*Varanus gouldii (Bungarra or Sand Monitor)*			
258.		*Venator immansueta*			
259.	24040	*Vulpes vulpes (Red Fox)*	Y		
260.	25765	*Zosterops lateralis (Grey-breasted White-eye, Silvereye)*			

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Australian Government

Department of the Environment

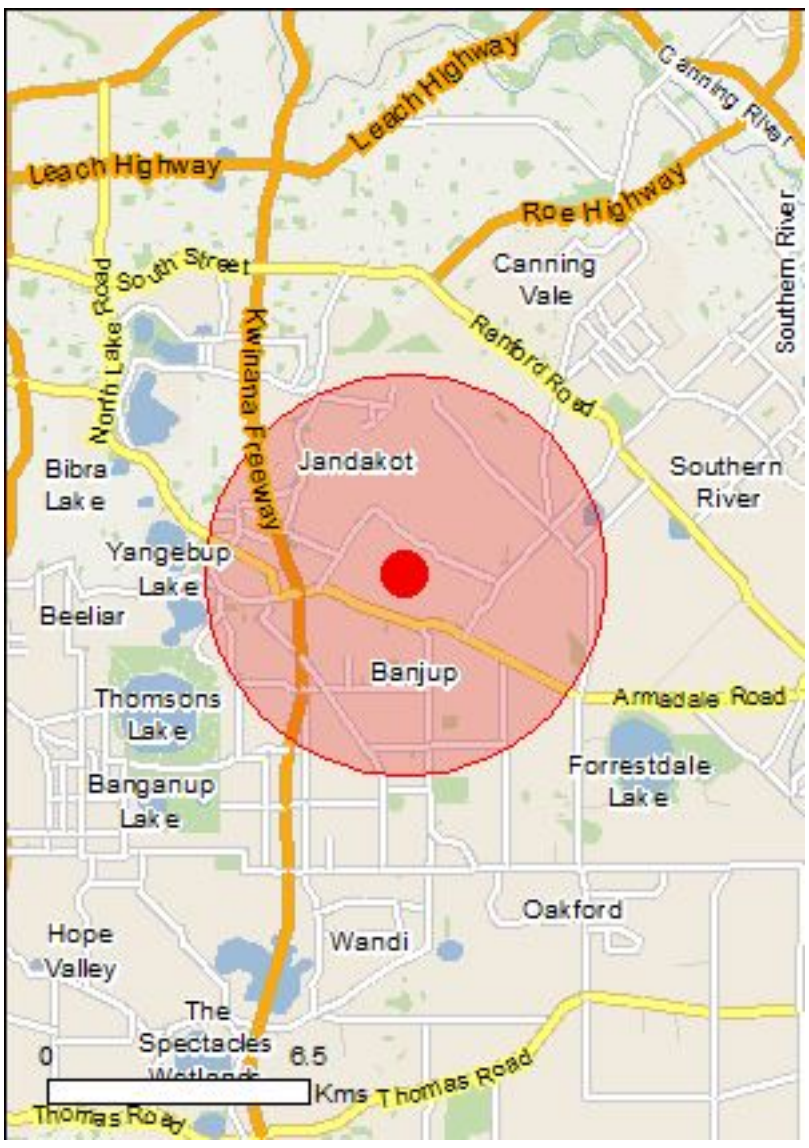
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 28/04/16 14:57:51



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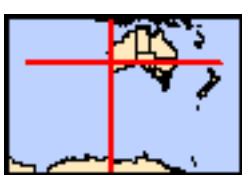
Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	19
Listed Migratory Species:	18

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	24
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	3
Regional Forest Agreements:	None
Invasive Species:	43
Nationally Important Wetlands:	1
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Forrestdale and thomsons lakes	Within 10km of Ramsar

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus		
Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii		
Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Insects		
Neopasiphae simplicior		
A native bee [66821]	Critically Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat may occur within area
Plants		
Andersonia gracilis		
Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat known to occur within area
Darwinia foetida Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat known to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species

Name	Threatened	Type of Presence
		habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Calidris canutus Red Knot, Knot [855]		Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Species or species habitat known to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Tringa nebularia		
Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis		
Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves	[Resource Information]
Name	State
Gibbs Road	WA
Piara	WA
Thomsons Lake	WA

Invasive Species	[Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis		
Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos		
Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis		
European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia		
Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus		
House Sparrow [405]		Species or species habitat likely to occur within area
Passer montanus		
Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis		
Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris		
Common Starling [389]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Nationally Important Wetlands [Resource Information]

Name	State
Gibbs Road Swamp System	WA

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.12428 115.88346

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX D

Conservation Significant Flora Likelihood Assessment

Conservation significant flora species likelihood assessment

The Likelihood of each species is based on the following criteria: Recorded: Recorded during the field survey or site reconnaissance;

- Likely: Suitable habitat present and records less than 5 km from the Study area
- Possible = Suitable habitat present and records between 5 km and 20 km from the Study area
- Unlikely = No suitable habitat present and/or records greater than 20 km from the Study area.

SPECIES	SPECIES DESCRIPTION	CONSERVATION STATUS	LIKELIHOOD	LIKELIHOOD JUSTIFICATION
Andersonia gracilis (Slender Andersonia)	*Andersonia gracilis is found in w*hite/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	DRF(T)/EN	Unlikely	Due to the lack of suitable habitat, *Andersonia gracilis* is considered as Unlikely to occur in the Study area.
Caladenia huegelii King Spider-(orchid)	*Caladenia huegelii* occurs in areas of mixed woodland of Jarrah (*Eucalyptus marginata*), Candlestick Banksia (*Banksia attenuata*), Holly Banksia (*B. ilicifolia*) and Firewood Banksia (*B. menziesii*) with scattered Sheoak (*Allocasuarina fraseriana*) and Marri (*Corymbia calophylla*) over dense shrubs of Blueboy (*Stirlingia latifolia*), Swan River Myrtle (*Hypocalymma robustum*), Yellow Buttercups (*Hibbertia hypericoides*), Buttercups (H. *subvaginata*), Balga (Xanthorrhoea preissii), Coastal Jugflower (*Adenanthos cuneatus*) and Conostylis species, from just north of Perth to the Busselton area, usually within 20 km of the coast. Throughout its range the species tends to favour areas of dense undergrowth. Soil is usually deep grey-white sand usually associated with the Bassendean sand-dune system.	DRF(T)/EN	Found on site	*Caladenia huegelii* was found on Site during numerous flora and vegetation surveys on-site (RPS 2010; PGV Environmental 2012; ENV Australia 2013; 360 Environmental 2015).

Species	Species Description	Conservation Status	Likelihood	Likelihood Justification
	However, rare plants have been known to extend into the Spearwood system (in which calcareous yellow sands dominate) in some areas (DEC 2009).			
Darwinia foetida (Muchea Bell)	*Darwinia foetida* occurs in grey-white sand on swampy, seasonally wet sites. Plants are found alongside sump land, that is, land acting as a pit or well where water collects (CALM 2006).	DRF(T)/CE	Unlikely	The nearest specimen of *Darwinia foetida* from the site is approximately 54 km and the extent of the population is approximately 1.2 $km^{2.}$ As such *Darwinia foetida* is considered Unlikely to occur in the Study area.
Diuris micrantha (Dwarf Bee-orchid)	The species grows in seasonally wet flats amongst sedges and scattered shrubs (Brown et al. 2013), on brown loamy clay.	DRF(T)/V	Unlikely	The habitat preference of the species being the borders of swamps and shallow water makes the species unlikely to occur
Diuris purdiei (Purdie's Donkey-orchid)	*Diuris purdiei* grows under dense shrubs in seasonally-wet swamps and drainage lines (Brown et al. 2013), in grey-black sand, moist, winter-wet swamps.	DRF(T)/EN	Unlikely	The habitat preference of the species being the borders of swamps makes the species unlikely to occur
Drakaea elastic (Glossy-leafed Hammer-orchid)	The species grows in deep sandy soil in Banksia woodland, in low lying areas alongside winter-wet swamps. (Brown et al., 1998).	DRF(T)/EN	Unlikely	The habitat preference of the species being the borders of swamps makes the species unlikely to occur

Species	Species Description	Conservation Status	Likelihood	Likelihood Justification
Drakaea micrantha (Dwarf Hammer-orchid)	*Drakaea micrantha* inhabits infertile white-grey sands in common sheoak (*Allocasuarina fraseriana*) and jarrah (*Eucalyptus marginata*) woodland or forest. It usually grows on fire breaks and in disturbed sites where competition from other plants has been removed (Brown et al., 1998).	DRF(T)/V	Likely	The nearest specimen of *Drakaea micrantha* is 4.1 km from the site and occurs sporadically over a wide range between Perth and Albany. The Study area has suitable habitat and as such is considered Likely to occur.
*Lepidosperma rostratum (*Beaked Lepidosperma)	Rhizomatous, tufted perennial, grass-like or herb) sedge. Prefers peaty sand and clay.	DRF(T)/EN	Possible	The nearest specimen being approximately 9 km from the site and the presence of its preferred habitat.
*Thelymitra dedmaniarum (*Cinnamon Sun Orchid)	A rare sienna sun orchid 200 to 400 mm high with a broad, pale green or yellowish-green leaf 100-200 mm long by 20 to 40 mm wide and up to 15 rich brown and yellow, cinnamon-scented flowers 40 to50 mm across with broad petals and sepals and a broad column with fimbriate outer lateral lobes and a bulbous apex	DRF(T)/EN	Unlikely	The nearest specimen is approximately 37.5 km from the site and is found in a small area near Gidgegannup in the Darling range, growing on granite slopes and in open wandoo woodland (Brown *et al.* 2013)
Stylidium aceratum	Fibrous rooted annual herb. Prefers sandy soils, swamp healthland.	P2	Possible	The nearest specimen being approximately 7 km from the site and the presence of its preferred habitat.

Species	Species Description	Conservation Status	Likelihood	Likelihood Justification
Byblis gigantea (Rainbow Plant)	*Byblis gigantea* inhabits sandy-peat swamps and seasonally wet areas.	P3	Unlikely	The absence of suitable habitat means that *Byblis gigantea is* considered unlikely to occur.
Cyathochaeta teretifolia	*Cyathochaeta teretifolia* inhabits grey sand, sandy clay. Swamps and creek edges.	P3	Likely	The nearest specimen is located 2.9 km from the Study area and suitable habitat is present. As such the species is considered as likely to occur in the Study area.
Jacksonia gracillima	Unknown	P3	Unknown	The nearest specimen is located 4.3 km from the Study area, however, it is unknown whether suitable habitat is present. As such the species is considered as unknown to occur in the Study area.
Phlebocarya pilosissima subsp. pilosissmia	Shortly rhizomatous, compactly tufted perennial grass-like or her, 0.15-.04 m high. Occurs in white or grey sand, lateritic gravel.	P3	Likely	The nearest specimen being less than 4 km from the site and the presence of its preferred habitat.
Schoenus pennisetis	Tufted annual, grass-like or herb (sedge), 0.05-0.15m high. Occurs in grey or peaty sand, sandy clay, swamps and winter wet depressions.	P3	Possible	The nearest specimen being approximately 6 km from the site and the presence of its preferred habitat.

Species	Species Description	Conservation Status	Likelihood	Likelihood Justification
Stylidium paludicola	Reed-like perennial, herb between .35 – 1m high. Inhabits peaty sand over clay, winter wet habitats. Marri and melaleuca woodland and melaleuca shrubland.	P3	Likely	The nearest specimen being less than 2 km from the site and the presence of its preferred habitat.
Jacksonia sericea (Waldjumi)	*Jacksonia sericea inhabits* calcareous and sandy soils.	P4	Likely	The nearest specimen is located 4.6 km from the Study area and suitable habitat is present. Therefore the species is considered likely to occur in the Study area.
Stylidium longitubum (Jumping Jacks)	*Stylidium longitubum inhibits* sandy clay, clay and seasonal wetlands.	P4	Unlikely	The nearest specimen is located 4.1 km from the Study area and no suitable habitat is present. Therefore *Stylidium longitubum* is considered unlikely to occur in the Study area.
Tripterococcus sp. brachylobus	No data available	P4	Unknown	Unknown
Verticordia lindleyi subsp. lindleyi	*Verticordia lindleyi subsp. lindleyi* inhabits sand, sandy clay.	P4	Likely	The nearest specimen is located 4.2 km from the Study area and suitable habitat is present. Therefore the species is considered likely to occur in the Study area

EN = Listed as Endangered under the EBPC Act

V = Listed as Vulnerable under the EBPC

CE= Critically Endangered under the EBPC Act

P = Listed as Priority by the DPaW

DRF (T) = Declared Rare Flora (Threatened) as listed by the State.

References

360 Environmental 2015, *Level 2 Flora and Vegetation Survey of Lot 131 Jandakot Road, Banjup.* Prepared for Perron Developments Pty Ltd.

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APPENDIX E

Conservation Significant Fauna Likelihood Assessment

Conservation significant fauna species likelihood assessment

The Likelihood of each species is based on the following criteria:

- Recorded: Recorded during the field survey or site reconnaissance;
- Likely: Suitable habitat is present in the Study area and the Study area is in the species' known distribution;
- Possible: Limited or no suitable habitat is present in Study Area, but is nearby. The species has good dispersal abilities and is known from the general area; and
- Unlikely: No suitable habitat is present in Study area but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however the Study area is outside of the species' known distribution.

SPECIES	SPECIES DESCRIPTION	CONSERVATION STATUS	LIKELIHOOD*	LIKELIHOOD JUSTIFICATION
Lerista lineata (Perth Slider)	The Perth Slider is listed as P3 under the DPaW priority list. The Perth Slider is a burrowing species found in coastal heaths and low shrubland, where it feeds at night on ants, termites and other small insects (Cogger 2014). This species is mainly found in coastal heath and shrubland on the lower west coast between Perth and Mandurah (Wilson & Swan 2013).	P3	Likely	The Study Area has sandy soils considered suitable for the Perth Slider and as such is considered Likely to occur in the Survey Area.
Leipoa ocellata (Malleefowl)	The Malleefowl is listed as Vulnerable under the EBPC Act and Schedule 3 under the WC Act. In the past century the range of the Malleefowl has contracted, particularly in arid areas and at the periphery of its former range. In Australia, clearing for Agriculture has eliminated and fragmented much of the Malleefowl habitat, resulting in localised extinctions and	V S1	Unlikely	The Study Area is not within the known distribution of the species (Barrett *et al*. 2003). Consequently, the Malleefowl is considered unlikely to occur.

SPECIES	SPECIES DESCRIPTION	CONSERVATION STATUS	LIKELIHOOD*	LIKELIHOOD JUSTIFICATION
	fragmented populations (Garnett *et al*. 2011). In WA since 1981, the Malleefowls range has been estimated to have contracted by between 28 and 30% (Parsons *et al*. 2008). Historically, the species was originally common and widespread in semiarid zones, mainly in scrubs of mallee and other low Eucalypts on sandy and lateritic soils; also Acacia scrubs on heavy red soils, especially north and east of the mulga-eucalypt line. The Malleefowl is now generally rare to uncommon and patchily distributed due to habitat loss.			
Falco peregrinus (Peregrine Falcon)	The Peregrine Falcon is listed as Schedule 7 under the WC Act. It is an uncommon but wide-ranging across Australia. It occurs mainly along rivers and ranges as well as wooded watercourses and lakes and nests primarily on cliffs, granite outcrops and quarries. They feed mostly on birds (Johnstone & Storr 1998).	S 4	Unlikely	A lack of suitable habitat result in this species being considered unlikely to occur in the Study Area.
Calyptorhynchus banksii subsp. *naso* (Forest Red-tailed Black Cockatoo)	The Forest Red-tailed Black Cockatoo (FRTBC) is listed as Vulnerable under the EPBC Act and Schedule 3 under the WC Act. The FRTBC is distributed through the humid and subhumid south-west of Western Australia from Gingin through the Darling Ranges to the south-west from Bunbury to Albany. The FRTBC feeds primarily on Marri and Jarrah fruit (Johnstone & Kirkby 1999) and to a lesser extent on Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*Eucalyptus staeri*), Karri (*Eucalyptus diversicolor*), Sheoak (*Allocasuarina*	V S1	Likely	The project area is located in the known distribution of this species and there are small areas of vegetation containing various *Eucalyptus* and *Banksia* species that the FRTBC is known to include in its diet.

SPECIES	SPECIES DESCRIPTION	CONSERVATION STATUS	LIKELIHOOD*	LIKELIHOOD JUSTIFICATION
	fraseriana) and Snottygobble (Persoonia longifolia). Forest Red-tailed Black Cockatoo can obtain energy faster when feeding on Marri and Jarrah than other food sources (Cooper *et al*. 2002) and these two plant species make up 90% of the diet of the FRBC.			
Calyptorhynchus baudinii (Baudin's Black-Cockatoo)	Baudin's Cockatoo is listed as Vulnerable under the EPBC Act and Schedule 2 under the WC Act. The species is distributed through the south-western humid and subhumid zones, from the northern Darling Range and adjacent far east of the Swan Coastal Plain (south of the Swan River), south to Bunbury and across to Albany. Baudin's Cockatoo rarely occurs near the coast north of Mandurah, and rarely occurs north of the Swan River (Johnstone & Kirkby 2008, Johnstone & Storr 1998). Baudin's Cockatoo usually occur in small flocks of up to 30, or occasionally up to 50 and rarely in aggregations of up to 1200 (Johnstone & Kirkby 2008). Baudin's Cockatoo is distinguished from the other white-tailed black cockatoo (Carnaby's Cockatoo) by its longer bill and slightly different call. This species forages primarily in eucalypt forest, where it feeds on Marri seeds, flowers, nectar and buds. They also feed on a wide range of seeds of Eucalyptus, Banksia, Hakea and Pines (*Pinus* sp.) as well as fruiting apples and pears and beetle larvae from under the bark of trees (Johnstone & Kirkby 2008, Johnstone & Storr 1998).	V S1	Likely	The project area is located in the known distribution of this species and there are small areas of vegetation containing various *Eucalyptus* and *Banksia* species which provide suitable foraging habitat.

Species	Species Description	Conservation Status	Likelihood*	Likelihood Justification
Calyptorhynchus latirostris (Carnaby's Cockatoo)	Carnaby's Cockatoo is listed as Endangered under the EPBC Act and Schedule 2 under the WC Act. Carnaby's Cockatoo is endemic to south-west Western Australia, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). The species was once common, but the population has declined significantly in the last half century, and is now locally extinct in some areas (Johnstone & Storr 1998, Shah 2006). In the last 45 years the species has suffered a 50% reduction in its abundance (Cale 2003). This reduction is due to the clearing of core breeding habitat in the wheatbelt, the deterioration of nesting hollows, and clearing of food resources on the Swan Coastal Plain (Cale 2003). The total population of Carnaby's Cockatoo is currently estimated at 40,000. Carnaby's Cockatoos feed on seeds, nuts and flowers of a variety of native and exotic plants. Food plants include Banksia (including those previously included in the genus Dryandra), Pine trees (*Pinus* sp.), Marri, Jarrah, Grevillea, Allocasuarina, and Hakea species (Shah 2006). Marri nuts that are damaged extensively, especially on the main body of the nut, are likely to have been chewed by Carnaby's Cockatoo or FRTBC.	EN S1	Likely	The project area is located in the known distribution of this species and there are small areas of vegetation containing various *Eucalyptus* and *Banksia* species which provide suitable foraging habitat.
Merops ornatus (Rainbow Bee-	The Rainbow Bee-eater is listed as Migratory under the EPBC Act and Schedule 5 under the WC Act. It occurs in lightly wooded, often sandy country, preferring areas near water. It	MiMa	Likely	The Rainbow Bee-eater was returned from both the NatureMap and EPBC PMST. This species is one of the

Species	Species Description	Conservation Status	Likelihood*	Likelihood Justification
eater)	feeds on airborne insects, and nests throughout its range in WA in burrows excavated in sandy ground or banks, often at the margins of roads and tracks. In WA this species can occur as a 'resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor' (Johnstone & Storr 1998). The Study areacontains potential foraging habitat for this species.			most common and widespread birds in Australia with a distribution that covers the majority of Australia (Barrett et al. 2003), as such it is considered as Likely to occur in the Survey Area.
Dasyurus geoffroii (Western Quoll)	The Western Quoll is listed as Vulnerable under the EPBC Act and Schedule 3 under the WC Act. Knowledge of the ecology of the Western Quoll is largely restricted to its distribution in mesic jarrah forests. Here, population densities are three times greater than in semi-arid zones where rainfall and consequently productivity are lower than mesic forests and home ranges are larger (Rayner et al. 2012). The Western Quolls diet includes mammals, birds, reptiles, invertebrates, plants and rubbish, which is consistent with it being a generalist predator. The Western Quoll was formerly distributed over nearly 70% of the continent, occurring in every Mainland State and Territory (Woinarski et al. 2014). Since European settlement, its range has contracted dramatically. Historically it was found in the vicinity of the Survey Area, but it is now restricted to the south-west of WA where it has a fragmented distribution.	V S1	Unlikely	This species is now only found in sclerophyll forest, woodland and mallee shrubland (Van Dyck & Strahan 2008). It is highly mobile, and appears able to utilise bush remnants and corridors. However, due to its now limited distribution and the fragmented nature of the Survey Area, the Western Quoll is considered unlikely to occur.
Isoodon obesulus	Southern Brown Bandicoot once occurred throughout the	P 5	Likely	The Southern Brown Bandicoot is

Species	Species Description	Conservation Status	Likelihood*	Likelihood Justification
(Southern Brown Bandicoot)	south west of WA. It now occurs from Guilderton southwards on the SCP, including the Perth metropolitan area, in the Jarrah and Karri forests and adjacent coastal vegetation complexes, east along the south coast to Cape Arid National Park. Southern Brown Bandicoots prefer dense vegetation, including wetland fringes and heathland. It is patchily distributed in suitable habitat and can still be found in forest, woodland, shrub and heath communities (Woinarski et al. 2012).			patchily distributed in suitable habitat, being often found near road verges and in fragmented and degraded areas. Suitable scrubby habitat with sandy soils is present in the Study area and as such the species is considered likely to occur.
Macropus irma *(Western Brush Wallaby)*	The Western Brush Wallaby is listed as Priority 4 under the DPaW priority list. This species occurs in open forest or woodland, particularly where grassy understory and scrubby thickets are present. It is found only in south-western WA, where it is in decline, probably as a result of an increase in the numbers of foxes. Due to limited studies on this species, very little is known of its food preferences, but it seems to manage without free water (Van Dyck & Strahan 2008).	P4	Unlikely	The Study Area does not have a grassy understory which results in a lack of suitable habitat and as such it can be considered Unlikely to occur in the Survey Area.

EN= Listed as Endangered under the EBPC Act

V= Listed as Vulnerable under the EBPC Act

Mi= Listed as Migratory under the EBPC Act

Ma= Listed as Marine under the EBPC Act

S= Scheduled under the WC Act (Threatened)

P= Listed as Priority by DPaW

The below wetland and marine species were returned from the 5km EPBC PMST and NatureMap database searches.

- *Actitis hypoleucos* (Common Sandpiper) IA
- *Ardea ibis* (Cattle Egret) IA
- *Ardea modesta* (Eastern Great Egret) IA
- *Botaurus poiciloptilus* (Australasian Bittern) Endangered
- *Calidris acuminata* (Sharp-tailed Sandpiper) IA
- *Calidris ferruginea (*Curlew Sandpiper*)*
- *Calidris melanotos* (Pectoral Sandpiper) IA
- *Calidris ruficollis* (Red-necked Stint) IA
- *Calidris subminuta* (Long-toed Stint) IA
- *Charadrius dubius* (Little Ringed Plover) IA
- *Apus pacificus (Fork-tailed Swift)*
- *Haliaeetus leucogaster* (White-bellied Sea-Eagle) IA
- *Limosa limosa* (Black-tailed Godwit) IA
- *Oxyura australis* (Blue-billed Duck) P4
- *Pandion cristatus* (Osprey) IA
- *Plegadis falcinellus* (Glossy Ibis) IA
- *Rostratula australis* (Australian Painted Snipe) Endangered
- *Thinornis rubricollis (*Hooded Plover*) IA*
- *Tringa glareola* (Wood Sandpiper) IA

- *Tringa nebularia* (Common Greenshank) IA

Database Errors and Locally Extinct Species

A number of species returned were also known to be historical records of species now extinct in the local area and more broadly in the region, or database errors:

- *Motacilla cinerea* (Grey Wagtail)
- *Myrmecobius fasciatus* (Numbat)
- *Pseudocheirus occidentalis* (Western Ringtail Possum)

These species have been omitted from any further discussion.

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360 environmental

10 Bermondsey Street West Leederville WA 6007 **t** (+618) 9388 8360 **f** (+618) 9381 2360
PO BOX 14, West Perth WA 6872
w 360environmental.com.au **e** admin@360environmental.com.au

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Appendix 2

Transport Assessment

(Transcore)

Banjup District Structure Plan

Transport Impact Assessment

PREPARED FOR:
Perron Developments

February 2017

Document history and status

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TABLE OF CONTENTS

REPORT FIGURES

REPORT TABLES

1.0 Introduction

Transcore prepared a Transport Impact Assessment (TIA) report on behalf of Perron Developments for the proposed Banjup District Structure Plan (DSP) in June 2016. The outcome of the TIA report was presented to the relevant authorities including the City of Cockburn, Main Roads WA and Public Transport Authority (PTA) during a Stakeholder Meeting on 20 September 2016.

During the Stakeholder Meeting Main Roads WA indicated that the existing traffic lights at Ghostgum Avenue/ Armadale Road would be converted to a left in/ left out intersection in the long term if the Armadale Road Deviation project and the construction of a grade separated interchange at Armadale Road/ Verde Drive/ Tapper Road was to proceed. Main Roads WA also expressed some concerns regarding the proposed left in/ left out intersection on Armadale Road between Ghostgum Avenue and Liddelow Road.

Accordingly, the June 2016 TIA report has been amended to include the outcome of the transport modelling and analysis for the proposed access arrangements along Armadale Road fronting the DSP area as per Main Roads WA request. The proposed Main Roads WA access arrangements (assuming that the Armadale Road Deviation project occurs in future) include:

- Downgrading the intersection of Armadale Road/ Ghostgum Avenue to a Left in/ Left out intersection in the long term;
- Removing the proposed left in/ left out intersection on Armadale Road between Ghostgum Avenue and Liddelow Road; and
- Installation of a roundabout at Armadale Road/ Liddelow Road/ DSP access road.

PTA and City of Cockburn also indicated that in the longer term if the intersection of Ghostgum Avenue/ Armadale Road is converted to a left in/ left out intersection, an alternative bus route should be prepared to replace the original proposed bus route within the Calleya LSP area.

This Transport Impact Assessment (TIA) report is an amendment to the June 2016 TIA report and provides the outcome of the additional modelling and analysis which has been undertaken to reflect the access arrangements proposed by MRWA along Armadale Road fronting the DSP area in the long term. The TIA also provides an alternative bus route option should the intersection of Ghostgum Avenue/ Armadale Road be converted to a left in/ left out intersection.

The boundary of the DSP is defined by Solomon Road, Armadale Road, Warton Road and Jandakot Road. The DSP area is approximately 641 ha and includes the existing 118.5 ha of regional reserves and the following Lots:

- Lots 132 and 9004 (Calleya Estate), 105.9 ha;
- Lot 1 east (previously Lot 821) Armadale Road, about 20.35 ha;
- Lot 2 Armadale Road, 3.15 ha;
- Lots 4 Armadale Road, 58.77 ha;
- Lot 131 Jandakot Road, 64.75 ha; and
- Lot 1 west Armadale Road.

Figure 1 shows the location of the DSP in relation to the surrounding regional roads.

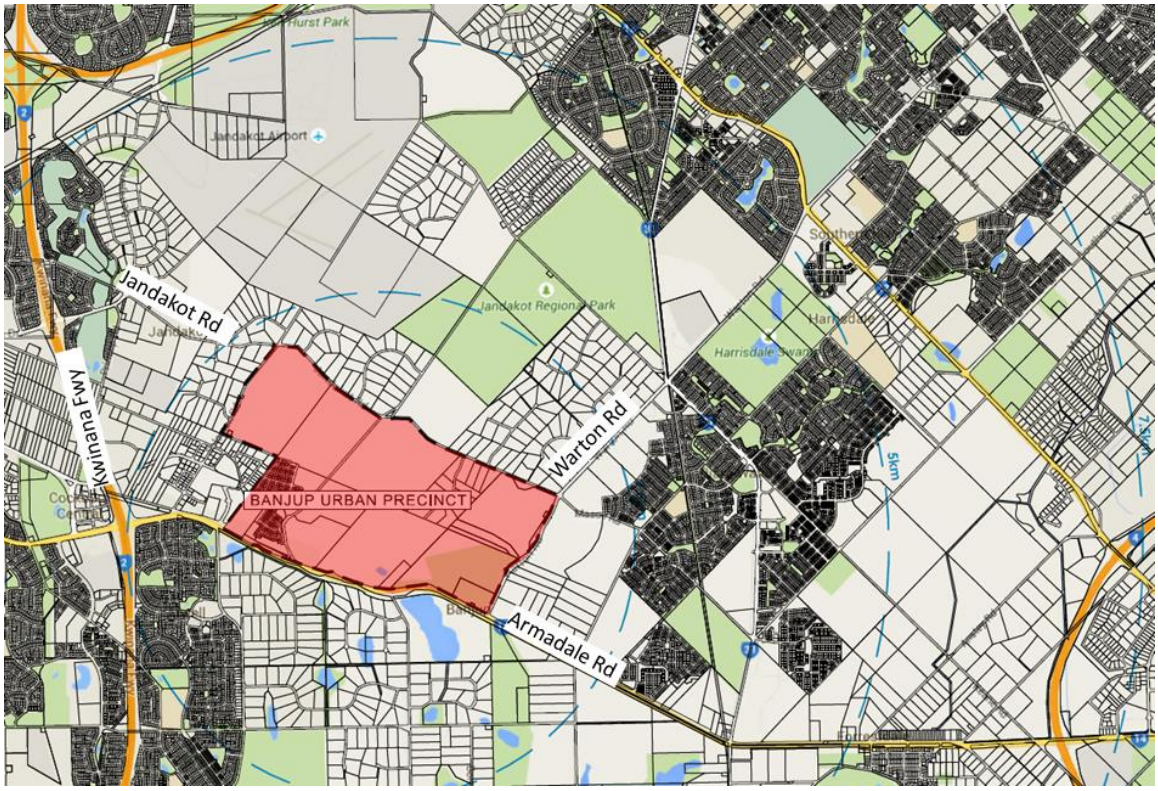

Figure 1: Location of Banjup District Structure Plan

2.0 Proposed District Structure Plan

The proposed Banjup District Structure Plan is shown in **Figure 2**. The proposed DSP entails the approved Banjup Quarry (Calleya) Local Structure Plan, the existing 14 Lots within the Skotsch Road Rural Residential Precinct, existing 118.5 ha of regional reserves and four potential development sites at Lots 1 west & east, 2, 4 and 131 Armadale Road.

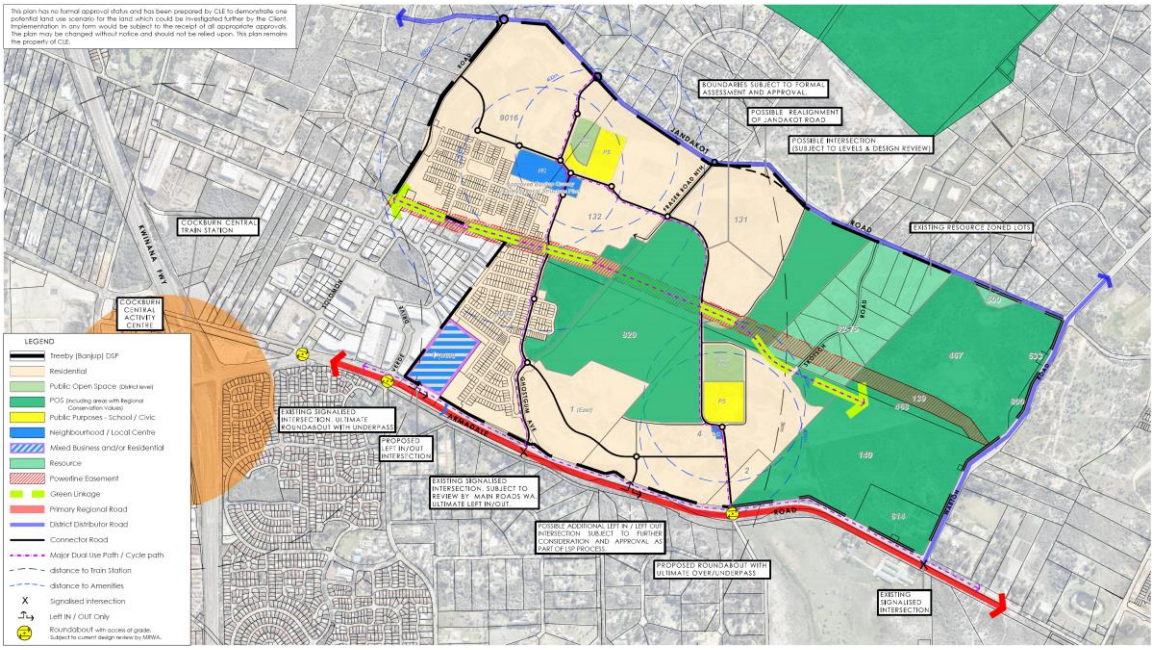

Figure 2: Proposed Banjup District Structure Plan

The proposed DSP internal road network is established through a number of Neighbourhood Connector roads which provides sufficient and logical connectivity through different Lots within the DSP area. The proposed internal road network facilitates the traffic circulation within the DSP area and provides connectivity to the surrounding regional roads including Armadale Road and Jandakot Road.

The access arrangements along Jandakot Road include three roundabout intersections at Solomon Road, the N-S spine road (within Calleya LSP) and Fraser Road. The existing priority controlled T-intersection of Jandakot Road/ Skotsch Road also provides access to the DSP area.

Jandakot Road in the vicinity of the DSP area will be upgraded to a dual divided carriageway standard with localised widening at intersections to cater for turn lanes. The proposed concept design for Jandakot Road includes 2x7.0m carriageways, 6.0m median with variable verges.

According to the information obtained from Main Roads WA Armadale Road in the vicinity of the DSP area will be duplicated in near future (Funding for

duplication of Armadale Road between Anstey and Tapper roads has been approved). Ultimately, Armadale Road is planned to be upgraded to six lanes.

The proposed DSP access arrangements along Armadale Road entail the existing traffic lights at Fraser Road/ Armadale Road and a proposed 4-way roundabout intersection at Liddelow Road/ Armadale Road/ DSP access road (to Lots 2&4 Armadale Road). In order to improve permeability and connectivity of the proposed DSP area a left in/ left out intersection is also proposed on Armadale Road between Ghostgum Avenue and Liddelow Road.

It is Transore's understanding that Main Roads WA has some concerns regarding the proposed left in/ left out intersection on Armadale Road. Accordingly the revised modelling and analysis undertaken for the long term option (assuming implementation of Armadale Road Deviation project) does not include the proposed left in/ left out intersection.

The proposed DSP area also shows a left in/ left out intersection for Lot 1 west as approved. It is Transcore's understanding that the final location and layout of the proposed left in/ left out intersection along Armadale Road for Lot 1 west is subject to future planning of this Lot.

The total number of residential lots within the DSP area is estimated to be about 3,500 lots with the following distribution on each Lot:

- About 2,000 Lots on Calleya LSP;
- About 330 Lots on Lot 1 east Armadale Road;
- About 700 Lots on Lots 2 & 4; and,
- About 500 Lots on Lot 131.

It must be noted that the proposed 3,500 Lots for the DSP area does not include any residential Lots on Lot 1 west or Skotsch Road locality.

According to the information provided to Transcore, the current status of planning for Lot 1 west is not clear yet, however for the purpose of traffic modelling and analysis and in the absence of more detailed planning for Lot 1 west, it has been assumed that Lot 1 west would accommodate about 60% service commercial with a lesser proportion (about 40%) residential Lots. Any changes to the above percentages would not change the traffic outcome of this report.

3.0 Existing Situation

3.1 Existing Land Use

The site currently is mainly vacant. There are about 14 residential Lots along Skotsch Road. The northern precinct of the Calleya LSP area is currently vacant but the southern precinct is under construction with the majority of the internal roads and some residential dwellings already constructed. About 118.5 ha (about 25%) of the DSP area is allocated to the Regional Reserve.

3.2 Existing Road Network

Armadale Road is a Primary Distributor road according to the Main Roads WA Functional Road Hierarchy and a Primary Regional Road in the Metropolitan Region Scheme. Armadale Road has been recently upgraded to dual carriageway standard at the intersection with Ghostgum Avenue. Armadale Road is of single carriageway standard with a speed limit of 80 km/h to the east of the Calleya LSP area and becomes dual carriageway again immediately to the west of Calleya. According to traffic counts published by Main Roads WA Armadale Road in this vicinity (west of Liddelow Road) carried 28,000vpd with 10% heavy vehicles in June 2015.

Jandakot Road is of single carriageway standard with a speed limit of 80km/h in the vicinity of the DSP area. According to Main Roads WA, Jandakot Road is a Regional Distributor and a District Distributor (B) in accordance with City of Cockburn classification. According to traffic counts provided by the City of Cockburn, Jandakot Road, 220m west of Skotsch Road, carried about 11,200vpd in 2015.

Jandakot Road continues to the east to form a dual lane roundabout intersection with Warton Road. Jandakot Road forms a 4-way roundabout with Berrigan Drive. This roundabout currently has single lane approaches on all legs. According to traffic counts provided by Main Roads WA Berrigan Drive, east of Kwinana Freeway, carried about 19,000vpd in 2014/2015.

Solomon Road is a District Distributor B Road of single carriageway standard with a speed limit of 70km/h in the vicinity of the DSP area. According to traffic counts provided by the City of Cockburn, Solomon Road, south of Jandakot Road, carried about 6,500vpd in 2015. Solomon Road connects to Jandakot Road at a T-intersection without any turn lanes or widening on Jandakot Road. Solomon Road connects to Armadale Road at a T-intersection with a 45m left turn pocket and a 70m right turn pocket on Armadale Road as well as a 45m flare on Solomon Road.

Skotsch Road is an access road which provides access to the existing residential dwellings to the south of Jandakot Road. The existing intersection of

Skotsch Road/ Jandakot Road is a priority controlled T-intersection with right turn pocket on Jandakot Road.

Warton Road is a District Distributor A Road of dual carriageway standard with a speed limit of 70km/h in the vicinity of the DSP area. According to traffic counts provided by Main Roads WA, Warton Road, south of Jandakot Road, carried about 18,600vpd in 2014/2015. Warton Road connects to Jandakot Road at a roundabout intersection. Warton Road connects to Armadale Road at a signalised intersection.

3.3 Public Transport

The closest bus service in the vicinity of the DSP area is the existing bus route 518 (from Challenger Institute of Technology to Cockburn Central Station) running along Armadale Road to the south of the DSP area.

The closest train station in the vicinity of the subject site is the Cockburn Central train station (refer **Figure 3**) which is located about 1.5km and 3km from the western and eastern boundary of the DSP area, respectively. On average the walking distance between the DSP area and the Cockburn Central Station is about 2 to 3km.

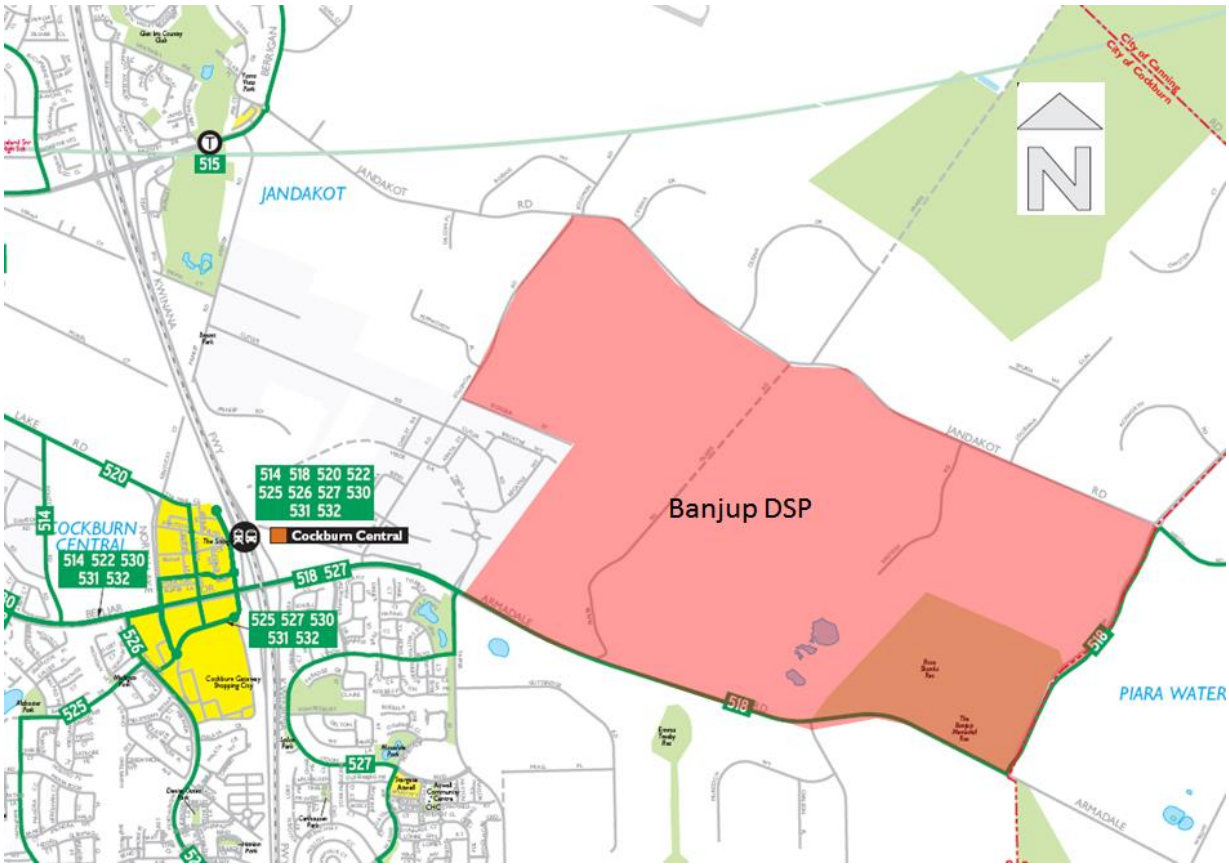

Figure 3: Existing Bus Routes

3.4 Pedestrian and Cyclist Facilities

There are no existing pedestrian or cyclist facilities on Jandakot Road or Solomon Road in the vicinity of the DSP area. The recent upgrading of Armadale Road through the Ghostgum Avenue intersection has provided on-road cycle lanes on Armadale Road along the frontage of the Calleya LSP although other sections of Armadale Road to the east and west have not yet been upgraded to this standard. A 2.5m concrete shared path is in place at the eastern side of Warton Road.

The Department of Transport's Perth Bike Map series (see **Figure 4**) shows that bicycle lanes or sealed shoulder are provided either side of Armadale Road and Jandakot Road.

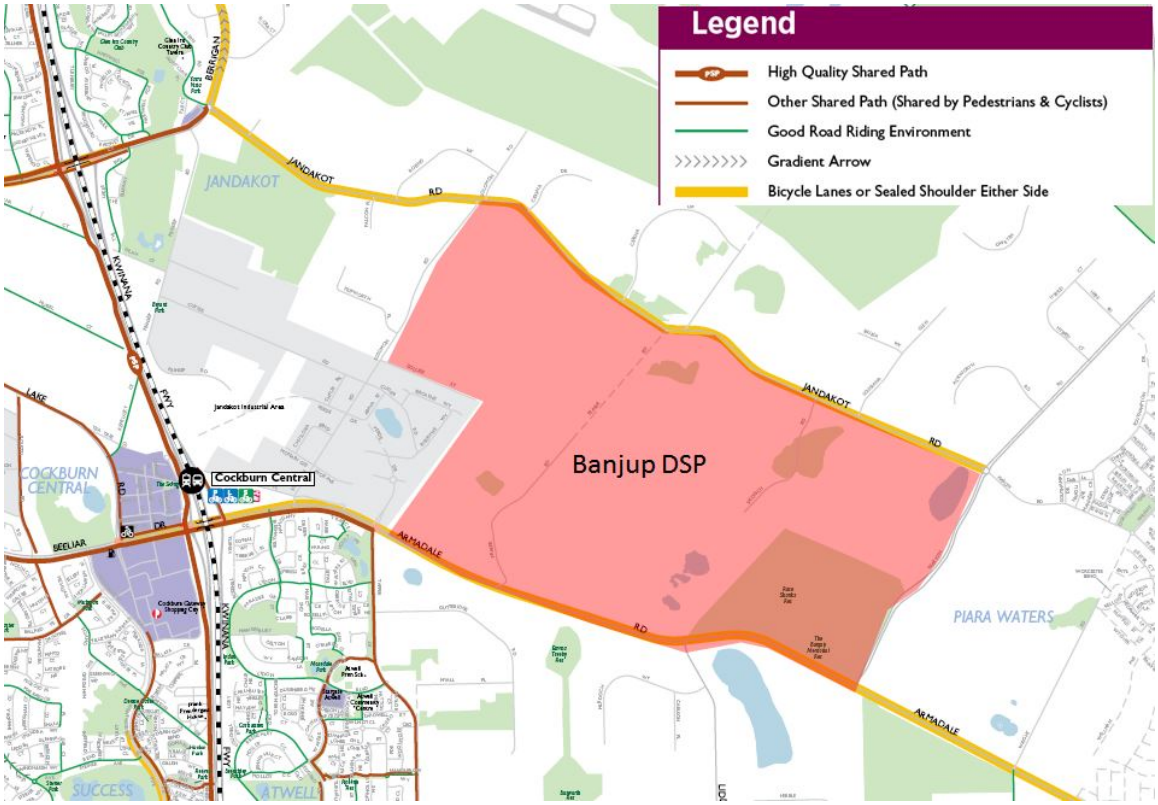

Figure 4: Bike Map

3.5 Changes to the Surrounding Road Network

There are regional and local proposed changes to the surrounding road network in this area. Armadale Road is expected to be upgraded to 4 lanes in the medium term and 6 lanes in the longer term. Jandakot Road is also expected to be upgraded to 4 lanes in future to provide another strong east-west link parallel to Armadale Road.

The Western Australian Planning Commission (WAPC) has recently issued a Planning Control Area (PCA No 122) for the Armadale Road Deviation (ARD) which indicates the realignment proposal of Armadale Road in this area. **Appendix A** contains a copy of PCA No 122.

The following statement provides City of Cockburn's advice on this project:

''Even with the Armadale Road Deviation project it should be noted that the existing North Lake Road (Verde Drive) Other Regional Roads alignment (established as part of MRS amendment 1038/33) remains unaffected by this proposal. That is, the Armadale Road Deviation does not in itself represent an overall road arrangement which in total would perform the general functions and objectives equivalent to those of the specific Other Regional Road alignment achieved by MRS Amendment 1038/33. Thus as established by the MRS amendment, the Other Regional Roads reserved portion representing North lake Road (Verde Drive) retains its function of providing regional access to the regionally significant Industrial area''.

It is understood that the ARD proposes lowering Armadale Road and placing it in a trench from west of Solomon Road all the way to the east of Verde Drive. As a result, the existing intersections of Armadale Road/ Solomon Road and Armadale Road/ Tapper Road/Verde Drive would need to be converted to roundabout at surface level, with on and off ramps connecting the roundabouts to the Armadale Road (referred to as a "duck and dive" treatment).

Due to the close proximity of the existing signalised intersection on Ghostgum Avenue/ Armadale Road to the future potential grade separated intersection on Armadale Road/ Tapper Road/Verde Drive, there would be a risk of safety issues associated with weaving movements for the section of Armadale Road between the end of the Armadale Road trench (the grade separation would involve lowering the through traffic lanes on Armadale Road) and the signalised intersection on Ghostgum Avenue. The length of the weaving would be affected by the queue back on Armadale Road at the traffic lights.

Main Roads WA is currently investigating the details of the traffic operation along Armadale Road assuming the proposed ARD project occurred. It is likely that the existing traffic lights at Ghostgum Avenue intersection would be converted to a left in / left out intersection to facilitate the future traffic operation on Armadale Road in this locality.

With respect to Jandakot Road upgrades (responsibility of the City of Cockburn and various developers), the plan is to:

- Upgrade Jandakot Road to dual carriageway ultimately. The ultimate standard would include two traffic lanes each way and 6m median (the proposed cross section does not fit with the existing road reserve of Jandakot Road and requires land take from both sides) and;
- The intersection of Jandakot Road/ Berrigan Drive/ Airport south link would be converted to traffic lights and Berrigan Drive would be duplicated between the Freeway and Jandakot Road (construction to commence in 2016).

The proposed local changes within the DSP area include provision of the proposed internal neighbourhood connector roads and in particular the N-S spine road within Calleya Master Plan area which provides a north-south link between

Armadale Road and Jandakot Road and would assist in the distribution of traffic onto Armadale Road and Jandakot Road.

The other proposed local changes to Armadale Road include conversion of the existing T-intersection of Armadale Road/ Liddelow Road into a roundabout intersection. A potential left in/ left out intersection on Armadale Road is also proposed in the DSP area.

Transcore understands that Main Roads WA has provided "in principal" approval for the proposed 4-way roundabout intersection at Armadale Road/ Liddelow Road; however Main Roads WA has concerns about the proposed left in/ left out intersection on Armadale Road. For the purpose of this report additional modelling and analysis are undertaken to reflect the removal of the proposed left in/ left out intersection from Armadale Road as per Main Roads WA request.

3.6 Public Transport Network Planning

According to the information provided by the Public Transport Authority (PTA) in February 2015 as part of the Calleya Master Plan development application, a bus route is likely to be run through the Calleya LSP area. This bus route would travel north-south through Calleya (refer **Figure 5**). This potential bus route could be:

- A new PTA bus route between Cockburn and Murdoch stations;
- A connection with Route 515 (Glen Iris); or
- An extension or alternative route to Route 515 (Glen Iris).

The timing of any future bus route is unknown at this stage and is subject to Government funding that may be influenced by passenger demand and the developers providing adequate road access/connections. Figure 5 also shows the potential bus stops along the proposed bus route within the Calleya LSP area.

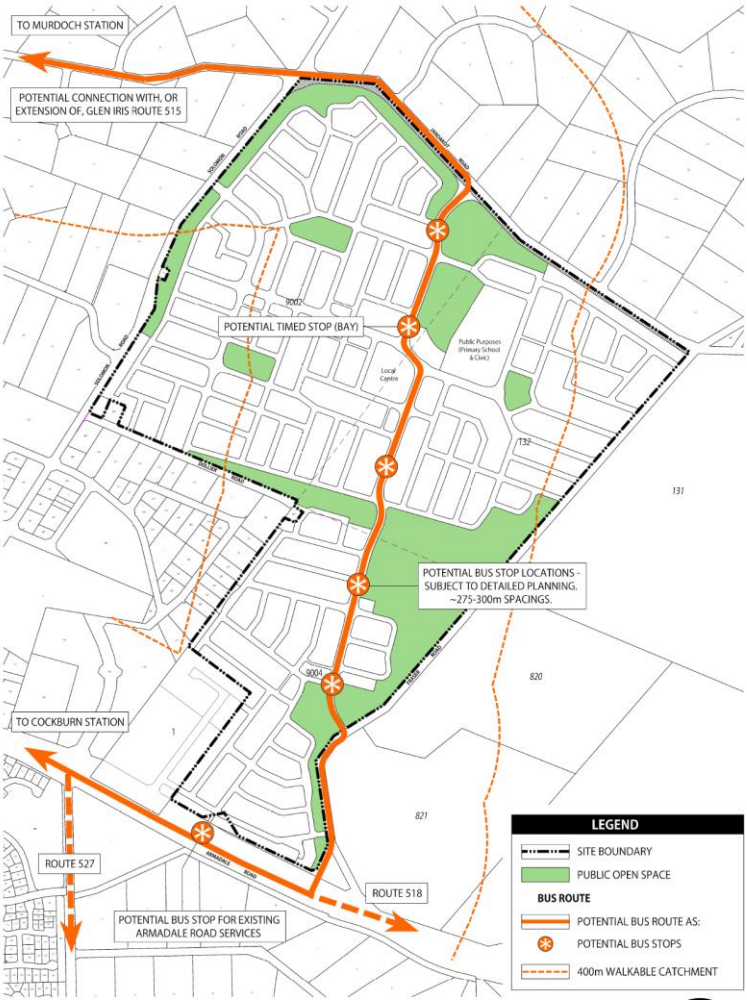

Figure 5: Proposed Bus Route through Calleya LSP Area

The latest information received from PTA in June 2016 confirms the above planning is still valid. According to the same information, a 1km separation distance between parallel bus routes in this area has been recommended. Accordingly, the proposed north south route through Calleya LSP area is not likely to be replicated through future developments further east and the existing bus route which currently travels on Warton Road will shift to Wright Road (in Piara Waters) once Wright Road is fully constructed.

However, PTA suggested that in the event that residential development extends east of the Calleya Master Plan and sufficient demand arises for secondary bus services, then there is likely to be a need for a supplementary bus route (indicated as the red line in **Figure 6**). The route would likely operate from Cockburn Central, along Armadale Road, then north- south through the eastern development across to the proposed Neighbourhood Activity Centre.

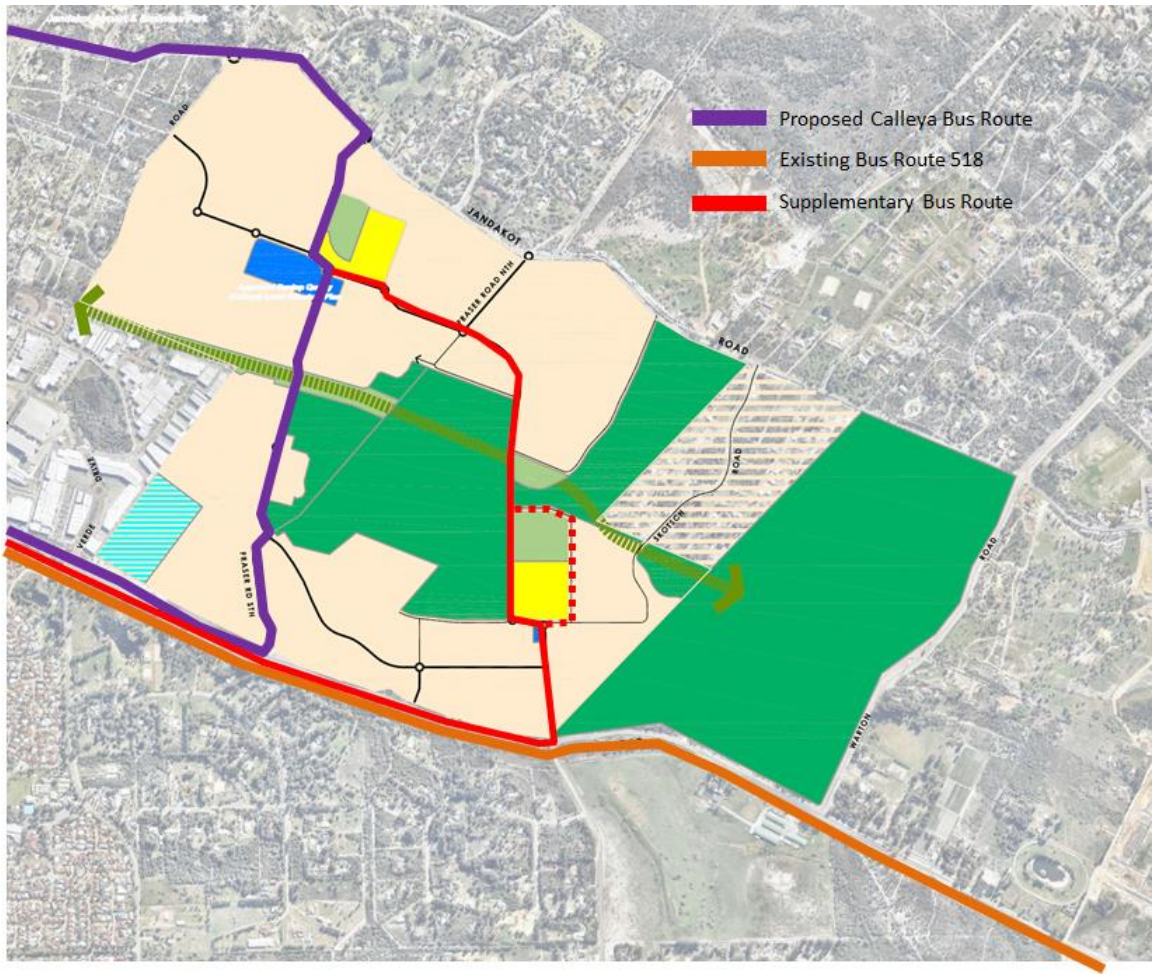

Figure 6: Potential future bus routes (PTA)

The proposed bus route within the Calleya LSP area shown in Figure 5 is subject to the availability of the full movement intersection at Ghostgum Avenue/ Armadale Road in future. However, if the existing signalised intersection at Ghostgum Avenue converts to a left in/ left out intersection in the longer term as a result of the proposed ARD project, then an alternative bus route option would be required to replace the current proposed bus route.

It is Transcore's understanding that City of Cockburn and PTA are collectively investigating the possible potential options for the proposed alternative bus route through consultation with Stockland. As a result of the current investigations PTA and City of Cockburn have prepared a potential alternative bus route option as shown in **Figure 7**.

The proposed alternative bus route option travels between Jandakot Road and Solomon Road through the northern part of the N-S spine road and some of the local roads within Calleya LSP area.

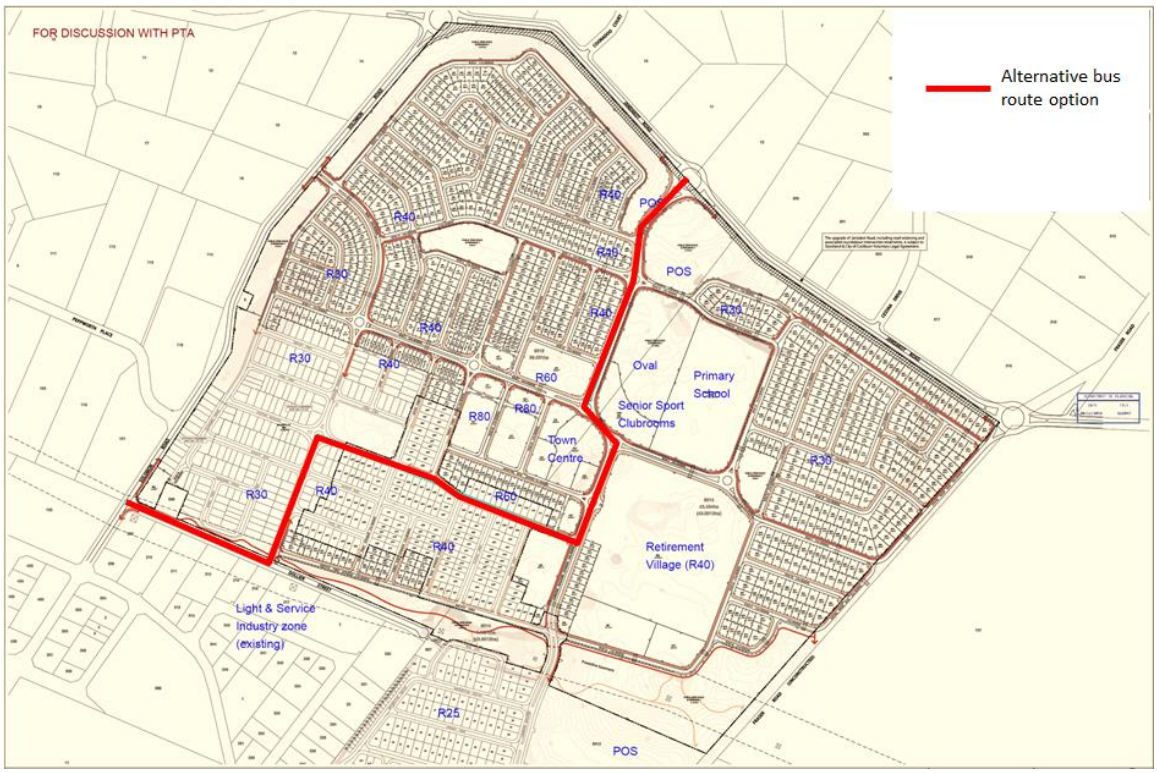

Figure 7: Proposed alternative bus route option

The Department of Transport plan, Public Transport for Perth in 2031, envisages a future bus rapid transit route from Armadale to Cockburn Central providing a cross-suburban link between the Mandurah and Armadale railway lines. However this is part of the ultimate network for a city of 3.5 million people and is indicated as beyond 2031 (refer **Figure 8**). According to the same plan extension of Thornlie rail line is also expected to connect Cannington to Cockburn Central and continuing further south-west towards Rockingham.

Figure 8: Transperth Future Service Development Plan Map

4.0 Proposed Transport Network

4.1 Road Hierarchy

The proposed hierarchy of roads within the DSP area is illustrated in **Figure 9** using the road hierarchy classification from Liveable Neighbourhoods (2007).

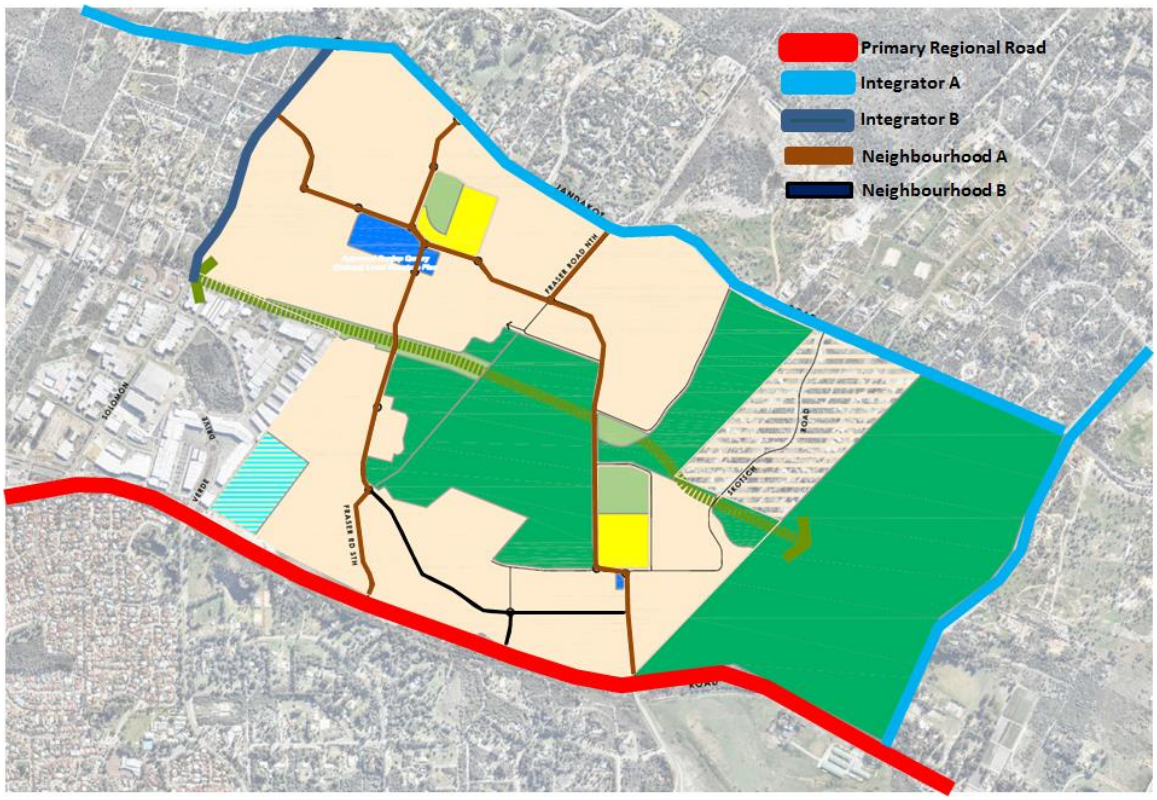

Figure 9: Proposed Road Hierarchy (Original access arrangements along Armadale Road)

Figure 10 illustrates the proposed road hierarchy of the DSP area as per access arrangements proposed by Main Roads WA for the longer term along Armadale Road. Traffic modelling and analysis undertaken indicates that if the intersection of Ghostgum Avenue/ Armadale Road converts to left in/ left out and the proposed left in/ left out intersection on Armadale Road between Ghostgum Avenue and Liddelow Road is removed then the projected daily traffic volume on the southern section of the N-S spine road (Ghosgum Avenue) would drop to less than 3,000vpd and therefore this section of Ghosgum Avenue would be classified as Neighbourhood Connector B road (refer Figure 10).

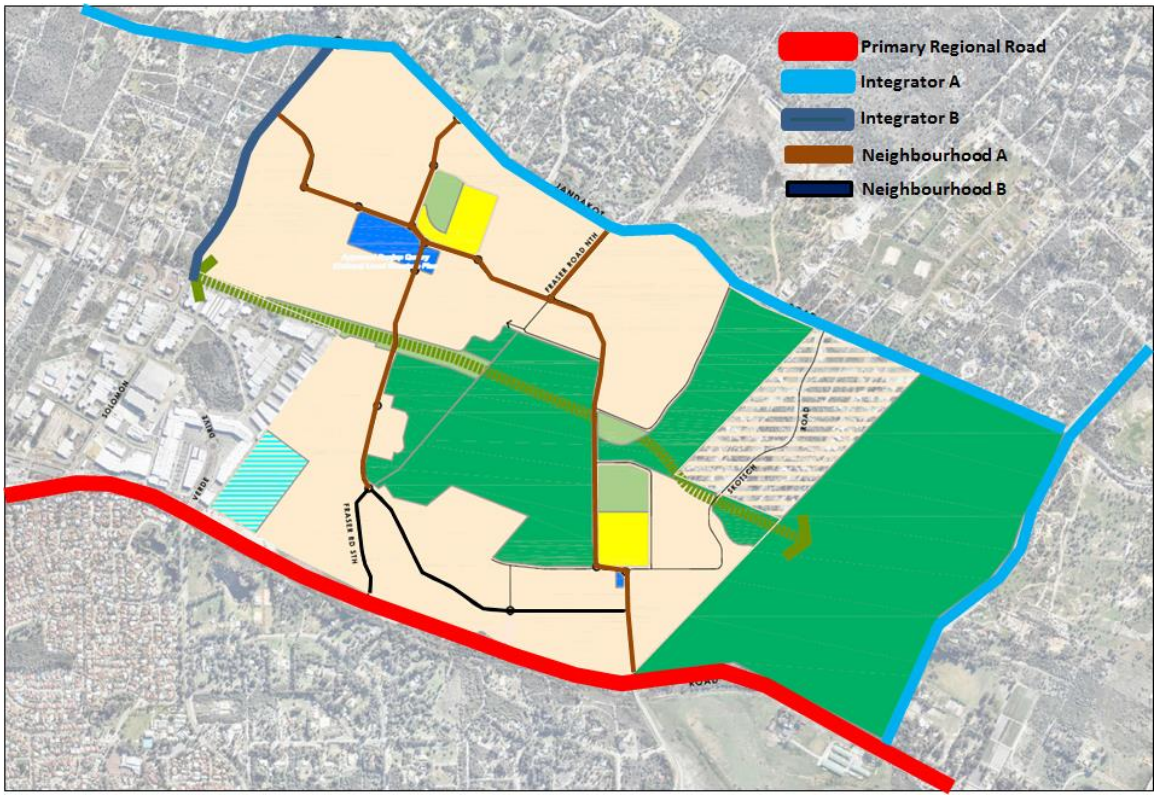

Figure 10: Proposed Road Hierarchy (Main Roads WA proposed access arrangements along Armadale Road)

Armadale Road is a Primary Distributor road according to the Main Roads WA Functional Road Hierarchy and a Primary Regional Road in the Metropolitan Region Scheme. The projected traffic volume along Armadale Road is expected to be over 50,000vpd in future after upgrading Armadale Road to six lanes.

The proposed Banjup DSP only shows the major internal roads within the DSP area. Some key characteristics of the relevant road classifications have been summarised in **Table 1** below. These are generally based on Liveable Neighbourhoods guidelines although the proposed widths would vary slightly from the standard Liveable Neighbourhoods cross-section diagrams.

Table 1: Key Characteristics for the Proposed LSP Road Classifications

Road Classification	Indicative upper volume (vpd)	Indicative road reserve width (m)	Indicative road pavement width (m)
Integrator A	35,000	40m	2 x 8.5m (incl. cycle lanes) + 6m median
Integrator B	15,000	25m	2 x 5m (incl. cycle lanes) + median
Neighbourhood Connector A	7,000	23m	2 x 5m (incl. cycle lanes), 2m median and embayed parking
Neighbourhood Connector B	3,000	20m	7.4m and embayed parking

It should be noted that these reserve widths are indicative only and are subject to further adjustment in consultation with the Department of Planning and City of Cockburn during detailed subdivision design.

Integrator A
Jandakot Road and Warton Road are expected to carry about 20,000vpd to 30,000vpd in the vicinity of the DSP area and therefore are classified as Integrator A Road of dual carriageway standard. The ultimate standard of Jandakot Road would include two traffic lanes each way and6m median.

Integrator B
Solomon road will be an Integrator B road in the Liveable Neighbourhoods road hierarchy. The projected traffic volume on Solomon Road is about 10,000vpd to 12,000vpd in the vicinity of the DSP area.

Neighbourhood Connectors
The proposed north-south and east-west roads within the Calleya Master Plan area are expected to carry about 3,000vpd to 7,000vpd and therefore are classified as Neighbourhood Connector A roads. The southern section of Ghostgum Avenue would be classified as Neighbourhood Connector B road if the intersection of Ghostgum Avenue/ Armadale Road converts to left in/ left out in longer term.

Fraser Road to the south of Jandakot Road is also classified as Neighbourhood Connector A road.

The proposed north-south Road within Lots 4 and 131 which connects Armadale Road to Fraser Road is expected to carry traffic volume of more than 3,000vpd and therefore is classified as Neighbourhood Connector A road.

The proposed east-west Road which travels through Lots 4 and 821 and the proposed left in/left out connector link into Armadale Road are classified as Neighbourhood Connector B Roads.

4.2 Public Transport

Existing bus services in this area are described in section 3.3 of this report and current planning by the Public Transport Authority is discussed in section 3.6.

4.3 Pedestrian and Cyclist Facilities

Figure 11 outlines the proposed pedestrian and cyclist network for the DSP area. The proposed pedestrian and cyclist facilities aim to provide a permeable road network within the DSP area and create excellent opportunities for the provision of good pedestrian and cyclist facilities that maximise the use of non-motorised transport modes.

According to Liveable Neighbourhood Guidelines Shared Paths and Footpaths are proposed along all Neighbourhood Connector A roads. Shared Paths are also proposed along Armadale Road, Solomon Road, Warton Road and Jandakot Road.

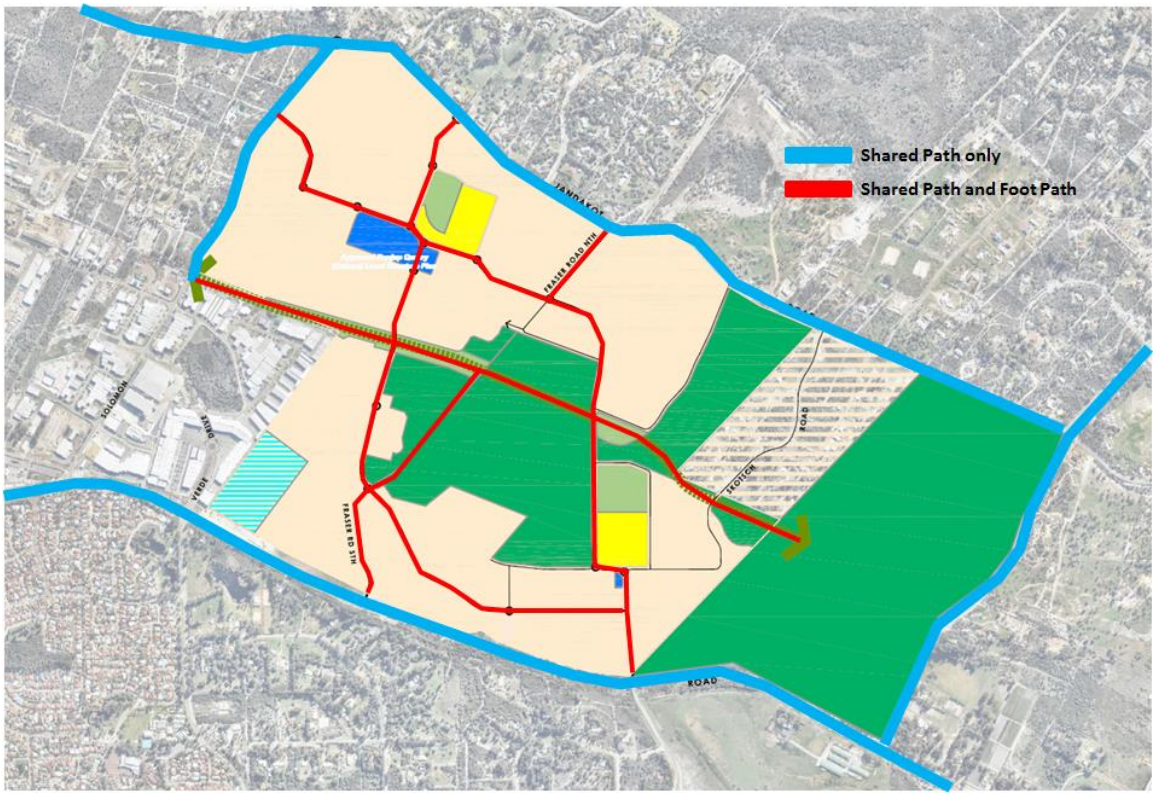

Figure 11: Proposed Pedestrian and Cyclist Network

4.4 Integration with Surrounding Area

The proposed land uses for the DSP area are predominantly residential dwellings which are in line with the existing and future surrounding land uses in this area.

The road network of the DSP area will connect to the surrounding road network including Armadale Road and Jandakot Road at a number of locations. This will include two connections to Armadale Road and four connections to Jandakot Road. The proposed pedestrian and cyclist facilities within the DSP area would provide connection to the proposed Shared Paths along Armadale Road and Jandakot Road.

5.0 Analysis of the Transport Network

5.1 Assessment Period

The assessment year that has been adopted for this analysis is 2031, with full development of the DSP area.

5.2 Traffic generation and distribution

Transcore has developed a subregional strategic transport model for weekday traffic flows for the Armadale area using the EMME transport modelling software package. This model was used to estimate the traffic projections of the proposed DSP area.

The daily traffic generation rate used for the DSP area for this transport assessment is 8 vehicle trips per day (vpd) per dwelling, which corresponds to peak hour trip generation rates recommended in the Western Australian Planning Commission (WAPC) Transport Assessment Guidelines for Development (2006).

The anticipated 3,500 (2000+330+700+500= 3,530 say 3,500) dwellings of the DSP area will therefore generate approximately 28,000vpd. It must be noted that the proposed 3,500 Lots for the DSP area does not include any residential Lots on Lot 1 west or the Skotsch Road locality.

According to the information provided to Transcore, the current status of planning for Lot 1 west is not clear yet, however for the purpose of traffic modelling and analysis and in the absence of more detailed planning for Lot 1 west, it has been assumed that Lot 1 west would accommodate primarily about 60% service commercial with a lesser proportion (about 40%) residential Lots.

For the proposed primary schools within the DSP area the trip rate used is 1.0 vph per student during the before and after school peak periods (typically 8-9am and 3-4pm) and 2vpd per student overall. For this assessment the Education Department's standard 430 student primary school design has been assumed, so each of the proposed primary schools are assumed to attract traffic flows of 860vpd.

For the proposed Neighbourhood and Local Centres within the DSP area a trip rate of 121 vpd per 100sqm NLA of the retail area is adopted. Accordingly, the local neighbourhood centre of about 2,800m^2 NLA within the Calleya LSP area is estimated to attract about 3,400vpd. Similarly the proposed 500m^2 Local Centre within Lot 4 would attract about 600vpd.

The distribution of these trips is determined by the traffic model in proportion to the location of trip productions and attractors for work trips, education trips and other trips (shopping, social, recreational, etc.) among all the land uses in the traffic model.

5.3 Traffic Flow Forecasts

Figure 12 illustrates future total daily traffic flows estimated for the road network of the DSP area based on the road network and access arrangements shown in the Banjup DSP (refer Figure 2).

Figure 13 shows the same figures for the long term. In the longer term it is likely that the existing signalised intersection of Armadale Road/ Ghostgum Avenue converts to a left in/ left out intersection. The traffic projections in Figure 13 reflect the proposed changes to the existing traffic lights at Ghostgum Avenue. The modelling and analysis undertaken for the long term option does not include the proposed left in/ left out intersection on Armadale Road between Ghostgum Avenue and Liddelow Road.

The future total daily traffic flows on the road network in and around the DSP area has been modelled for the future scenario of full development of this area. The modelled surrounding district road network reflects latest future road network upgrades for this area. Accordingly 6 and 4 lanes were assumed for Armadale and Jandakot Roads respectively to reflect the future upgrades proposed for these roads in long term.

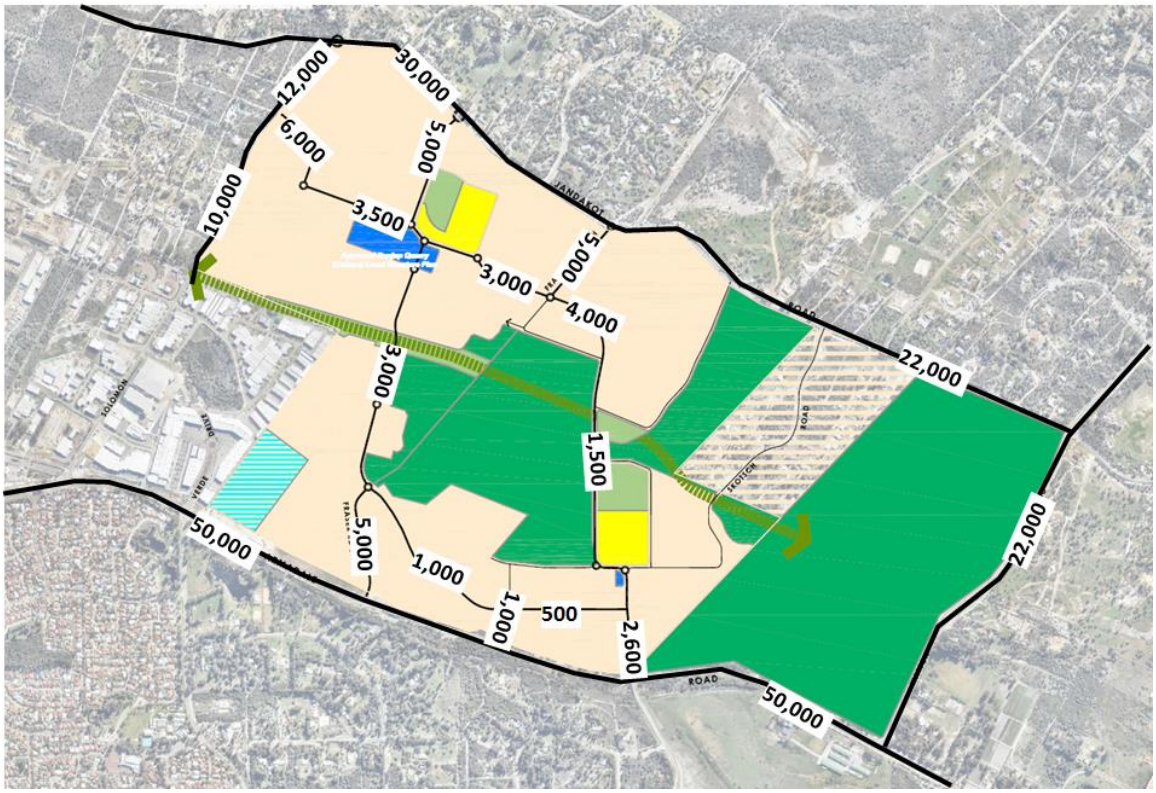

Figure 12: Projected Daily Traffic Volumes (Original access arrangements along Armadale Road)

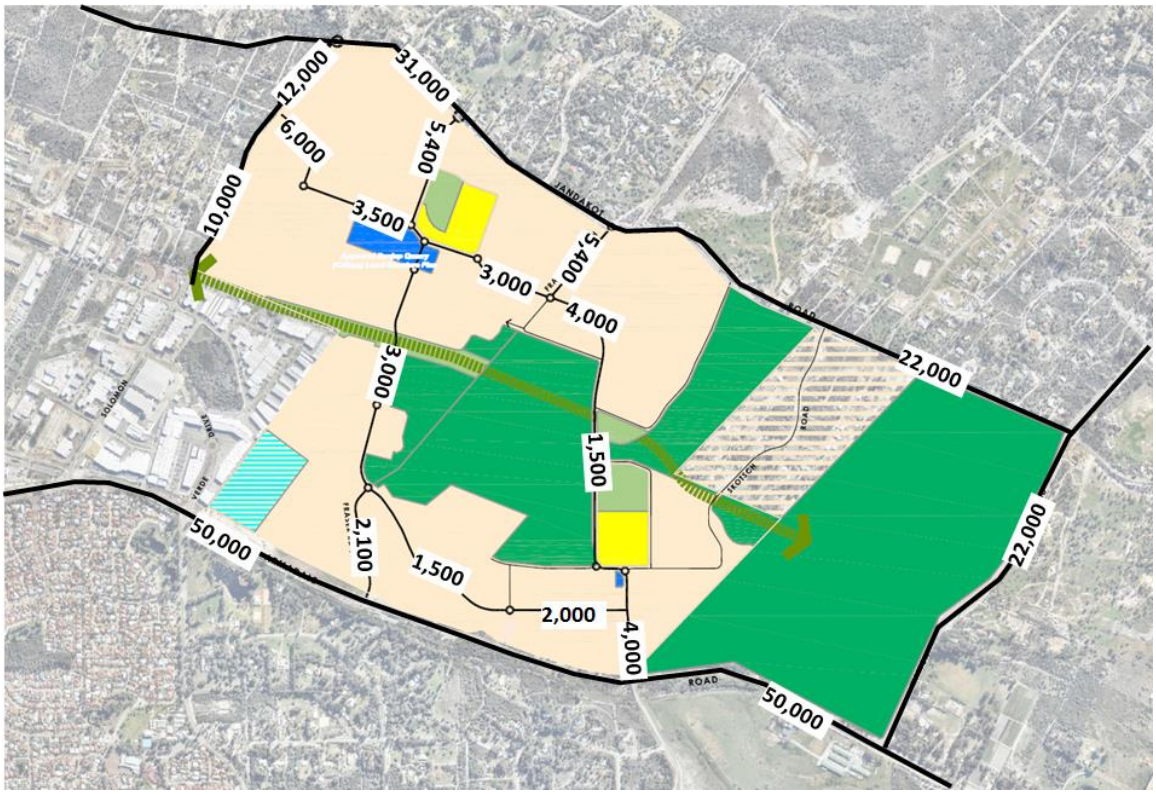

Figure 13: Projected Daily Traffic Volumes (Main Roads WA proposed access arrangements along Armadale Road)

Reviewing the projected traffic volumes in Figures 12 and 13 indicates that in the long term (after downgrading the Ghostgum Avenue/ Armadale Road signalised intersection to left in/ left out intersection and removal of the proposed left in/ left out intersection on Armadale Road between Ghostgum Avenue and Liddelow Road) more traffic would utilise the future roundabout intersection at Armadale Road/ Liddelow Road/ DSP access road. Accordingly the proposed east-west neighbourhood connector B road parallel to Armadale Road would attract more traffic and the projected daily traffic volume on the southern section of the N-S spine road (Ghostgum Avenue) would drop to less than 3,000vpd.

5.4 Roads and Intersections

The proposed road network to accommodate these traffic volumes has been detailed in section 4 of this transport assessment, including the details of the proposed road hierarchy in section 4.1.

Figure 14 details the proposed intersection controls for key intersections within the DSP area.

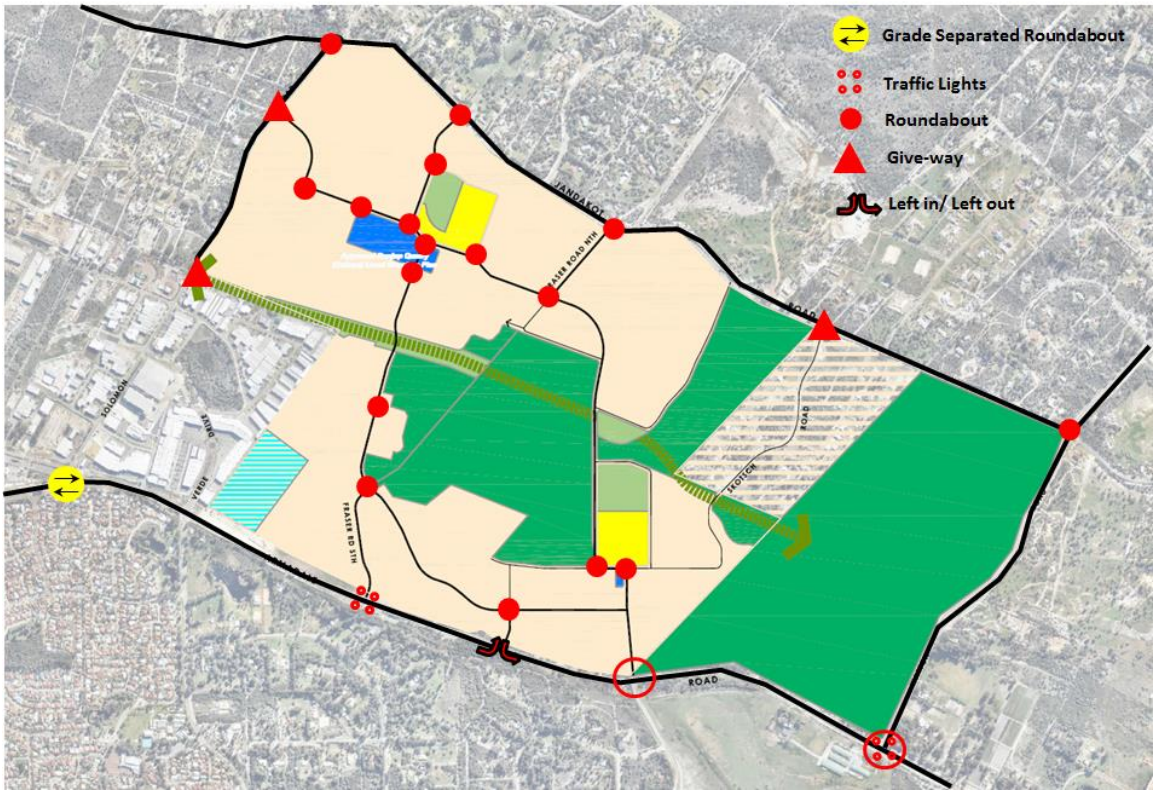

Figure 14: Intersection Treatments

Armadale Road Intersections

The primary access to the DSP area on Armadale Road is proposed by two 4-way intersections at Ghostgum Avenue and Liddelow Road as shown in Figure 14.

Currently the intersection of Ghostgum Avenue/ Armadale Road is controlled by traffic lights, however in the longer term (after the Armadale Road Deviation project), this intersection would be downgraded to a left in left out intersection and the existing traffic lights would be removed. The proposed 4-way intersection of Armadale Road/ Liddelow Road/ DSP access road is proposed to operate as a roundabout.

The DSP shows a left in/ left out access intersection on Armadale Road between Ghostgum Avenue and Liddelow Road. The proposed left in/ left out intersection would improve connectivity and permeability of the DSP area. Main Roads WA expressed some concerns with the proposed left in/ left out intersection and therefore the traffic modelling and analysis in the amended TIA report includes the option without the left in/ left out intersection.

Jandakot Road Intersections

The proposed DSP provides four connections to Jandakot Road including three roundabout intersections at Solomon Road, N-S road and Fraser Road. The existing intersection of Skotsch Road and Jandakot Road is expected to operate as a priority controlled T-intersection. It is Transcore's understanding that Skotsch Road would not connect to the Lot 4 from south to minimise the level of through traffic on this road.

Solomon Road Intersections
Two priority controlled T-intersections are proposed on Solomon Road from Dolier Road and main east-west road in the Calleya LSP area.

Internal Intersections
A number of roundabouts are proposed within the DSP area for the proposed internal 4-way intersections and major T-intersections. These roundabouts will help manage circulating traffic flows and assist with speed management on the neighbourhood connector roads.

5.5 Intersection Analysis

Capacity analysis of the proposed intersections on Armadale Road and Jandakot Road has been undertaken using the SIDRA computer software package for the typical peak hour. SIDRA is an intersection modelling tool commonly used by traffic engineers for all types of intersections. SIDRA outputs are presented in the form of Degree of Saturation, Level of Service, Average Delay and 95% Queue. These characteristics are defined as follows:

- Degree of Saturation is the ratio of the arrival traffic flow to the capacity of the approach during the same period. The Degree of Saturation ranges from close to zero for infrequent traffic flow up to one for saturated flow or capacity.
- Level of Service is the qualitative measure describing operational conditions within a traffic stream and the perception by motorists and/or passengers. In general, there are 6 levels of service, designated from A to F, with Level of Service A representing the best operating condition (i.e. free flow) and Level of Service F the worst (i.e. forced or breakdown flow).
- Average Delay is the average of all travel time delays for vehicles through the intersection.
- 95% Queue is the queue length below which 95% of all observed queue lengths fall.

The results of the SIDRA analysis are summarised in **Appendix B**.

The SIDRA analysis indicates that the existing traffic lights on Armadale Road/Ghostgum Avenue and proposed roundabout at Liddelow Road/ Armadale Road/ DSP access road would operate satisfactorily and within capacity.

The proposed roundabout intersections along Jandakot Road would also operate satisfactorily with acceptable levels of service at the intersections. The existing intersection of Skotsch Road/ Jandakot Road is also expected to operate satisfactorily as priority controlled T-intersection in future. The proposed large median along Jandakot Road would provide the opportunity for right turn traffic from Skotsch Road to Jandakot Road to occur in two stages.

Additional transport modelling and intersection analysis are undertaken for the future roundabout intersection of Armadale Road/ Liddelow Road/ DSP access road during the longer term and assuming that the intersection of Ghostgum

Avenue/ Armadale Road converts to a left in/ left out intersection. Figure B7 and Table B7 in Appendix B show the intersection layout and intersection operation respectively. SIDRA analysis undertaken indicates that the proposed roundabout intersection would work satisfactorily with overall level of service A and maximum queue of about 48m on Armadale Road.

5.6 Access to Frontage Properties

The WAPC *Liveable Neighbourhoods* policy requires that "Development along integrator B and neighbourhood connector streets with ultimate vehicle volumes over 5,000 vehicles per day should be designed either so vehicles entering the street can do so travelling forward, or are provided with alternative forms of vehicle access. Wider lots with paired driveways and protected reversing areas in the parking lane may be used on streets with up to 7,000 vehicles per day."

All of the neighbourhood connector roads within the DSP area are expected to carry less than 5,000vpd, so no restriction on vehicular access is required on the proposed neighbourhood connector roads.

No direct access is permitted for the properties along Armadale Road, Jandakot Road and Solomon Road.

5.7 Pedestrian / Cycle Networks

The proposed network of shared paths for pedestrians and cyclists is described in section 4.3 of this transport assessment. This network of paths will provide an excellent level of accessibility and permeability for pedestrians and cyclists within the DSP area, and connections to neighbouring precincts at strategic locations.

5.8 Access to Public Transport

WAPC Transport Assessment Guidelines for Developments (2006) suggest that it is desirable for at least 90 per cent of dwellings to be within 400m straight line distance of a bus route.

The original proposed PTA bus routes within the Calleya LSP area and potential secondary bus route within the residential developments to the east of Calleya (indicated as the red line in Figure 6) would cover the majority of the proposed residential developments within the DSP area.

The proposed alternative bus route option which would replace the original PTA bus route within the Calleya LSP (should the intersection of Ghostgum Avenue/ Armadale Road be converted to a left in/ left out intersection, should the ARD project occure) would cover only the northern part of the Calleya LSP.

Therefore the southern part of the Calleya LSP would be outside of the 400m straight line distance of the proposed alternative bus route. It is desirable that further consideration be given to public transport accessibility of the southern part of Calleya LSP during the detailed planning stages of ARD project.

6.0 Conclusions

The DSP area is anticipated to accommodate approximately 3,500 dwellings, two primary schools, a neighbourhood centre and a local centre.

This residential area is anticipated to generate traffic flows of approximately 28,000vpd. The proposed schools are estimated to attract about 1,700vpd. The proposed local and neighbourhood centres are expected to attract about 4,000vpd.

The proposed key road network of the DSP area has been planned based on WAPC Liveable Neighbourhoods guidelines to accommodate the future traffic flows that will be generated in this area.

Access to the DSP area will be served by two four-way intersections and a left in/ left out intersection on Armadale Road, Three roundabout intersections and a priority controlled T-intersection on Jandakot Road.

Main Roads WA has provided “in principal” support for the proposed 4-way intersection of Armadale Road/ Liddelow Road and installation of a roundabout at this intersection. However, Main Roads WA have expressed concerns regarding the proposed left in/ left out intersection on Armadale Road between Ghostgum Avenue and Liddelow Road.

Main Roads WA also indicated that the existing signalised intersection of Ghostgum Avenue/ Armadale Road could be converted to left in/ left out intersection should the Armadale Road Deviation and construction of a grade separated intersection on Verde Drive/ Tapper Road/ Armadale Road intersection occure.

Due to the uncertainty of the timing of confirmation of the Armadale Road Deviation project this TIA report provides the outcome of the modelling and analysis for the proposed access arrangements shown in the DSP area and the proposed access arrangements by Main Roads WA along Armadale Road assuming implementation of Armadale Road Deviation and construction of the grade separated intersection on Verde Drive/ Tapper Road/ Armadale Road.

Transport modelling and analysis undertaken indicate that if the intersection of Ghostgum Avenue/ Armadale Road converts to left in/ left out and the proposed left in/ left out intersection on Armadale Road between Ghostgum Avenue and Liddelow Road is removed then more traffic would utilise the future roundabout intersection at Armadale Road/ Liddelow Road/ DSP access road.

SIDRA analysis undertaken indicates that the proposed roundabout intersection at Armadale Road/ Liddelow Road/ DSP access road would work satisfactorily in the longer term with overall level of service A and maximum queue of about 48m on Armadale Road.

SIDRA analysis undertaken for future traffic flows (when the DSP area is fully developed) indicates that the proposed intersections on Jandakot Road would operate satisfactorily and within capacity and therefore they can accommodate the DSP traffic after full development and future traffic growth along Armadale Road and Jandakot Road.

The proposed DSP area provides for a comprehensive network of shared paths and footpaths to encourage and facilitate non-motorised travel as well.

The original PTA bus routes within the Calleya LSP area and potential secondary bus route within the residential developments to the east of Calleya would cover the majority of the proposed residential developments within the DSP area.

The proposed alternative bus route option prepared by PTA and City of Cockburn which would replace the original PTA bus route within the Calleya LSP in the longer term (should the intersection of Ghostgum Avenue/ Armadale Road be converted to a left in/ left out intersection) would cover only the northern part of the Calleya LSP. Therefore the southern part of the Calleya LSP would be outside of the 400m straight line distance of the proposed alternative bus route.

It is desirable that further consideration be given to public transport accessibility of the southern part of Calleya LSP during the detailed design stage of the Armadale Road Deviation Project.

Appendix A

Planning Control Area No 122
Armadale Road Deviation

Signed for and on behalf of the Western Australian Planning Commission

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

Witness

Date

Approved - Minister for Planning

Date

Planning control area No: 122

Planning Control Area No. 122 - Armadale Road Deviation (Cockburn Central)

Department of Planning

Western Australian Planning Commission

Created on date: 9 February 2016
Produced by Geo/Spatial Research and Modelling, Department of Planning, Perth WA
Base information supplied by Western Australian Land Information Authority (2 782-2015-1

Legend

Planning control area

Program Manager: I. Szilo
Geospatial Officer: S. Jenkins
Examined: J. Ballarotta
Revised:
Version No: 1
Date: WAPC/240.10.3.2 February 2016

N

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metres

Plan Number
1.7415
2874 Sheet 1 of 1

File number: 835/02/23/11 (RLS/052)
Plan reference:
Metropolitan Region Scheme
1:25,000 sheet 2.4

Appendix B

Intersection Analysis

(2031 Typical Peak Hours)

Figure B1: Proposed roundabout Intersection on Armadale Road/ Liddelow Road/DSP Road (based on DSP access arrangements along Armadale Road)

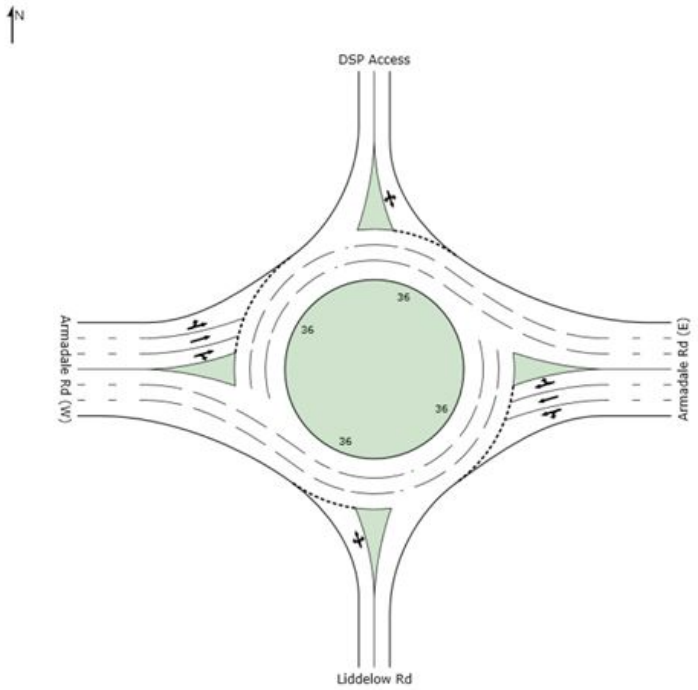


Table B1. SIDRA results for Armadale Road/ Liddelow Road/ DSP Road (based on DSP access arrangements along Armadale Road)

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Liddelow Rd											
1	L	11	0.0	0.454	15.8	LOS B	2.2	15.4	0.86	0.99	41.1
2	T	24	0.0	0.454	14.8	LOS B	2.2	15.4	0.86	0.98	41.3
3	R	151	0.0	0.454	22.2	LOS C	2.2	15.4	0.86	1.04	38.9
Approach		185	0.0	0.454	20.9	LOS C	2.2	15.4	0.86	1.03	39.3
East: Armadale Rd (E)											
4	L	175	0.0	0.637	5.8	LOS A	5.2	38.8	0.39	0.52	50.2
5	T	2446	10.0	0.637	4.5	LOS A	5.3	40.3	0.38	0.40	51.0
6	R	72	0.0	0.637	11.8	LOS B	5.2	39.1	0.39	0.82	46.9
Approach		2693	9.1	0.637	4.8	LOS A	5.3	40.3	0.38	0.42	50.8
North: DSP Access											
7	L	53	0.0	0.419	16.6	LOS B	2.0	14.2	0.89	0.99	41.0
8	T	36	0.0	0.419	15.7	LOS B	2.0	14.2	0.89	0.98	41.2
9	R	53	0.0	0.419	23.0	LOS C	2.0	14.2	0.89	1.04	38.8
Approach		141	0.0	0.419	18.8	LOS B	2.0	14.2	0.89	1.01	40.2
West: Armadale Rd (W)											
10	L	34	0.0	0.668	7.0	LOS A	5.5	41.3	0.58	0.64	49.2
11	T	2474	10.0	0.668	5.6	LOS A	5.5	41.4	0.57	0.51	49.5
12	R	11	0.0	0.668	12.9	LOS B	5.5	41.4	0.58	0.87	46.7
Approach		2518	9.8	0.668	5.6	LOS A	5.5	41.4	0.57	0.52	49.5
All Vehicles		5537	8.9	0.668	6.1	LOS A	5.5	41.4	0.50	0.50	49.3

Figure B2: Proposed Roundabout at Jandakot Road/N-S Spine Road

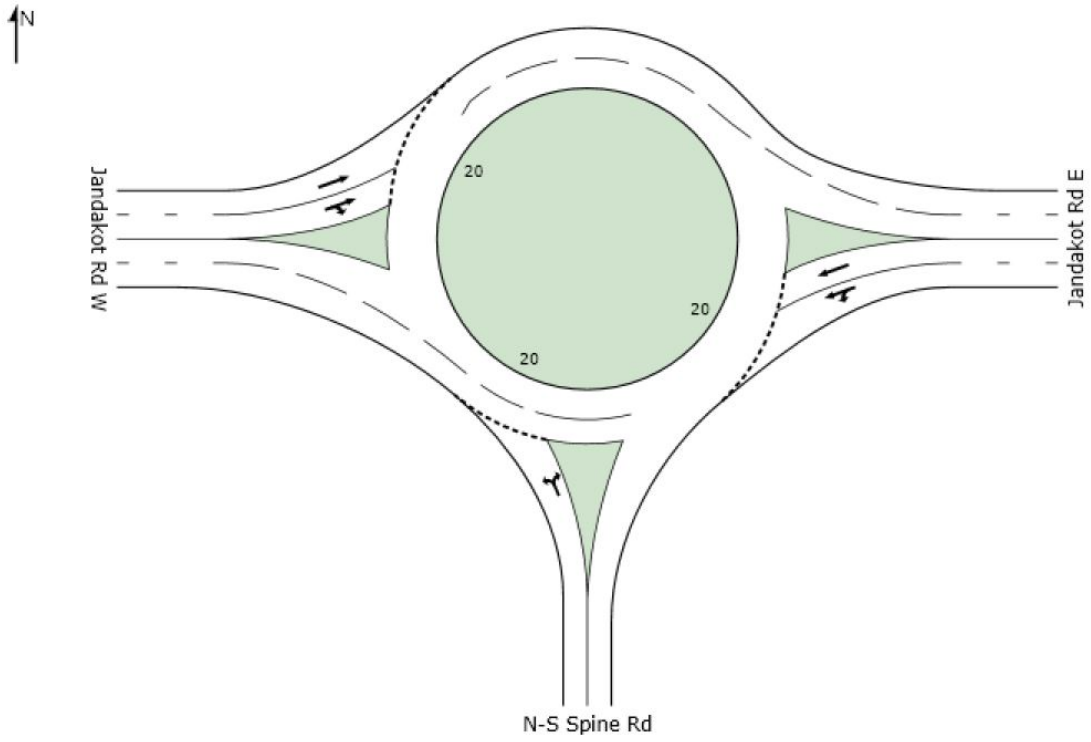


Table B2: SIDRA result for the Jandakot Road/N-S Spine Road intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: N-S Spine Rd											
1	L	232	0.0	0.548	13.9	LOS B	3.1	21.9	0.82	0.99	43.3
3	R	53	0.0	0.548	18.7	LOS B	3.1	21.9	0.82	1.04	40.8
Approach		284	0.0	0.548	14.8	LOS B	3.1	21.9	0.82	1.00	42.8
East: Jandakot Rd E											
4	L	21	0.0	0.535	7.8	LOS A	4.4	32.4	0.53	0.63	48.4
5	T	1393	6.0	0.535	6.9	LOS A	4.4	32.4	0.55	0.58	48.5
Approach		1414	5.9	0.535	6.9	LOS A	4.4	32.4	0.55	0.58	48.5
West: Jandakot Rd W											
11	T	1495	6.0	0.550	5.9	LOS A	5.7	41.9	0.32	0.44	50.0
12	R	211	0.0	0.550	11.5	LOS B	5.6	40.8	0.34	0.73	46.1
Approach		1705	5.3	0.550	6.6	LOS A	5.7	41.9	0.32	0.48	49.4
All Vehicles		3403	5.1	0.550	7.4	LOS A	5.7	41.9	0.46	0.56	48.4

Figure B3: Proposed Roundabout at Jandakot Road/Solomon Road

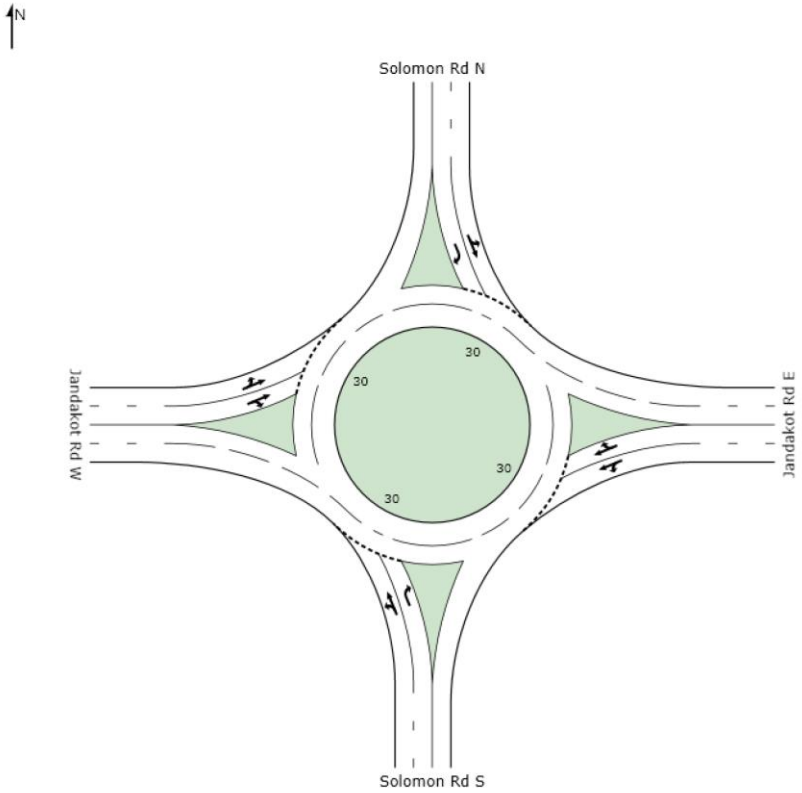


Table B3: SIDRA result for the Jandakot Road/Solomon Road intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Solomon Rd S											
1	L	145	0.0	0.349	11.1	LOS B	1.7	12.2	0.79	0.92	46.2
2	T	37	0.0	0.349	9.9	LOS A	1.7	12.2	0.79	0.89	46.5
3	R	358	0.0	0.492	16.4	LOS B	3.1	22.0	0.84	1.01	42.4
Approach		540	0.0	0.492	14.5	LOS B	3.1	22.0	0.82	0.98	43.6
East: Jandakot Rd E											
4	L	238	0.0	0.645	6.8	LOS A	5.4	39.5	0.57	0.60	48.7
5	T	1389	6.0	0.645	5.9	LOS A	5.4	39.6	0.59	0.52	48.9
6	R	26	0.0	0.645	12.7	LOS B	5.4	39.6	0.60	0.83	46.6
Approach		1654	5.0	0.645	6.1	LOS A	5.4	39.6	0.59	0.54	48.8
North: Solomon Rd N											
7	L	26	0.0	0.129	12.0	LOS B	0.8	5.4	0.89	0.92	45.7
8	T	38	0.0	0.129	10.8	LOS B	0.8	5.4	0.89	0.90	46.0
9	R	35	0.0	0.100	19.6	LOS B	0.5	3.6	0.85	0.95	40.1
Approach		99	0.0	0.129	14.2	LOS B	0.8	5.4	0.88	0.92	43.6
West: Jandakot Rd W											
10	L	35	0.0	0.717	9.4	LOS A	7.7	56.7	0.81	0.86	47.8
11	T	1347	6.0	0.717	8.6	LOS A	7.7	56.7	0.81	0.84	47.2
12	R	142	0.0	0.717	15.8	LOS B	7.5	54.8	0.82	0.98	44.1
Approach		1524	5.3	0.717	9.3	LOS A	7.7	56.7	0.81	0.86	46.9
All Vehicles		3817	4.3	0.717	8.8	LOS A	7.7	56.7	0.72	0.74	47.1

Figure B4: Proposed Roundabout at Jandakot Road/Fraser Road

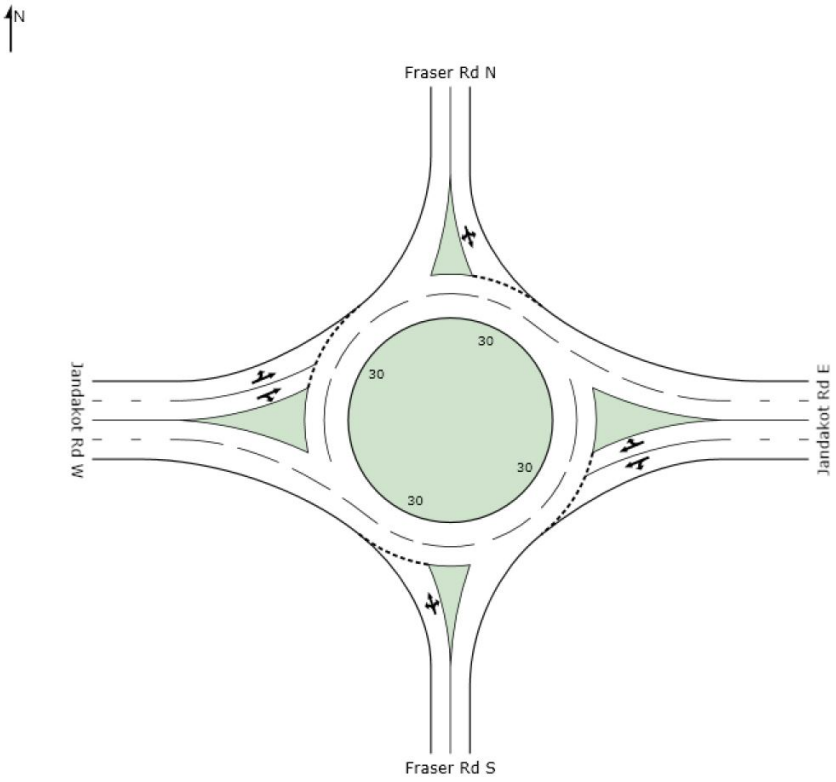


Table B4: SIDRA result for the Jandakot Road/Fraser Road intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Fraser Rd S											
1	L	118	0.0	0.484	11.9	LOS B	2.9	20.2	0.83	0.97	44.9
2	T	54	0.0	0.484	11.0	LOS B	2.9	20.2	0.83	0.95	45.1
3	R	101	0.0	0.484	17.8	LOS B	2.9	20.2	0.83	1.03	42.0
Approach		273	0.0	0.484	13.9	LOS B	2.9	20.2	0.83	0.99	43.8
East: Jandakot Rd E											
4	L	89	0.0	0.552	8.1	LOS A	4.4	32.3	0.70	0.73	48.2
5	T	1053	6.0	0.552	7.3	LOS A	4.4	32.3	0.70	0.67	48.1
6	R	26	0.0	0.552	14.3	LOS B	4.3	31.9	0.71	0.92	45.4
Approach		1168	5.4	0.552	7.5	LOS A	4.4	32.3	0.70	0.68	48.0
North: Fraser Rd N											
7	L	53	0.0	0.594	13.4	LOS B	4.0	28.2	0.85	1.02	43.3
8	T	57	0.0	0.594	12.4	LOS B	4.0	28.2	0.85	1.00	43.5
9	R	252	0.0	0.594	19.3	LOS B	4.0	28.2	0.85	1.06	40.7
Approach		361	0.0	0.594	17.3	LOS B	4.0	28.2	0.85	1.05	41.4
West: Jandakot Rd W											
10	L	360	0.0	0.581	6.5	LOS A	4.8	34.7	0.51	0.58	48.9
11	T	1053	6.0	0.581	5.6	LOS A	4.8	34.7	0.53	0.50	49.2
12	R	107	0.0	0.581	12.4	LOS B	4.7	34.3	0.54	0.79	46.5
Approach		1520	4.2	0.581	6.3	LOS A	4.8	34.7	0.52	0.54	48.9
All Vehicles		3322	3.8	0.594	8.5	LOS A	4.8	34.7	0.65	0.68	47.2

Figure B5: Proposed Traffic Lights at Armadale Road/Ghostgum Avenue (N-S Spine Rd)

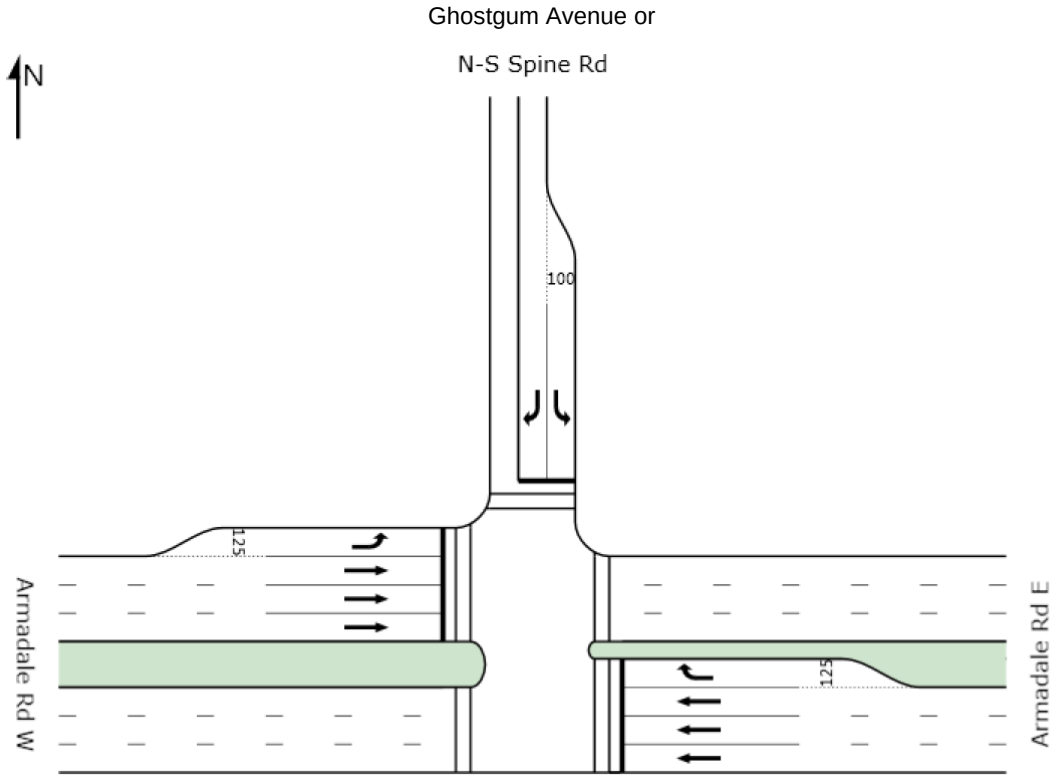
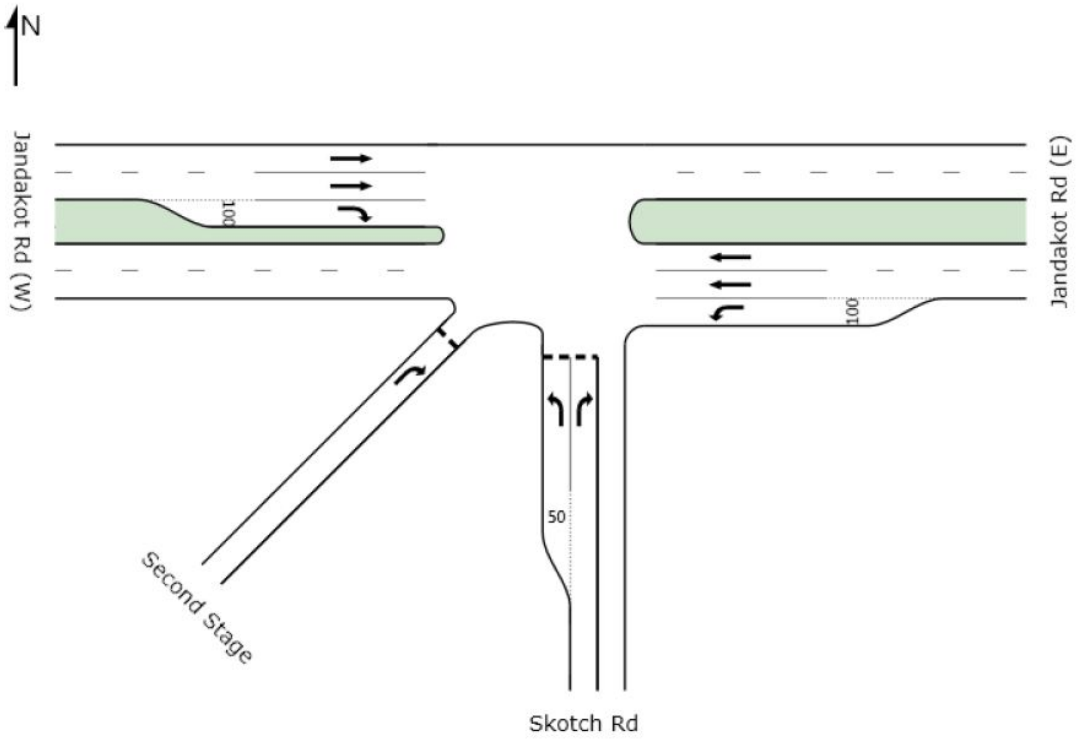


Table B5: SIDRA result for the Armadale Road/Ghostgum Avenue (N-S Spine Rd) intersection

Movement Performance - Vehicles

Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Armadale Rd E											
5	T	2632	4.0	0.705	12.9	LOS B	29.7	215.4	0.70	0.64	42.2
6	R	53	0.0	0.554	67.3	LOS E	3.0	20.9	1.00	0.76	21.1
Approach		2684	3.9	0.705	14.0	LOS B	29.7	215.4	0.70	0.65	41.3
North: N-S Spine Rd											
7	L	53	0.0	0.120	43.7	LOS D	2.2	15.5	0.82	0.75	27.2
9	R	211	0.0	0.480	47.3	LOS D	9.8	68.9	0.91	0.81	26.1
Approach		263	0.0	0.480	46.6	LOS D	9.8	68.9	0.89	0.80	26.3
West: Armadale Rd W											
10	L	211	0.0	0.134	8.6	LOS A	0.7	4.8	0.13	0.69	48.4
11	T	2632	4.0	0.846	26.1	LOS C	42.1	305.0	0.92	0.88	33.2
Approach		2842	3.7	0.846	24.8	LOS C	42.1	305.0	0.86	0.87	34.0
All Vehicles		5789	3.6	0.846	20.8	LOS C	42.1	305.0	0.79	0.76	36.5

Figure B6: Proposed priority controlled T-intersection at Jandakot Road/Skotsch Road



Note: The diagonal link is not a physical traffic lane at this intersection. This is just a technique to represent the second stage of the Skotsch Road right turn movement from the median to Jandakot Road eastbound.

Table B6: SIDRA result for controlled T-intersection at Jandakot Road/Skotsch Road

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Skotch Rd											
1	L	11	0.0	0.032	17.3	LOS C	0.1	0.7	0.73	0.91	40.6
3	R	26	0.0	0.080	17.6	LOS C	0.3	1.8	0.74	0.91	40.4
Approach		37	0.0	0.080	17.5	LOS C	0.3	1.8	0.74	0.91	40.5
East: Jandakot Rd (E)											
4	L	37	0.0	0.020	8.2	LOS A	0.0	0.0	0.00	0.67	49.0
5	T	1053	0.0	0.270	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		1089	0.0	0.270	0.3	NA	0.0	0.0	0.00	0.02	59.5
West: Jandakot Rd (W)											
11	T	1053	0.0	0.270	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
12	R	11	0.0	0.024	15.1	LOS C	0.1	0.6	0.70	0.85	42.4
Approach		1063	0.0	0.270	0.1	NA	0.1	0.6	0.01	0.01	59.8
South West: Second Stage											
32	R	26	0.0	0.046	14.9	LOS B	0.2	1.2	0.69	0.88	42.5
Approach		26	0.0	0.046	14.9	LOS B	0.2	1.2	0.69	0.88	42.5
All Vehicles		2216	0.0	0.270	0.7	NA	0.3	1.8	0.02	0.04	58.9

Figure B7: Proposed roundabout Intersection on Armadale Road/ Liddelow Road/ DSP Road (based on Main Roads WA access arrangements along Armadale Road)

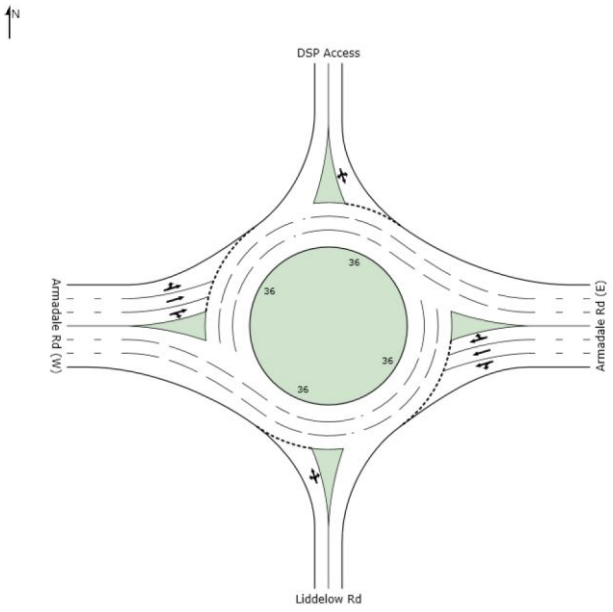


Table B7: SIDRA result for roundabout Intersection on Armadale Road/ Liddelow Road/ DSP Road (based on Main Roads WA access arrangements along Armadale Road)

Movement Performance - Vehicles											
Mov ID	Turn	Demand Flow veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Liddelow Rd											
1	L	11	0.0	0.700	24.3	LOS C	4.3	29.8	0.93	1.14	35.4
2	T	37	0.0	0.700	23.3	LOS C	4.3	29.8	0.93	1.13	35.6
3	R	195	0.0	0.700	30.7	LOS C	4.3	29.8	0.93	1.16	34.3
Approach		242	0.0	0.700	29.3	LOS C	4.3	29.8	0.93	1.16	34.5
East: Armadale Rd (E)											
4	L	172	0.0	0.677	6.3	LOS A	5.7	43.0	0.55	0.56	49.3
5	T	2398	10.0	0.677	4.9	LOS A	5.9	45.1	0.54	0.44	49.7
6	R	106	0.0	0.677	12.2	LOS B	5.7	43.2	0.55	0.80	46.8
Approach		2676	9.0	0.677	5.3	LOS A	5.9	45.1	0.54	0.46	49.5
North: DSP Access											
7	L	72	0.0	0.735	26.3	LOS C	4.6	32.2	0.95	1.16	34.6
8	T	56	0.0	0.735	25.4	LOS C	4.6	32.2	0.95	1.15	34.7
9	R	107	0.0	0.735	32.8	LOS C	4.6	32.2	0.95	1.18	33.6
Approach		235	0.0	0.735	29.1	LOS C	4.6	32.2	0.95	1.17	34.1
West: Armadale Rd (W)											
10	L	51	0.0	0.685	8.1	LOS A	6.2	46.5	0.68	0.76	48.7
11	T	2349	10.0	0.685	6.6	LOS A	6.3	47.7	0.67	0.64	48.8
12	R	11	0.0	0.685	14.0	LOS B	6.2	46.7	0.68	0.92	46.0
Approach		2411	9.7	0.685	6.7	LOS A	6.3	47.7	0.67	0.64	48.7
All Vehicles		5563	8.5	0.735	8.0	LOS A	6.3	47.7	0.63	0.60	47.3

Appendix 3

District Water Management Strategy

(JDA Consultant Hydrologist)

Government of **Western Australia**
Department of **Water and Environmental Regulation**

Your ref: J6195e
Our ref: RF14675
PA: 17036
Enquiries: Mark Hingston

JDA Consultants Hydrologists
PO Box 117
Subiaco WA, 6008

Attn: Scott Wills

Dear Scott

RE: *Treeby (Banjup) - Strategic District Water Management Strategy*

Thank you for the Treeby (Banjup) - Strategic District Water Management Strategy (DWMS) received in October 2017. The Department of Water and Environmental Regulation (DWER) has reviewed the plan and is satisfied with the document subject to any further comments from the City of Cockburn.

Water Resource Advice Only
The Department of Water has recently merged with the Department of Environment Regulation and Office of the Environmental Protection Authority to create the new agency Department of Water and Environmental Regulation.

The former agencies are in the process of amalgamating their functions. Until this fully occurs, please note that the advice in this correspondence pertains only to water resource matters previously dealt with by the Department of Water.

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

Yours sincerely

for Jane Sturgess
A/Program Manager – Land Use Planning
Peel Region

November 8, 2017

CC: Sabbir Hussain
City of Cockburn
9 Coleville Crescent Spearwood
Western Australia 6163

Kwinana Peel Region
107 Breakwater Parade Mandurah Ocean Marina Mandurah Western Australia 6210
PO Box 332 Mandurah Western Australia 6210
Telephone: 08 9550 4222 Facsimile: 08 9581 4560
www.dwer.wa.gov.au

Perron Developments Pty Ltd

Treeby (Banjup) Strategic District Water Management Strategy

October 2017

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Front page image from Google Earth (2016)

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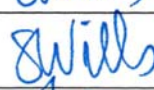
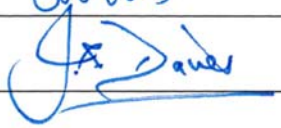
	Name	Signature	Date
Author	Scott Wills		05 October 2017
Checked by	Scott Wills		05 October 2017
Approved by	Jim Davies		05 October 2017

CONTENTS

LIST OF TABLES

LIST OF FIGURES

APPENDIX

EXECUTIVE SUMMARY

Lots 1, 2, 4, 140, 820 and 9004 Armadale Rd; Lot 1 Ghostgum Avenue; Lots 131, 132, 467, 500 and 9002 Jandakot Road; Lots 62 to 75 Skotsch Rd; and Lots 139, 468, 533, 614 and 800 Warton Road, Banjup have historically supported several rural and quarrying land uses including sand extraction and brick manufacturing with considerable clearing of vegetation and substantial quantities of sand removed. The area is hydrologically unconstrained with free draining sandy soils, clearance to groundwater, moderate to low risk of Acid Sulphate Soils (ASS), and no regional surface water features.

The primary constraint to rezoning is the P1 and P2 Water Protection Zone which covers a portion of the Study Area. Urban development is listed as an incompatible land use within P1 or P2 areas. With appropriate controls in place, urban development is compatible with a P3 classification. The DoW is the lead agency in protecting catchments for water supply in WA.

The reclassification of the land from P2 to P3 Water Protection Zone (with the retention / application of P1 zone over retained bushland) will occur upon rezoning of land to Urban under the MRS. Consideration of groundwater impacts will occur as part of the rezoning process, with the implementation of best practice water sensitive design to include the dot points enlisted below:

- Identification of a Study Area within the Draft South Metropolitan Peel Sub Regional Framework and classification of this land within short to medium term development timeframes.
- The proximity of the site to a high order Activity Centre, Railway Station and Freeway Interchange.
- The site represents a logical extension of development east of the developing Calleya Estate.
- A large portion of the site has been cleared and disturbed for sand quarrying operations.
- Consolidated ownership of sites enabling master planning and application of best practice urban water management.
- Service infrastructure within the area can accommodate the additional urban development.
- Compliance with the criteria for urbanisation included within State Planning Policy 2.3 – Jandakot Groundwater Protection (WDPC, 2011).

A number of initiatives will be applied to limit any potential groundwater impacts associated with urban development, including:

- Extension of deep sewer to all lots;
- Application of water sensitive urban design principles including at-source stormwater infiltration, rain gardens and water harvesting;
- Provision of lot types which maximise land use efficiency and reduce excessive garden area and hence fertiliser and pesticide use;
- Encourage home purchasers to use native plants for landscaping (which will also reduce fertiliser and pesticide use);
- Use of promotional information to land purchasers aimed at raising awareness of water issues;
- An on-going monitoring programme;
- Exclusion of high risk land uses from the development area (e.g. service station).

The information provided in the Strategic District Water Management Strategy (SDWMS) demonstrates that the Study Area can support urban development and best practice urban water management.

SUMMARY OF SDWMS DESIGN OBJECTIVES

Key Guiding Principles

- Provide a framework for the preparation of future LWMS
- Facilitate implementation of sustainable best practice urban water management
- Provide integration with planning processes and clarity for agencies involved with implementation
- Protection of infrastructure and assets from flooding and inundation
- Encourage environmentally responsible development

Category	SDWMS Objectives
Stormwater Management	• Non-structural measures to reduce applied nutrient loads • At source retention of 1yr 1hr ARI events • On site infiltration of all stormwater runoff of at least 5yr ARI and 100yr ARI where suitable.
Groundwater Management	• No management of groundwater levels is requires (subsoil drainage) • Finished levels to provide sufficient separation to groundwater to allow infiltration of stormwater on-site to enhance recharge to the Jandakot Mound. • Limit impacts to Bush Forever and wetland sites. • Limit groundwater abstraction. • Manage fertiliser and pesticide application in streetscapes and POS areas using soil amendments, appropriate plant selection, limiting turf areas and maintenance management plans.
Water Conservation and Sustainability	• Ensure that non-potable water supply systems are considered as part of an integrated water supply; • Household target water use of 100 kL/person/year; • Scheme water target use of 40-60 kL/person/year • Use of waterwise landscaping practices both at development and lot scale.
Water Quality	• Adopt nutrient load reduction design objectives for stormwater runoff • Use of amended soils and ephemeral bio-retention systems to treat stormwater.
Monitoring	• Pre-development monitoring to inform decisions at LWMS stage • Post-development programme to ensure water quality targets are met.

1. INTRODUCTION

This Strategic District Water Management Strategy (SDWMS) has been prepared by JDA Consultant Hydrologists on behalf of Perron Developments Pty Ltd. The SDWMS area comprises Lots 1, 2, 4, 820 and 9012 Armadale Rd; Lot 1 Ghostgum Avenue; Lots 9016, 9021, 131, 467 and 500 Jandakot Road; Lots 62 to 75 Skotsch Rd; and Lots 139, 468, 140 and 614 Warton Road, Banjup comprising a total area of approximately 461 ha (Figure 1), herein referred to as the Study Area.

The Study Area is located within the City of Cockburn, approximately 19 km south of Perth and 2.5 km from Cockburn Central and the Kwinana Freeway.

This SDWMS has been prepared to provide a coordinating framework and to guide the key requirements for water sensitive urban design. The preparation of this SDWMS has been prepared in consultation with relevant stakeholders.

1.1 Planning Context

1.1.1 Drinking Water Source Protection Areas

The site is located in the Jandakot Underground Water Pollution Control Area (JUWPCA) (DoW, 2013c).

The JUWPCA occupies a total area of 7400 ha, including more than 4000 ha within the City of Cockburn. The JUWPCA was Proclaimed in 1975 under the Metropolitan Water Supply Sewerage and Drainage Act 1909. Water from the Jandakot mound is extracted by the Water Corporation as part of the Perth Metropolitan integrated water supply system (IWSS) (WAPC, 1998).

The DoW is the lead agency in protecting catchments for water supply in Western Australia. The Department supports the Australian Drinking Water Quality Guidelines (ADWQG) barrier approach to water quality protection, with catchment management the first barrier of protection. Subsequent barriers are water storage, treatment and disinfection. The catchment management measures are also supported by Wellhead Protection Zones (WPZ) around public water supply wells. Two public water supply production wells are located within the Study Area, one on the western boundary (P2, UWPCA) and one on the eastern boundary (P1, UWPCA); see Figure 2. These production wells (located in the UWPCA) currently require a WPZ of 300 m radius. WPZ's are generally circular (unless information is available to determine a different shape or size) (DoW, 2009a).

Water Quality Protection Note 36 (WQPN) (DoW, 2009a) sets out the groundwater catchment priority classification system. Water Quality Protection Note 25 (DoW, 2016) sets out land use compatible with Public Water Source Priority areas.

Priority 1 (P1) – P1 source protection areas are defined to ensure no degradation of the water source. P1 areas are declared over land where the high quality drinking water is the prime beneficial land use protected in accordance with the objective of risk avoidance.

Priority 2 (P2) – P2 source protection areas are defined to ensure there is no increased risk to the water source. P2 areas are generally declared over land with low intensity development such as pasture which already exists. Public water supply protection is of a high priority relative to other land use values protected in accordance with the objective of risk minimisation.

Priority 3 (P3) – P3 source protection areas are defined where it is necessary to manage the risk of pollution to the water source where other land use such as residential areas occur. P3 areas generally have the requirement of using best management practices and connection to deep sewerage. P3 areas are protected in accordance with the objective of risk management.

Other information provided in the WQPN includes (DoW, 2009a):

- DoW's advice on land and water based activities in proclaimed Public Drinking Water Source Areas (PDWSA);
- Best Management Practices (BMPs) guidance used to protect water quality in PDWSAs;
- Overview of legislation, policies and processes used to protect PDWSAs; and
- The development of a multi-agency guideline designed to balance views of community, industry and government, in order to maintain a reliable safe public drinking water supply.

1.1.2 Land Use Zoning

Lots 131, 500 Jandakot Road, 62 to 75 Skotsch Road, and Lots 2 and 4 Armadale Road are currently zoned 'Rural – Water Protection'; Lots 140, 139, 468, 614 and 800 Warton Road are zoned 'Parks and Recreation' and; Lots 467 Jandakot Rd and 139 Warton Road are zoned 'Public Purpose (Special Uses)' under the Metropolitan Region Scheme (MRS) (Figure 2). Implementation of the DSP would see Lots 2, 4 and 131 as 'Urban'.

Lots 1, 9021, 9016 and 9012 were rezoned 'Urban' under Metropolitan Region Scheme Amendment 1221/4, 1 gazetted in January 2013. The site is currently undergoing subdivision (Calleya Estate) in line with water management plans prepared for the site. The plans include an approved District Water Management Strategy (Emerson Stewart, 2011), Local Water Management Strategy (PDC, 2013) and Urban Water Management Plan (UWMP).

Lot 821 Ghostgum Avenue has recently been rezoned to 'Urban' under the MRS and includes a DWMS (Hyd2o, 2013).

Lots 2, 4 and 131 have been identified as 'Urban Investigation' within Perth and Peel @ 3.5 Million Draft Sub-Regional Spatial Framework (Structure Plan). An MRS rezoning application is currently being considered by WAPC for Lots 2 and 4, also supported by a DWMS (JDA, 2015).

The urban area demarcated as Lot 131 within the DSP reflects a refinement to the area illustrated within the draft Perth and Peel @ 3.5 Million Sub Regional Planning Framework. The refinement is based on a detailed review of the site undertaken as part of the DSP exercise and is consistent with a detailed submission made on the draft Frameworks documents during public advertising. The revised boundary has been the subject of consultation with the Department of Planning and other agencies and is subject to formal determination through the finalisation of the Frameworks documents and subsequent rezoning.

This SDWMS supports the Treeby District Structure Plan as shown on Figure 3. This SDWMS consolidates background information and provides broad direction to inform preparation of Local Water Management Strategies.

1.1.3 Land Use Rezoning

The primary constraint to rezoning is the P1 and P2 Water Protection Zone which covers a portion of the Study Area. Urban development is not a compatible land use within P1 or P2 areas. With appropriate controls in place, development is compatible with a P3 classification.

The reclassification of the land from P2 to P3 Water Protection Zone (with the retention / application of P1 over retained bushland) will occur upon rezoning of land to Urban under the MRS. Consideration of groundwater impacts will occur as part of the rezoning process, with the implementation of best practice water sensitive design to include the following additional dot points enlisted below:

- Identification of a Study Area within the Draft South Metropolitan Peel Sub Regional Framework and classification of this land within short to medium term development timeframes.
- The proximity of the site to a high order activity centre, railway station and freeway interchange.
- The site represents a logical extension of development east of the developing Calleya Estate.
- A large portion of the site has been cleared and disturbed for sand quarrying operations.
- Consolidated ownership of sites enabling masterplanning and application of best practice urban water management.
- Service infrastructure within the area can accommodate the additional development.
- Compliance with the criteria for urbanisation included within State Planning Policy 2.3 – Jandakot Groundwater Protection (WDPC, 2011).

1.1.4 Relevant Documents

Key documents used to guide the SDWMS are:

- State Planning Policy No. 2.3: Jandakot Groundwater Protection Policy (WAPC, 1998)
- Better Urban Water Management (WAPC, 2008);
- Stormwater Management Manual for Western Australia (Department of Water, 2009b); and
- Liveable Neighbourhoods (WAPC, 2007).

2. SITE CHARACTERISTICS

2.1 Land Use

The Study Area includes former sand quarries and brick manufacturing sites, semi-rural residential lots, remnant native vegetation, Rose Shank Reserve, Banjup Memorial Reserve and Cockburn Fremantle Pistol Club. The sand extraction has included in gradual clearing of vegetation with substantial quantities of sand removed. Three surface expressions of groundwater exist as a result of sand extraction, described in Section 2.7 below.

2.2 Rainfall

The long term average annual rainfall (1972 to 2016) at the closest Bureau of Meteorology's monitoring site, Jandakot Aero (Station No: 009172) located approximately 2.5 km to the north of the Study Area, is 824.3 mm. The short term (2003 to 2016) average annual rainfall is 726.9 mm, a decrease of approximately 12%, with most of the reduction occurring during the winter months.

2.3 Topography

Topographic mapping from Landgate (DoW, 2013d) shows a mixture of undulating and steep rises with elevations ranging from 28 to 42 mAHD (Figure 4). The steep rises are a result of the previous sand extraction carried out across the Study Area.

2.4 Surface Geology

Surface geology mapping by Gozzard (1986) is shown on Figure 4.

The surface geology of the Study Area is classified by Gozzard as Bassendean Sands (S8 and S10). S8 sand is described as very light grey at surface, yellow at depth, fine to medium grained, sub-rounded quartz, moderately well sorted, of eolian origin. S10 sand is described as S8 sands, but occurring as a thin veneer over clayey sands of the Guildford Formation.

2.5 Acid Sulphate Soils

The WAPC *Planning Bulletin No. 64* (2009) classifies the Study Area as having moderate to low risk of actual acid sulphate soils (AASS) or potential acid sulphate soils (PASS) occurring at depths < 3m from the soil surface (DoW, 2013a) (Figure 5).

2.6 Contamination

The status of the resolution of contamination issues for the Study Area is summarised in the Environmental Assessment report prepared by 360 Environment (2016). Parts of some lots within the Study Area have been sources for sand extraction while the remainder are covered with native vegetation. There is a relatively small potential for lots that have been quarried to be contaminated as a result of chemical and hydrocarbon storage.

Contamination studies have been performed over parts of the Study Area particularly Lot 4 and Calleya and these issues are being addressed as required by the Contaminated Sites Act 2003. Boral Pty Ltd is responsible for the ongoing testing and remediation of the isolated hydrocarbon spills on Lot 4 within the Study Area. Boral Pty Ltd is currently undertaking testing and remediation in consultation with a contaminated sites auditor and the Department of Water and Environment Regulation (DWER).

Consequently, contamination issues will be dealt with in a manner consistent with the requirements of the Contaminated Sites Act 2003.

2.7 Wetlands and Significant Vegetation

Geomorphic Wetland mapping (DoW, 2013b), Figure 6 shows there are three (3) Resource Enhancement Wetlands (REW) and one (1) Conservation Category Wetland (CCW) within the Study Area.

Bush Forever site 390 currently occupies 172 ha of the Study Area. The final boundary is subject to a negotiated planning solution in order to manage the integration of the Bush Forever with the planning and design of the urban development.

Impacts to the wetlands and significant vegetation will be mitigated through the implementation of the following management measures:

- Retention of wetlands within regional and local POS areas within the DSP;
- Provision of appropriately sized buffers for the wetlands. These will be defined at Local Structure Planning stage through consultation with the City of Cockburn and DPaW;
- Overarching Open Space Masterplan;
- Wetland Management Plan;
- Bushfire Management Plan;
- Local Water Management Strategy; and
- Urban Water Management Plan.

It should be noted that the artificial water bodies within the site are not natural wetlands and will be in-filled during the development. Infilling the water bodies would ideally be undertaken in summer when water levels tend to be at their lowest.

Further detailed investigations through the LWMS and UWMP may identify opportunities to integrate stormwater management in the wetlands, including storage of minor rainfall events within wetland buffers and overflow into wetlands in less frequent rainfall events.

2.8 Surface Water Hydrology

No natural surface water features are present across the Study Area. Groundwater expressions are found in three locations and are the result of previous sand extraction (Figure 6).

2.9 Hydrogeology

2.9.1 Superficial Aquifer

The superficial aquifer in this region is referred to as the Jandakot Mound, and extends over an area of approximately 522 km^2. The aquifer has a maximum thickness of 40 m and includes three formations which are, in order of increasing depth: Bassendean Sand, Gnangara Sand and Ascot Formation. Aquifer transmissivities range between 200 to 1000 m^2/d (Davidson, 1995).

The formations are highly permeable with horizontal hydraulic conductivity ranging between 10 to 50 m/d. In the Jandakot area, where limonite cement (coffee rock) is present, horizontal hydraulic conductivity may reduce to less than 10 m/d (Davidson & Yu, 2008). Site specific investigations completed to date indicate limonite cement is more extensive than indicated on regional mapping (Emerson Stewart, 2011 and JDA, 2013). Given the extent of the limonite mapped over Calleya and Lot 4, Armadale Road, we would expect the limonite to be present to some extent at Lot 131 and the other lots further east.

Seasonal fluctuations in the water table may be several metres, consistent with Perth's winter-dominated rainfall pattern. Groundwater levels from 1975 to 2015, captured from DoW JM bores series, show groundwater levels between 21.96 and 27.96 mAHD (Table 1). Maximum (DoW, 1997) and minimum (DoW, 2004) groundwater contours shown on Figure 7 are generally consistent with the values in Table 1.

TABLE 1: DOW GROUNDWATER MONITORING BORE DATA

Bore	Period of Record	Minimum Recorded (mAHD)	Maximum Recorded (mAHD)
JM19	1975-2015	24.29	27.96
JM22	1975-2010	24.50	26.92
JM25	1975-1995	23.74	25.91
JM26	1975-2015	24.91	27.56
JM27	1975-2015	21.96	26.22
JM45	1975/2015	22.70	25.83

2.9.1.1 Ministerial Statement 688

Ministerial Statement 688, established in 1992, provides a framework for the management and abstraction of groundwater for public and private water supply from the Jandakot Mound, with provision for environmental requirements (EPA, 1992). As part of the conditions twenty-three sites across the Jandakot Mound have Ministerial water level criteria to ensure the protection of environmental assets.

For the 2008 to 2011 monitoring period thirteen out of the twenty-three sites breached the relevant criteria (DoW, 2012) as a result of declining rainfall and groundwater abstraction by existing users.

Seven sites (8284/8284B, JM19, JM45, JM14, JM16, JM8 and JM7) located near the top of the Jandakot Mound are in close proximity to the Study Area. Three sites, JM19, JM45 and JM14, have all breached Ministerial Conditions with the latest breach in 2011.

2.9.1.2 Groundwater Quality

Water quality is not measured in DoW monitoring bores. Water quality is measured by Water Corporation to inform treatment of public water supply abstracted from production bores across the mound.

Water quality information presented in Water Corporation (2006), states that the water quality of the Jandakot Mound has consistently been good, with the exception of iron and colour, and has generally met Australian Drinking Water Quality Guideline (ADWQG) values. The absence of thermotolerant coliforms indicates that there has not been any pathogenic contamination of the wellfield, despite a large percentage of the UWPCA being privately owned (Water Corporation, 2006), which includes P3 urban areas.

Although there has been no evidence of contaminants reaching the groundwater, many activities throughout the Control Area, including irrigated parks and uncontrolled domestic activities on residential properties, are considered medium management priorities (major to significant risks) because of their potential to transmit contaminants to the groundwater. Controls currently in place have improved protection and there has been no observed increase in risk since the 1998 assessment (Water Corporation, 2006).

2.9.1.3 Non-Potable Supply for Land Development

The Study Area is located within the Jandakot groundwater management sub-areas of Airport and Canning Vale. As of 14 September 2017 the available water allocation in the Superficial Aquifer is summarised in Table 2.

TABLE 2: GROUNDWATER AVALIABILITY

Aquifer Sub Area	Allocation Limit	Licenced Allocation	Committed Volume	% Committed & Allocated
Superficial Swan - Airport	790,000 kL	1,041,975kL	50,500 kL	138.29%
Superficial Swan – Canning Vale	310,000 kL	68,325kL	0 kL	22.04%

Calleya Estate is located in the Airport sub-area. The remainder of the Study Area is within the Canning Vale Sub-area and the available allocation is expected to be sufficient for implementation of the DSP, as outlined in Section 3.3.1.

The use of local groundwater resources for non-potable supply within the Study Area will be considered as part of future LWMS's. If considered appropriate, the implementation of the strategy should take into consideration bore design to ensure the installation of the wells do not create unwanted contaminant pathways through the aquifer.

2.9.2 Leederville Aquifer

The Leederville Aquifer is of Cretaceous age and consists of interbedded sandstone, siltstone and shales made up by the Mariginiup, Wanneroo and Pinjar Members and the Henley Sandstone Formation. It is separated from the overlying Superficial Aquifer by the Kardinya Shale, which acts as a confining bed between the two aquifers (Davidson & Yu, 2008).

The Leederville aquifer is a major regional water resource of good quality water. Underneath the Jandakot Mound, groundwater salinity is typically <500 mg/L. Jandakot production bore J105 screened in the Leederville Aquifer has the highest concentration of bicarbonate (compared to other Jandakot drinking water production bores) with a concentration of 200 mg/L. Dissolved iron concentrations from the production bores generally exceed Australian Drinking Water Guidelines (Davidson, 1995).

2.9.3 Yarragadee Aquifer

The South Perth Shale underlies the Leederville Aquifer and acts as the confining bed between the Leederville and Yarragadee aquifers (Davidson, 1995).

The Yarragadee aquifer is a major regional water resource of generally good quality water. South of Perth salinities vary between 1000 and 2000 mg/L. Dissolved iron levels are generally below Australian Drinking Water Quality Guidelines (Davidson, 1995).

3. DISTRICT WATER MANAGEMENT STRATEGY

3.1 Groundwater Management

3.1.1 Existing Groundwater Expressions

Sand extraction from the site has resulted in some areas where the groundwater is exposed at surface. Excavations are to be filled in as part of future development so that groundwater is no longer exposed.

3.1.2 Fill and Groundwater Controls

Based on the DoW maximum groundwater contours (1997), Figure 8 highlights the areas within Study Area which are likely to encounter groundwater within 2m of natural surface (approximately 15% of the Study Area). With the exception of localised surface water expressions in Catchment 1 and 4 (see Figure 9), there is expected to be a sufficient depth of sand (>2m) within the majority of the Study Area to allow development with adequate separation to groundwater (see Figure 8). This will be confirmed by a more detailed analysis of earthworks at LWMS stage.

3.2 Stormwater Management

For the Study Area the following key objectives will apply:

- Minimise changes in hydrology to prevent impacts on receiving environments.
- Manage water flows from major events to protect infrastructure and assets.
- Apply the principles of WSUD.

Minor Drainage System

Due to the elevation and sandy soils that characterise the site, many of the best practice stormwater management strategies presented in the Stormwater Management Manual for Western Australia (DoW, 2009) are appropriate and can be implemented.

These strategies include;

- Retention of rainfall events up to the 1yr ARI 1 hour duration at source via infiltration.
- Retention of rainfall events up to the 5yr ARI high in the catchment using rain gardens, swales, tree pits and other contemporary water infiltration techniques.
- The use of vegetation and amended soils within infiltration systems to treat stormwater runoff and improve the quality of stormwater infiltrating to the groundwater table.

Major Drainage System

The major drainage systems across all catchments will manage rainfall events greater than the 5yr ARI, up to the 100 yr ARI. With the exception of Catchment 1 (Lot 131) all previous DWMS and LWMS documents prepared for existing and proposed MRS zoned ‘Urban’ lots have included stormwater modelling carried out. The results of these analyses are presented in Table 3 and shown on Figure 9, with a summary of stormwater management during major rainfall events across all catchments provided below.

The design strategy is consistent with the objectives provided in the Stormwater Management Manual (DoW, 2007). Key points of the major drainage system strategy are as follows:

- All lot finished levels will have a minimum 0.3 m clearance above the estimated 100yr ARI flood level of the retention storages;

- Roads graded to direct flow to the lowest point in the catchment; and
- At the low point (where practical), verges graded to drain flows off the street into the retention storage.
- Using road levels and grading to convey major storm events away from houses and other key infrastructure.
- In general where land area and distance to groundwater (>2 m) allows (see Figures 8 and 9) the 100yr ARI should preferentially be retained onsite and infiltrated within Public Open Spaces (POS).

Catchment 1 *(Calleya Estate)* - Lot 9002, 9004 & 132

Emerson Stewart (2011) conducted the stormwater management assessment for the Calleya Estate. The stormwater design by Emerson (2011) allowed for all events greater than the 5yr ARI to be directed via overland flow paths (within the road reserve) to POS infiltration areas, and overflow into the main trunk drain. The trunk drainage system discharges into the Atwell drain and ultimately into Thompson Lake. Discharges into Thompson Lake (via the Atwell drain) from Calleya Estate has been approved by the EPA (WAPC, 2016) and the DoW.

Catchment 2 – Lot 821

Preliminary stormwater modelling using the PONDS infiltration model was performed by Hyd2o (2013) to determine appropriate stormwater management requirements to infiltrate the 100 year ARI on site.

The design strategy adopted in Catchment 2 is consistent with the Better Urban Water Management principles which guides City of Cockburn's (CoC) water quality management. Consistent with the CoC's design principles no discharge will occur from the site for events up to the 100 year ARI, with all stormwater retained and infiltrated onsite (Hyd2o, 2013). Further detailed design at the LWMS stage will refine their distribution, sizing and locations.

Catchment 3 – Lot 131

Preliminary modelling of the 100yr ARI stormwater infiltration storage for Lot 131 (Catchment 3) was performed by JDA using the infiltration model MODRET.

Results from modelling the 100yr ARI found that 19,670 m^3 of rainfall runoff is required to be stored and infiltrated onsite. Figure 8 indicates there is sufficient depth to groundwater to implement this strategy.

More detailed analysis, additional site information (e.g. groundwater levels) and more refined analysis, as part of the future LWMS is required.

Catchment 4 – Lot 4

Preliminary modelling of the 100yr ARI stormwater infiltration storage for Lot 4 (Catchment 4) was performed by JDA (2015) using the infiltration model MODRET.

Results from modelling the 100yr ARI found that 18,700 m^3 is required to be stored and infiltrated onsite. The stormwater infiltration requirement for the 100yr ARI represents approximately 4% of the developable area. Figure 8 indicates there is sufficient depth to groundwater to implement this strategy.

Catchment 5

Catchment 5 (Figure 9) is not proposed for urban development and preliminary stormwater storage has not been assessed.

TABLE 3: STORAGE DATA FOR THE CRITICAL 100YR ARI RAINFALL EVENT

Catchment	1[1]	2[2]	3	4[3]
Catchment Area (ha)	153.0	20.5	64.7	61.9
Assumed Impervious Area (ha)	53.0	8.2	20.9	18.6
Top Water Level Area (m^2)	36,545	4700	21,385	20,000
Stored Volume (m^3)	21,870	3300	19,670	18,700

1- PDC (2013)
2- Hyd2o (2013)
3- JDA (2015)

JDA does not take responsibility for the content of reports by PDC (2013) and Hyd2o (2013).

3.3 Water Source Planning & Conservation

3.3.1 Water Supply

Residential Lots

In order to minimise any potential impact on the groundwater resource the development will aim to:

- Utilise scheme water as the main water supply for residents.
- Appropriately manage bore use through structure planning and community education.

Public Open Spaces

The use of local groundwater resources for non-potable supply within the Study Area will be considered in more detail as part of the LWMS. An initial estimate of the amount of groundwater required for POS irrigation was calculated based on a residential area of 253 ha. Assuming a rate of 7,500 kL/yr an indicative water demand for irrigation of approximately 25 ha of irrigated residential POS would be 187,500 kL/yr plus an additional 3 ha or 22,500 kL/yr for the open areas/gardens within the school sites. The combined total annual irrigation volume is 210,000 kL/yr. The allocation estimate will be refined as part of the LWMS.

An allocation of 241,675 kL/yr is available in the Canning Vale sub-area (Table 2), which should be sufficient supply for most of the Study Area. The Airport sub-area is overallocated (Table 2) which may impact Calleya Estate. The Calleya development is well progressed and we expect arrangements to secure a water licence are also well progressed.

3.3.2 Wastewater Management

The Water Corporation has advised that this site falls outside of a planned sewerage scheme and therefore a reticulated wastewater supply is not immediately available. An approved MRS amendment would facilitate sewer reticulation scheme planning by the Water Corporation.

The project engineers have indicated that wastewater servicing is likely to come from Armadale Rd, via a connection at Liddelow Rd, south-east of the site. Two pump stations will likely be required to meet demand for the Study Area. Pump stations are a compatible land use with conditions in P3 areas, as presented in WQPN 25, Table 3 (DoW, 2016)

3.3.3 Water Conservation Measures

The objective for water conservation is to minimise use of water and maximise water use efficiency where possible. This objective can be achieved at both the development and lot scale and is identified in the State Water Plan (Government of Western Australia, 2007) as a priority item for potable water. The State Water

Plan target for household water use is 100 kL/person/year (potable and non-potable water), with a consumption target for scheme water of 40-60 kL/person/year (potable water).

Consistent with the State Water Plan, the main objectives for the development are:

- Avoid use of potable water for irrigation in POS areas
- Reduce household water use to not more than 100 kL/person/year
- Minimise use of potable water where drinking water quality is not essential.
- Household consumption targets for in-house potable water use of 40-60 kL/person/yr.

Development Scale

Development scale water conservation measures appropriate for the site include:

- Strategic planning (orientation, shape, elevation etc.) of irrigation areas such as pocket parks, active and passive public open space areas, and road reserves to minimise long-term irrigation demand.
- Where possible co-locate facilities with significant irrigation demand.
- Within irrigation areas, the use of waterwise landscaping practices including hydrozoning, mulching, soil amendments, water retention products and installation of appropriate water efficient irrigation fixtures.
- Retain and where appropriate rehabilitate native bush areas.

Lot Scale

Lot scale water conservation measures appropriate for the site include;

- Increased residential density, including smaller lots with reduced ex-house irrigation areas.
- Buildings constructed to current Building Codes of Australia (BCA) water efficiency standards and the State Government 5 Star Plus Scheme. These include using AAA rated appliances such as toilets, washing machines, dishwashers, water saving showerheads, taps and toilets and sub-surface irrigation. The Water Corporation's Waterwise Rebate Program will also assist in encouraging the purchase of waterwise AAA rated appliances.
- Initiatives to encourage waterwise landscaping of residential lots including hydrozoning, mulching, soil amendments, water retention products and installation of appropriate irrigation fixtures.

4. IMPLEMENTATION FRAMEWORK

4.1 Local Structure Planning

The water management planning requirements for the various stages of land use planning are set out in Better Urban Water Management (WAPC, 2008) and include a Local Water Management Strategy (LWMS) in support of the Local Structure plan and an Urban Water Management Plan (UWMP) as a condition of subdivision approval. The design objectives outlined in this DSWMS form the basis for design criteria to be developed and reported in the LWMS. The design criteria of the LWMS are implemented through the final design concept presented in the UWMP.

4.2 Monitoring Requirements

Pre-development monitoring for a minimum two year period is required to support rezoning applications as outlined in BUWM. At the end of the two-year program the results should be submitted to the Department of Water and City of Cockburn and utilised to assist preparation of the LWMS's.

A post development monitoring program will be developed at the LWMS stage. The monitoring program will be designed to allow a quantitative assessment of the hydrological impacts of the proposed development within the Study Area. Post-development monitoring program will include measurement of groundwater levels and quality for comparison to pre-development levels.

4.3 Funding and Responsibilities

The key roles and responsibilities for the implementation of this SDWMS are presented in Table 4 below.

TABLE 4: SUMMARY OF RESPONSIBILITIES OF FUNDING

Management Issue	Responsibility and Funding		
	Developer	Department of Water	City of Cockburn
Pre-development monitoring	✓		
Preparation of LWMS	✓		
Approval of LWMS		✓	✓
Preparation of UWMP	✓		
Approval of UWMP		✓	✓
Construction of urban infrastructure	✓		
Long-term maintenance of stormwater management system			✓
Post-development monitoring	✓		

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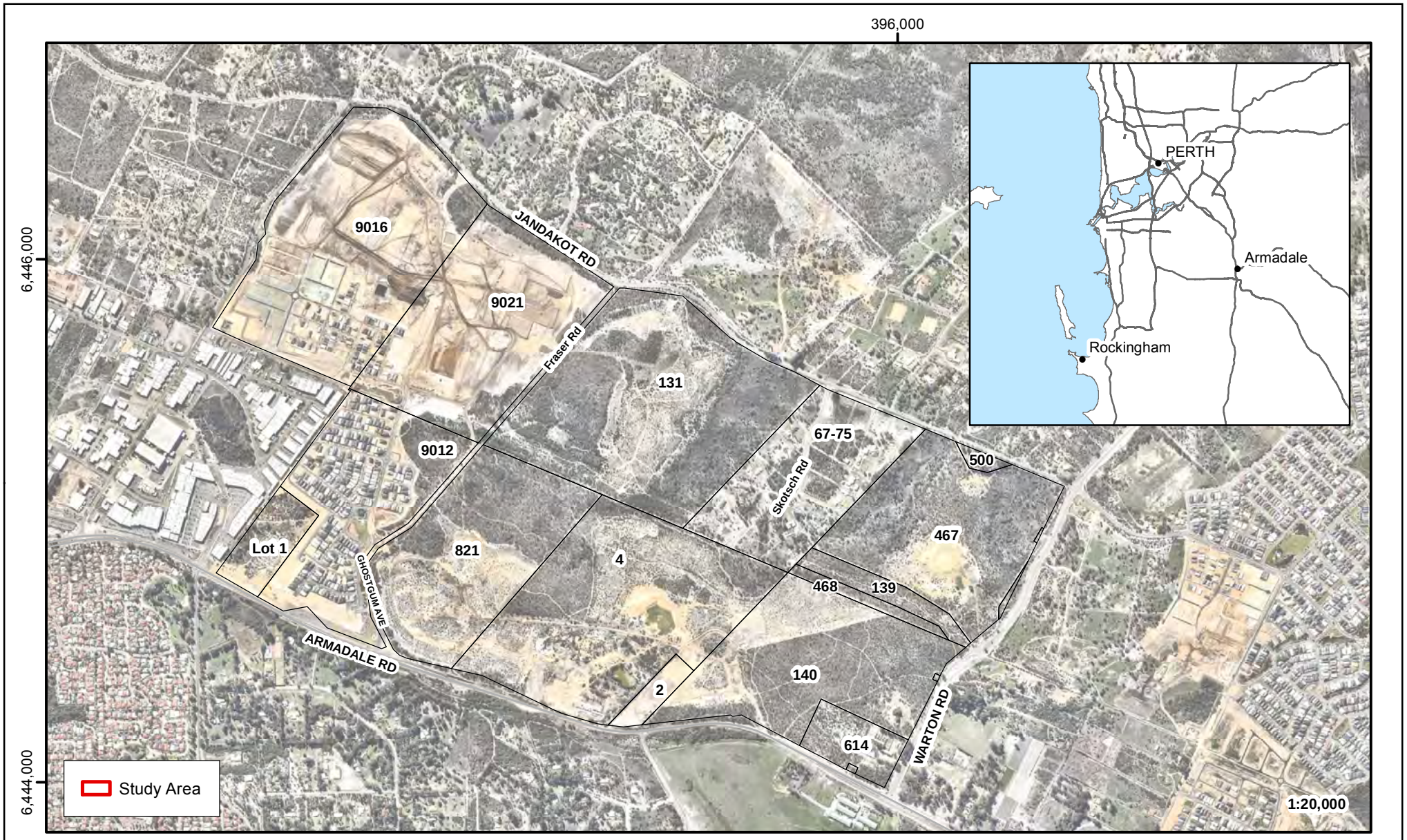
Western Australian Planning Commission, (2009), *Acid Sulphate Soils.* Planning Bulletin 64/2009.

Figures



Data Source: Nearmap (2016)

Coordinate System: GDA 94, Zone 50

Job No. J6195

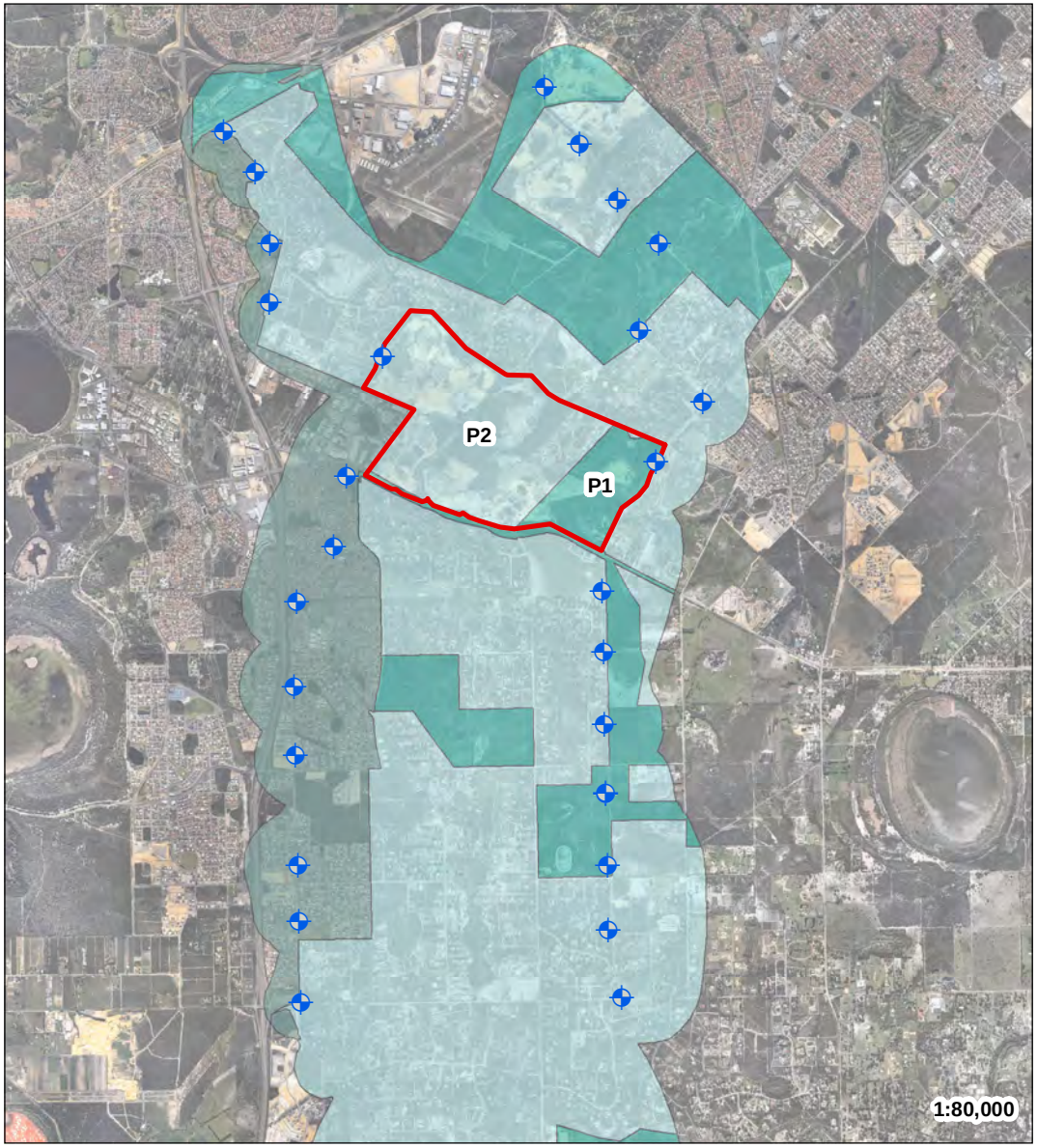
0 0.175 0.35 0.7 1.05 1.4 Kilometres

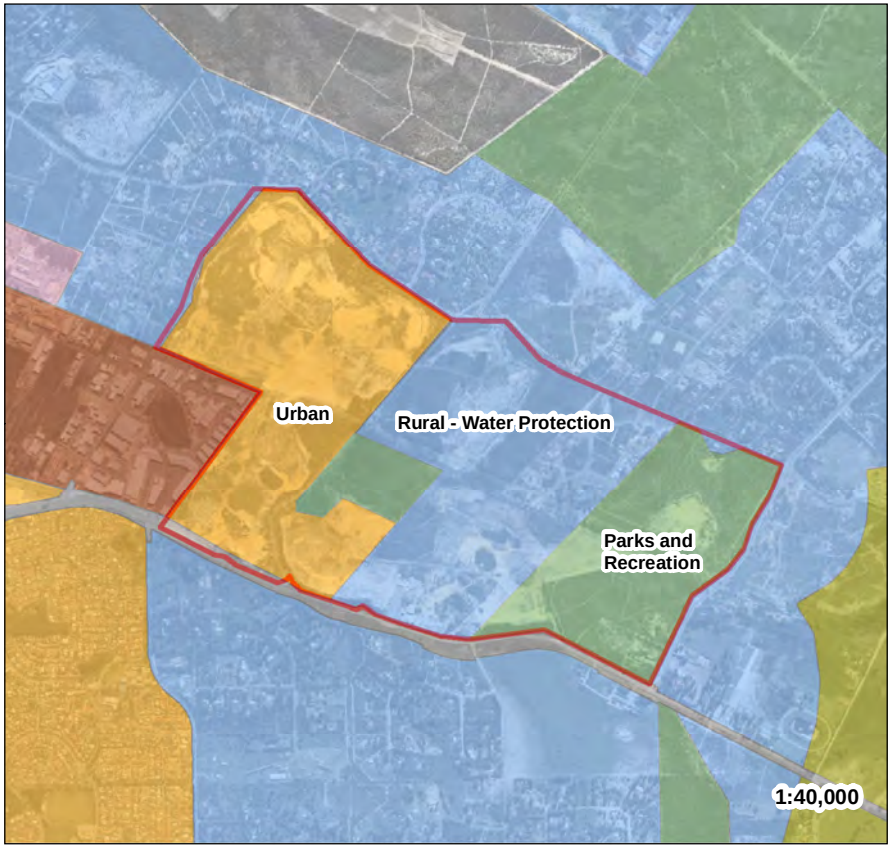
N

Perron Developments Pty Ltd

Treeby Strategic District Water Management Plan

Figure 1: Location Plan





Study Area
Jandakot Mound Production Bores

Underground Water Pollution Control Areas
P1
P2
P3

MRS Land Zonings
Industrial
Parks & Recreation
Primary Regional Roads
Public Purposes (SECWA)
Public Purposes (Special Uses)
Rural
Rural - Water Protection
Urban

Data Source: DoW (2013c), DoP (2012)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6195

0 0.75 1.5 3 4.5 6 Kilometres

N

Perron Developments Pty Ltd

Treeby Strategic District Water Management Plan

Figure 2: Underground Water Pollution Control Areas and Regional Planning

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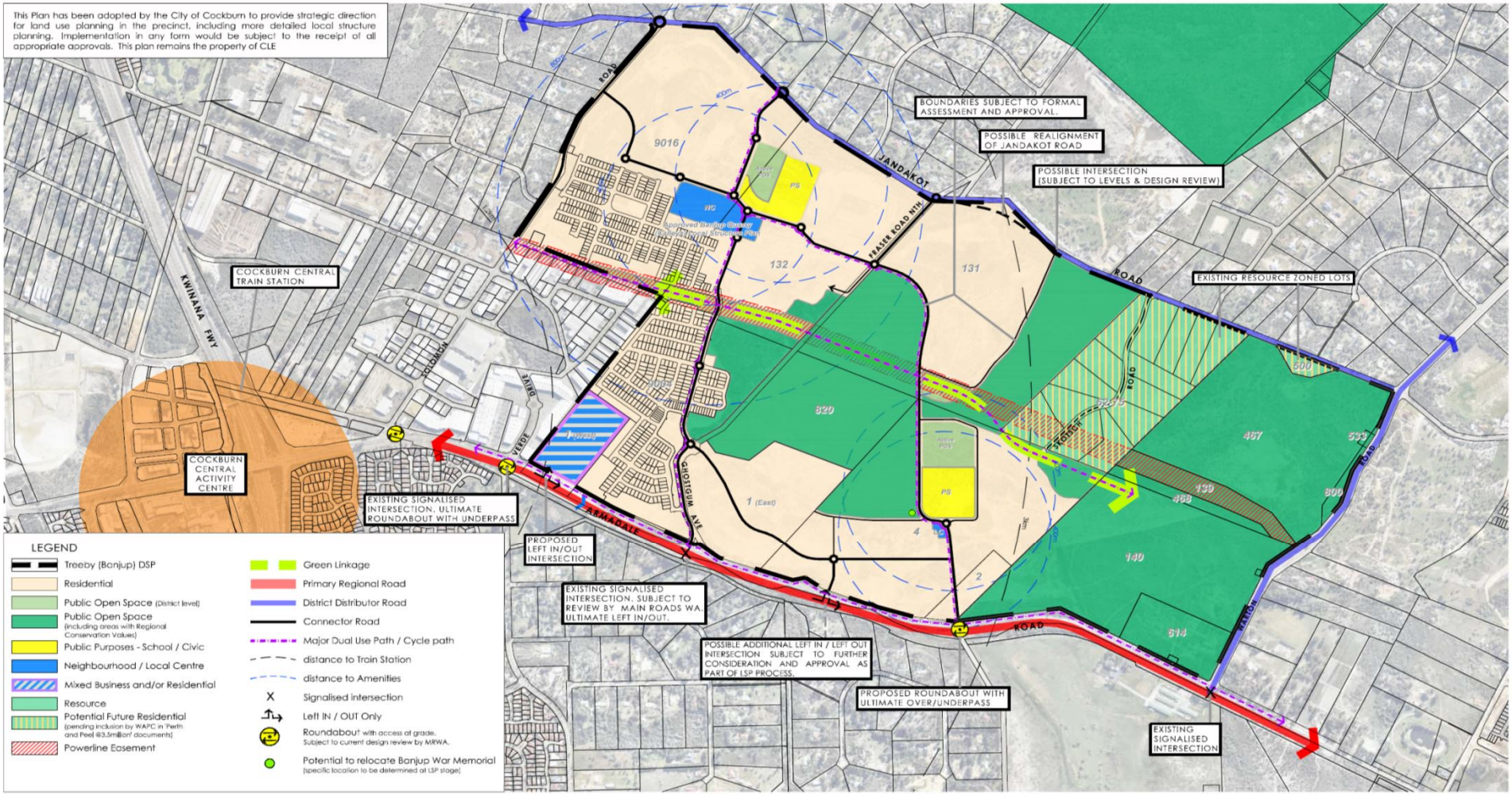
CLE TOWN PLANNING + DESIGN



2310-122F-01 (29.09.2017), NTS

TREEBY (BANJUP) DISTRICT STRUCTURE PLAN

Banjup, City of Cockburn

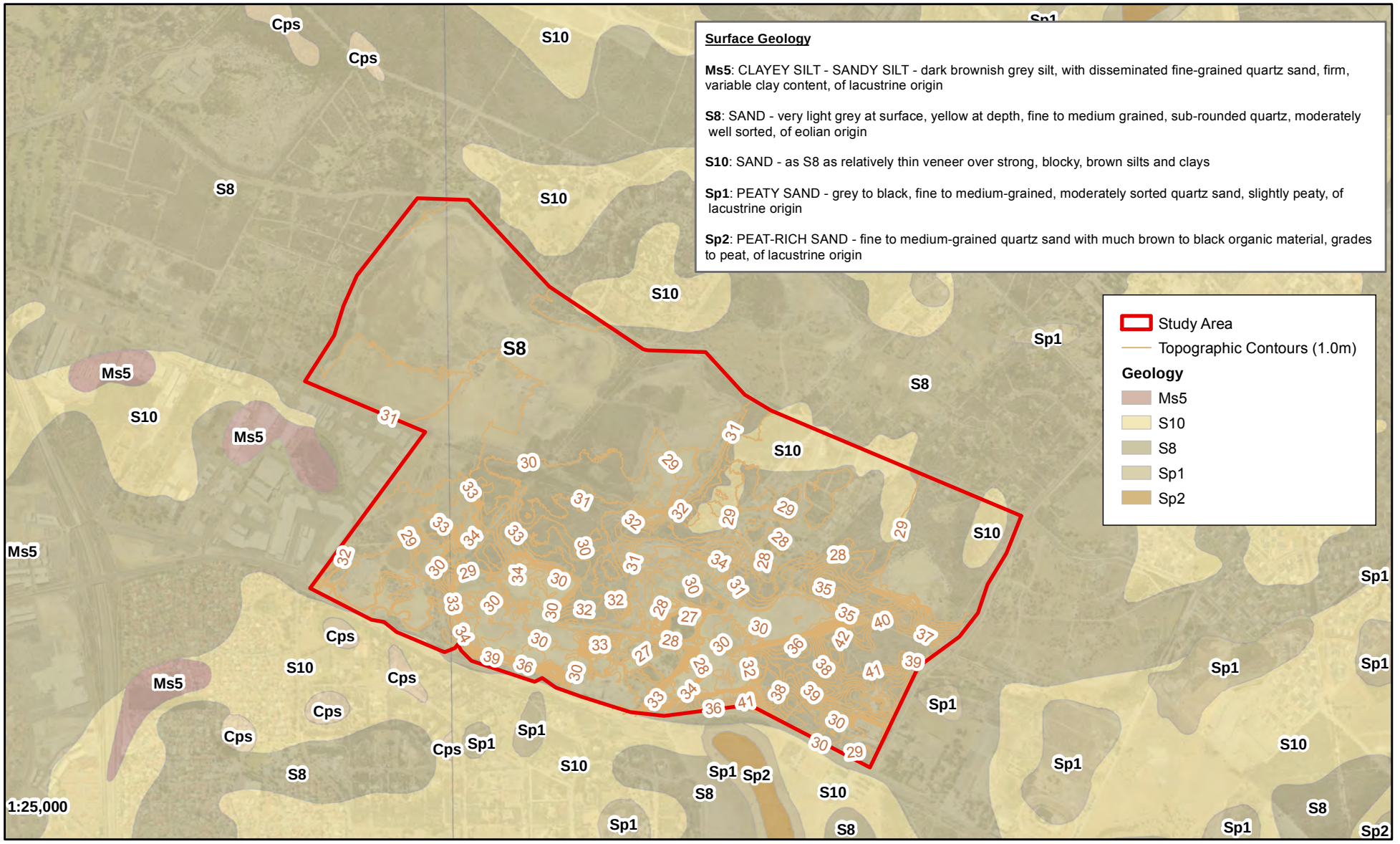
JDA Consultant Hydrologists

Job No. J6195

Perron Developments Pty Ltd

Treeby Strategic District Water Management Plan

Figure 3: Concept Plan



Data Source: DoW (2013d), Gozzard (1986)

Coordinate System: GDA 94, Zone 50

Job No. J6195

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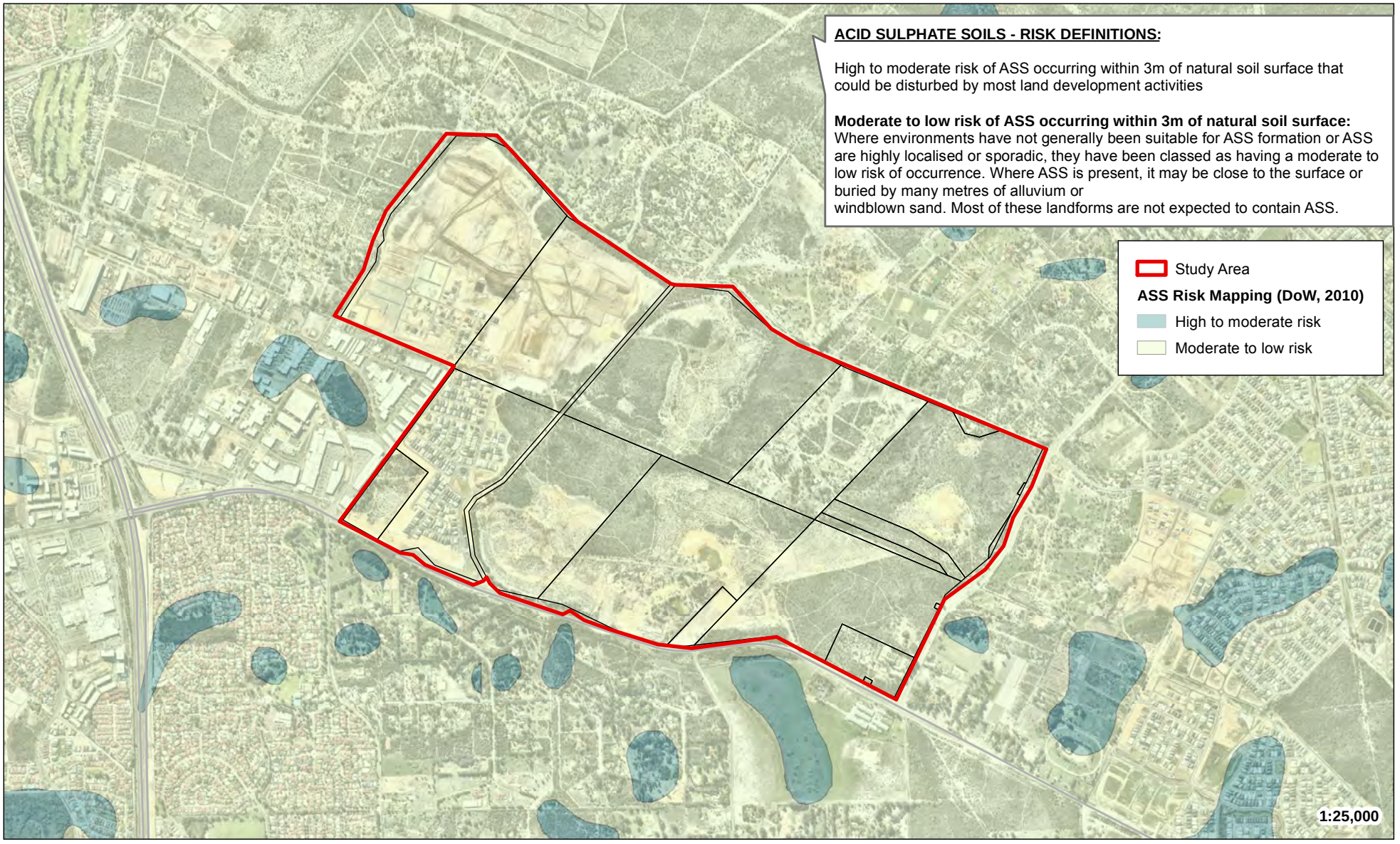
N

Perron Developments Pty Ltd

Treeby Strategic District Water Management Plan

Figure 4: Topography and Surface Geology



Data Source: Nearmap (2016), DoW (2013a)

Coordinate System: GDA 94, Zone 50

Job No. J6195

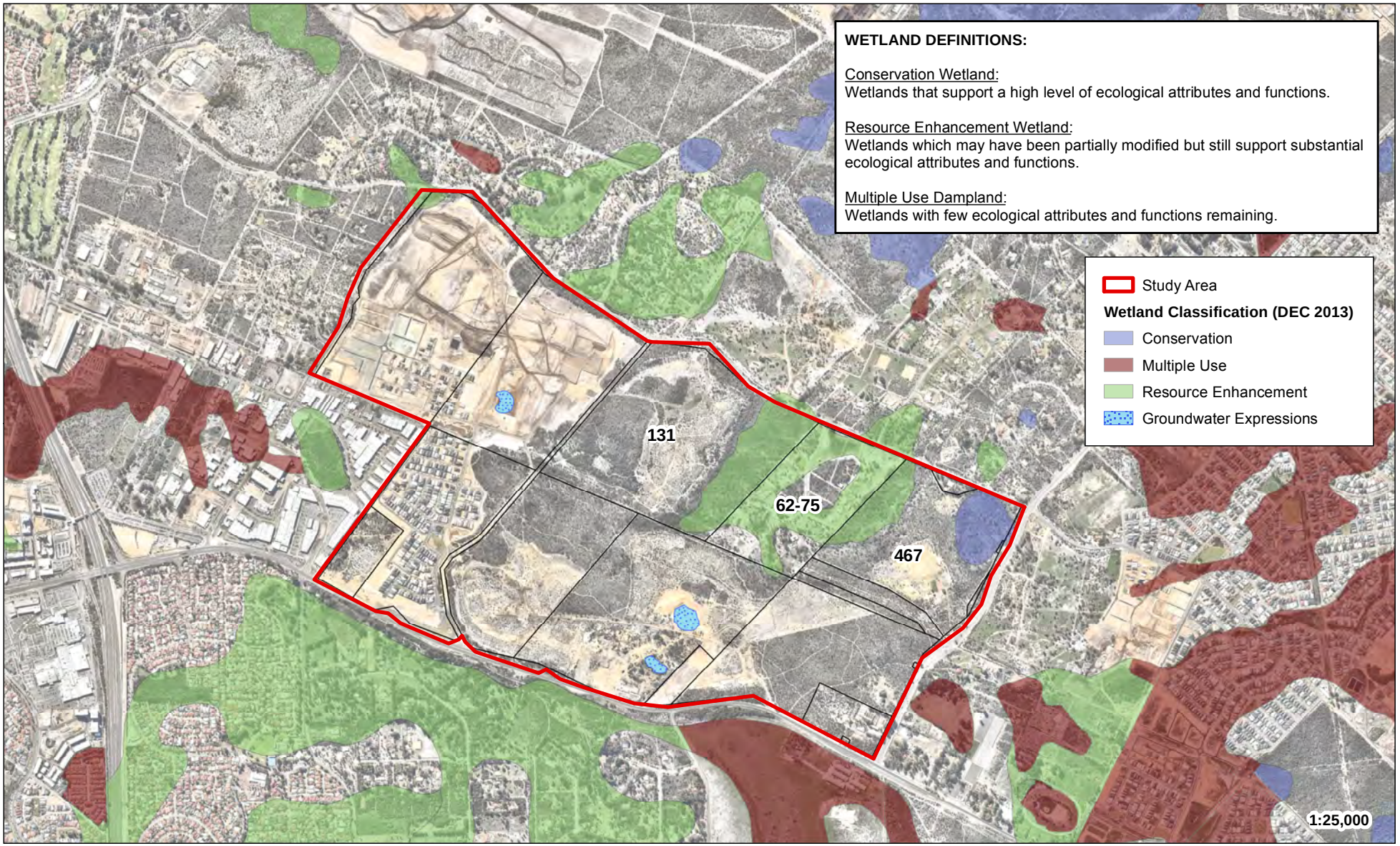
0 0.225 0.45 0.9 1.35 1.8 Kilometres

N

Perron Developments Pty Ltd

Treeby Strategic District Water Management Plan

Figure 5: Acid Sulphate Soils



Data Source: Nearmap (2016)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6195

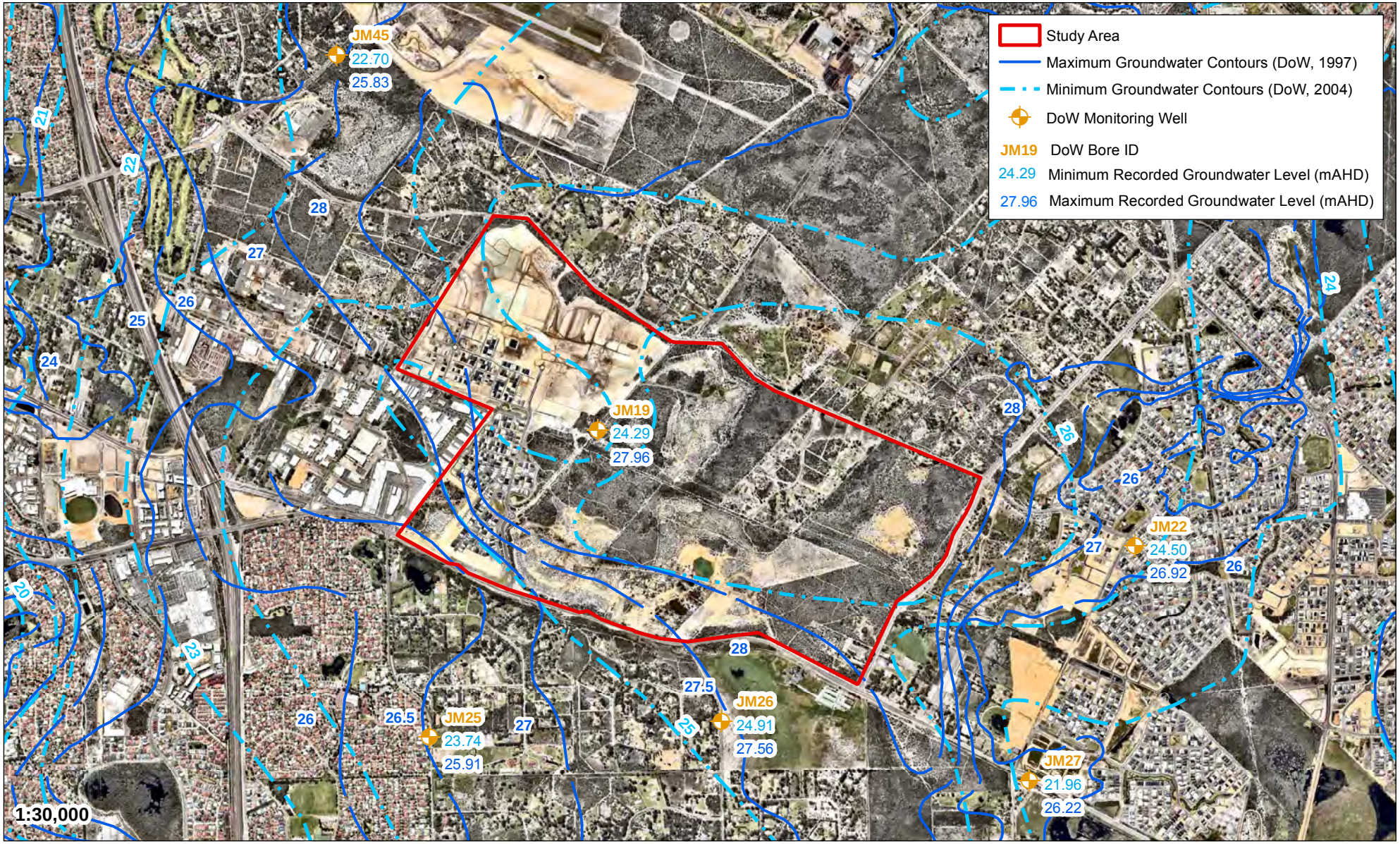
0 0.225 0.45 0.9 1.35 1.8 Kilometres

N

Perron Developments Pty Ltd

Treeby Strategic District Water Management Plan

Figure 6: Wetlands



Data Source: Nearmap (2016)

Coordinate System: GDA 94, Zone 50

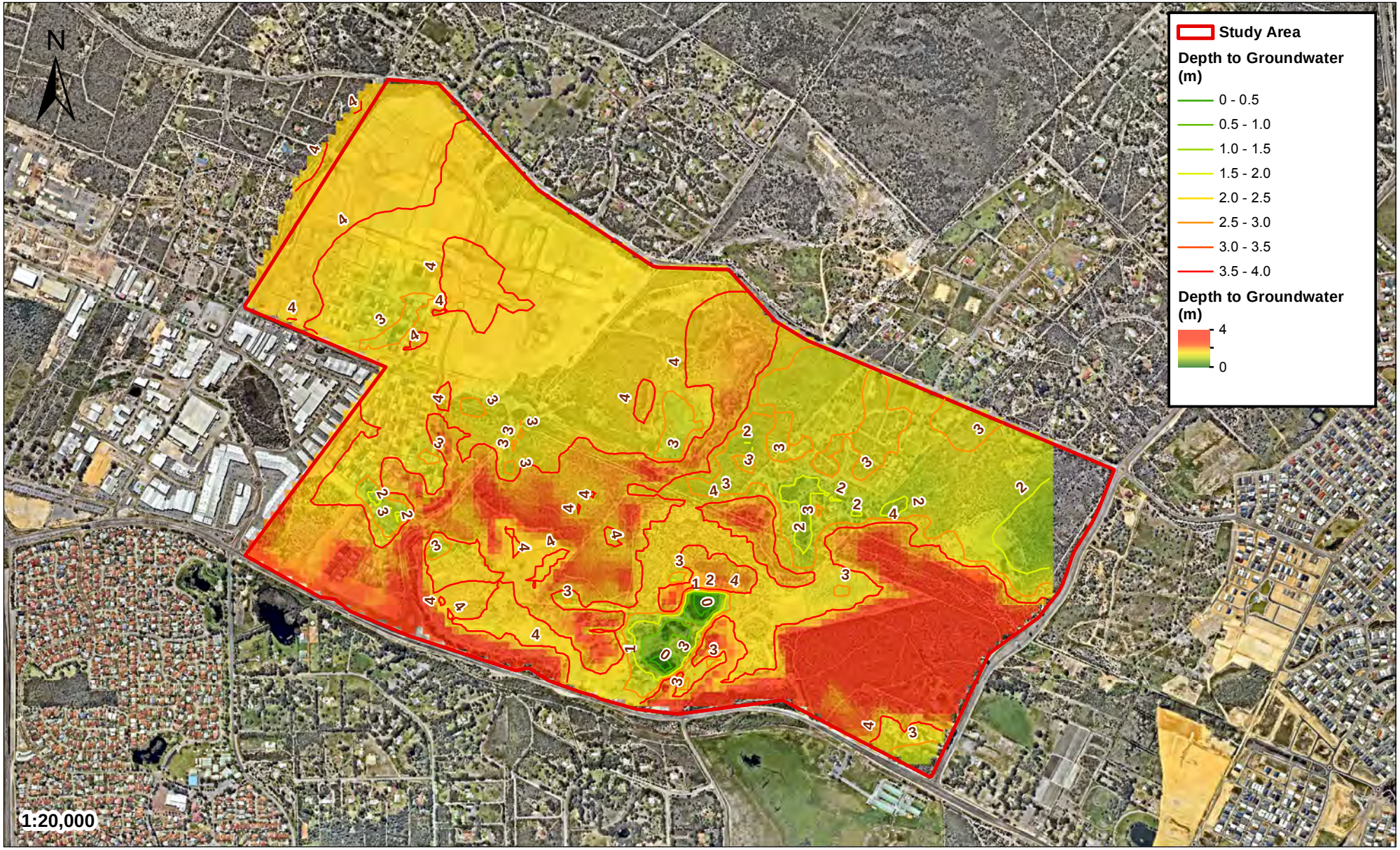
JDA

Job No. J6195
Scale: 1:30,000 @A4

0 500 1,000 1,500 2,000 Metres

N

Perron Developments Pty Ltd
Treeby Strategic District Water Management Strategy
Figure 7: Minimum and Maximum Groundwater Levels



Data Source: Nearmap (2016)

Coordinate System: GDA 94, Zone 50

JDA

Job No. J6195

0 500 1,000 1,500 2,000 Meters

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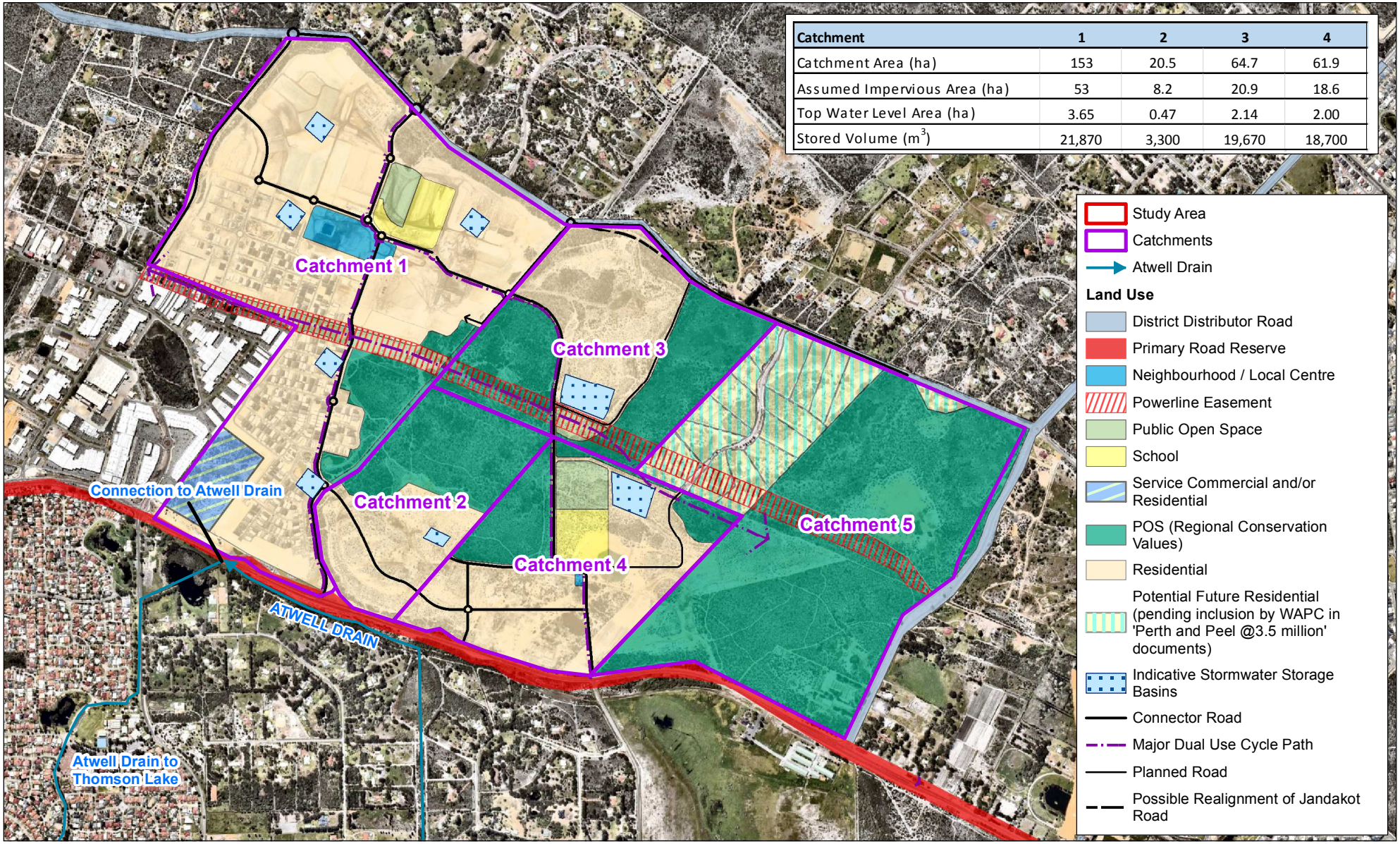
Treeby Strategic District Water Management Strategy

Figure 8: Depth to Estimated Max Groundwater Elevation

Document Set ID: 6934306
Version: 1, Version Date: 12/12/2017



Catchment	1	2	3	4
Catchment Area (ha)	153	20.5	64.7	61.9
Assumed Impervious Area (ha)	53	8.2	20.9	18.6
Top Water Level Area (ha)	3.65	0.47	2.14	2.00
Stored Volume (m^3)	21,870	3,300	19,670	18,700

Data Source: Nearmap (2016), CLE (2016), PDC (2013), Hyd2o (2013), JDA (2015)

Coordinate System: GDA 94, Zone 50

Job No. J6195
Scale: 1:20,000 @A4

0 400 800 1,200 1,600 Metres

N

Perron Developments Pty Ltd
Treeby Strategic District Water Management Strategy
Figure 9: Stormwater Management Plan

APPENDIX A

Infiltration Basin Modelling Results

MODRET - Summary Results

Job: Lot 131 Jandakot Rd, SDWMS Date : 19/05/2016 Performed by : RD

Basin: Catchment 3

Catchment Area 1	20.9 EIA	ha
Catchment Area 2		ha
Top Elevation	29.8	mAHD
Base Elevation	28.8	mAHD
Base Length	120	m
Base Width	150	m
Depth	1	m
Batter	1 in 6	
K_H	5	m/day
K_V	5	m/day
n	0.2	
Groundwater Level	26.8	mAHD
Base of Aquifer	-20	mAHD

Stage Volume relationship		
Stage (mAHD)	Volume (m^3)	Area (m^2)
28.8	0	18000
28.9	1815	18325
29.0	3665	18655
29.1	5547	18985
29.2	7460	19320
29.3	9410	19655
29.4	11395	19995
29.5	13410	20340
29.6	15460	20685
29.7	17545	21035
29.8	19670	21385

Duration	1 Yr ARI			5 Yr ARI			10 Yr ARI			100 Yr ARI		
	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)	Peak Level (mAHD)	Volume (m^3)	Total Runoff (m^3)
0.5hr										28.84	18120	7950
1hr										28.94	18450	9905
3hr										29.10	18985	13795
6hr										29.19	19320	17055
12hr										29.32	19655	21770
24hr										29.50	20340	28740
48hr										29.70	21035	38420
72hr										29.80	21385	44090

Suite 1, 27 York St, Subiaco WA 6008
PO Box 117, Subiaco WA 6904
Ph: +61 8 9388 2436
Fx: +61 8 9381 9279

www.jdahydro.com.au

info@jdahydro.com.au

Appendix 4

Engineering Infrastructure Report

(Wood & Grieve Engineers)

WOOD & GRIEVE ENGINEERS

Treeby (Banjup) District Structure Plan Engineering Infrastructure Report

Perron Developments Pty Ltd
30 June 2016
Revision No. 1

Project Number: 25421-PER-C
Ground Floor, 226 Adelaide Terrace, Perth WA 6000
Phone (08) 6222 7000 **Fax** (08) 6222 7100 **Email** perth@wge.com.au **Web** www.wge.com.au

Revision

REVISION	DATE	COMMENT	APPROVED BY
1	30 June 2016	Original Issue	J. Fabling

Contents

1. Background

Wood & Grieve Engineers have been engaged by Perron Developments Pty Ltd to undertake an assessment of civil infrastructure requirements for the development of land within the Treeby District Structure Plan (DSP).

The purpose of this report is to outline the servicing strategy for the purposes of the preparation of the Treeby District Structure Plan.

It is noted that the Stockland Calleya development (Lot 9004 Armadale Road and Lot 9002 & 132 Jandakot Road) is included within the District Structure Plan however as the development and servicing of this land parcel is significantly progressed we have not focussed on this area within our report.

In summary the DSP area can be serviced by the construction, upgrade and/or extension of regional service infrastructure to the site.

2. Earthworks

The final earthworks levels for the site are a complex combination of geotechnical, hydrological, planning, environmental, engineering design and marketing factors.

The existing topography of the site varies in elevation from RL25 at the center of the site to RL46 near Warton Road, with undulation varying between these levels over the site. The gradient available provides the subject land with the flexibility to orientate the home sites to suit passive solar orientation and to obtain some cut material, together with imported fill material to achieve required lot levels to suit clearance to groundwater and storm event flood routing.

The DSP design has considered the need to match into existing ground levels to suit the preservation Bush Forever vegetation.

Detailed hydrological and geotechnical investigations have been undertaken over Lot 4 which have revealed a typical subsurface profile of a relatively thick 4.5m layer of Bassendean Sands overlaying cemented “coffee rock” at depth. It is anticipated that this surface profile would be indicative of the greater structure plan area. These results indicate that a site classification of Class A in accordance with AS2870-2011 would be anticipated.

Market forces presently dictate the provision of flat building sites with retaining walls to accommodate level differences. It is anticipated that lots will be designed with a maximum of 500mm front elevation from the verge level, with retaining walls installed for greater elevations.

Final earthwork levels will be designed to accommodate market requirements together to ensure adequate clearance to the 100 year flood level for the local and district drainage network, as well as providing adequate clearance to groundwater and ensuring roadway geometrical design incorporates flood routing constraints. Sufficient site levels will be required to be provided for the operation of gravity sewer connections.

3. Storm Water Drainage

The Better Urban Water Management requirements for Western Australia prescribes that storm water drainage design ensures that the post development flows are maintained to the predevelopment levels specified, as well as incorporating best practice water sensitive urban design.

It is proposed that minor drainage events (typically less than 5year ARI) discharge via a piped drainage network to drainage treatment train systems with water quality structural controls.

Major storm events (those in excess of the 5 year event and up to the 100 year event) are to be conveyed via roadways to online detention storage systems within multiple use corridors. Discharge from these detention areas is to be controlled to retain existing outflow discharge rates and is to be conveyed offsite using swales and spillways.
Seasonal fluctuations in the water table result in groundwater levels being close to the existing surface levels at the some portions of the site though the year. These areas will be filled to remove the expressions of groundwater at the

surface. Individual lot levels will need to have sufficient clearance to the average annual maximum groundwater level to achieve the desired site classification.

It is anticipated that the Local Structure Plans developed for the individual developments would incorporate storm water detention requirements of the individual Local Water Management Stragegy, with POS locations selected to logically and sympathetically cater for proposed catchments.

4. Roadworks

The DSP is bounded by Jandakot Road (to the north), Warton Road (to the east), Armadale Road (to the south) and Solomon Road (to the west). It is proposed that Liddelow Road is extended north through the structure plan area and this together with Fraser Road south will provide two north south links from Armadale Road to Jandakot Road.

Roadways within the DSP area would be constructed in accordance with the configurations established as part of the traffic engineering requirements of this proposal and the City of Cockburn standard requirements. Road pavement configuration would be designed in accordance with specific geotechnical advice.

It is recommended that the upgrading of Armadale Road by Main Roads WA (MRWA) considers the intersection connections with the DSP area. These intersections will be required to be constructed to the standards of MRWA.

5. Wastewater

The DSP area is currently outside of the Water Corporations current formal sewer planning scheme, which will require review to accommodate the proposal. The Water Corporation have advised that an approved MRS Amendment would be the catalyst for the review of their wastewater planning scheme to establish the detailed requirements for servicing of the site. However, the Water Corporation have commenced conceptual wastewater supply planning about the subject site which is included as Appendix 1.

Disposal of wastewater within the subject land will be achieved via a network of gravity reticulation sewers gravitating to two wastewater pumping stations. One of the wastewater pump stations servicing the DSP area has already been constructed at the intersection of Clementine Boulevard and Ginger Loop within the Calleya development which discharges, via a pressure to existing infrastructure west of the DSP area. The balance of the DSP area discharges to a proposed Type 40 wastewater pumping station within Lot 4, which will discharge via a section of 100 diameter pressure main and 225 diameter gravity sewer to the existing pump station within the Calleya development. The structure plan would ultimately provide for suitable site to house the required Water Corporation infrastructure. It is anticipated a site in the order of 1000 m^2 would be required near the center of Lot 4.

Local structure plans for individual developments will be designed to have a layout sympathetic to the landform, while providing very direct links though the development to the wastewater pumping station to ensure minimisation of sewer extent and depth.

6. Water Supply

The Water Corporation have commenced conceptual water supply planning about the DSP area, as an extension of the Thomson Lake Gravity Supply Scheme, which is included as Appendix 2. This indicates that provision of a DN375 water main extension from the existing DN760 water distribution main crossing Liddelow Road south of Armadale Road and the provision of DN500 water main extension from the existing DN760 water distribution main to Armadale Road, becoming a DN375 within the DSP area.

This water supply arrangement to the site is conceptual and the approval of the MRS Amendment would provide the catalyst for review of the water supply scheme to suit the proposal.

Provision of a potable water supply to individual lots would be achieved the construction of a network of DN100 to DN250 throughout the internal road network of the landholding.

7. Underground Power

Power supply to the DSP area can be achieved via expansion and/or upgrading of Western Power's network in the vicinity of the site. There are currently 22kV high voltage overhead power lines installed in Armadale Road and in the western portion of Jandakot Road adjacent to the DSP area. There is existing underground high voltage infrastructure that has been constructed as part of the Calleya development within the DSP area.

An underground network will be progressively constructed through the proposed subdivision with interconnected switchgear and transformers located about the site being reticulated as a low voltage underground network connecting to each lot.

It is anticipated that the existing overhead power lines located in Armadale Road and Jandakot Road would be removed and be replaced by underground power cables as part of the development works.

330kv transmission lines traverse the DSP area in a north west to south east alignment. The DSP has allowed for a easement about these transmission lines and landuse within this easement will be required to conform with Western Power's requirements.

8. Telecommunications

The current communications legislation details developments of greater than 100 premises National Broadband Network (NBN) are the Wholesale Provider of last resort, recent amendments to the Communications act has encouraged competition within the wholesale sector; as such the developer has the option to sign up with an alternative provider for a Broadband solution.

NBN has already been installed within the Calleya development and noting the relatively large landholdings within the DSP area, it is expected that the NBN network would be extended through the DSP area. An underground network of NBN cabling (in a common trench with underground power) would be progressively constructed through the proposed land parcel with fibre distribution hubs located about the site as required.

If a particular development was to be less than 100 lots then it is anticipated that telecommunication services would be provided by Telstra.

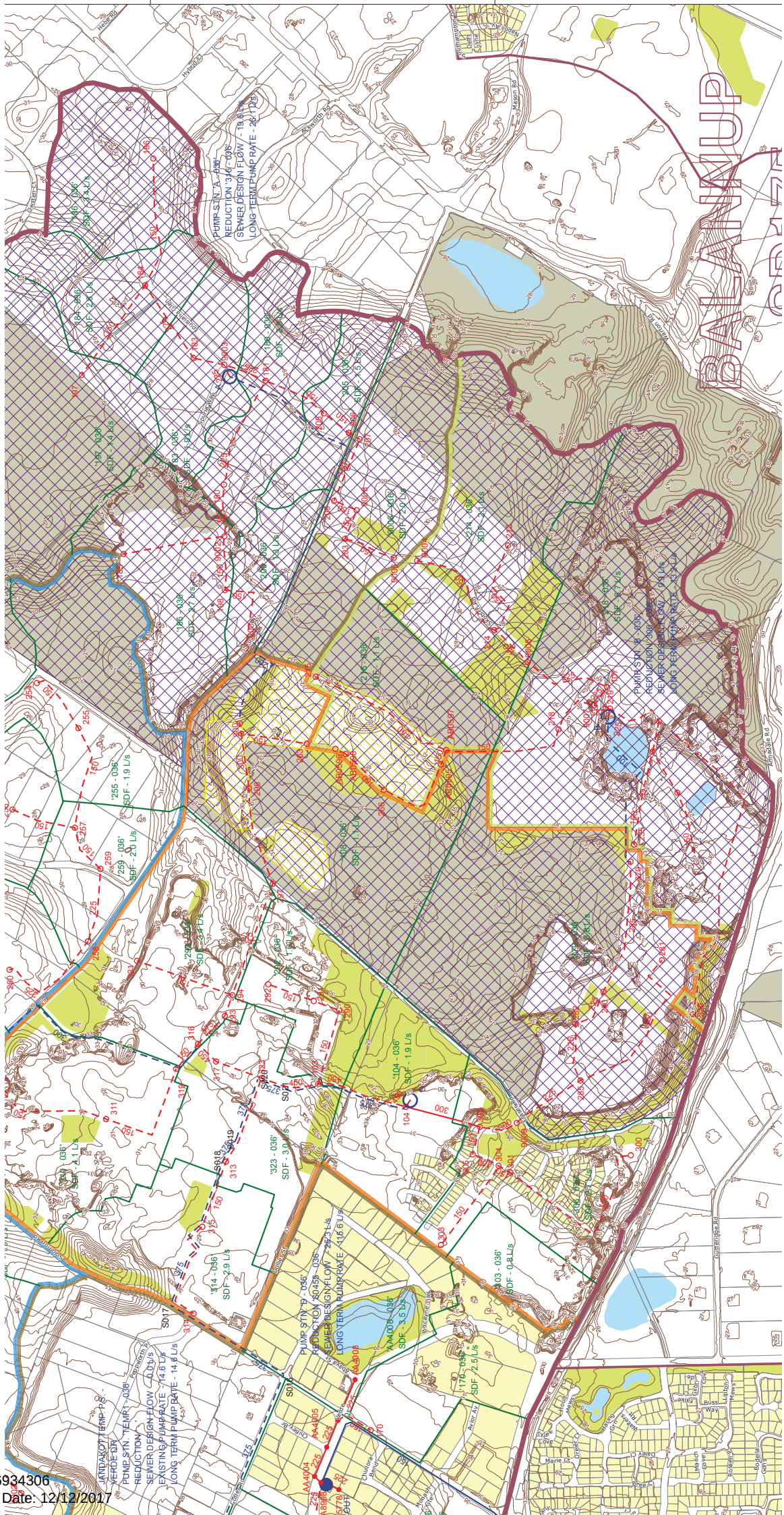
9. Gas

The DSP area is currently serviced by an existing connection to Atco Gas's DN300 high-pressure steel gas main located in Armadale Road.

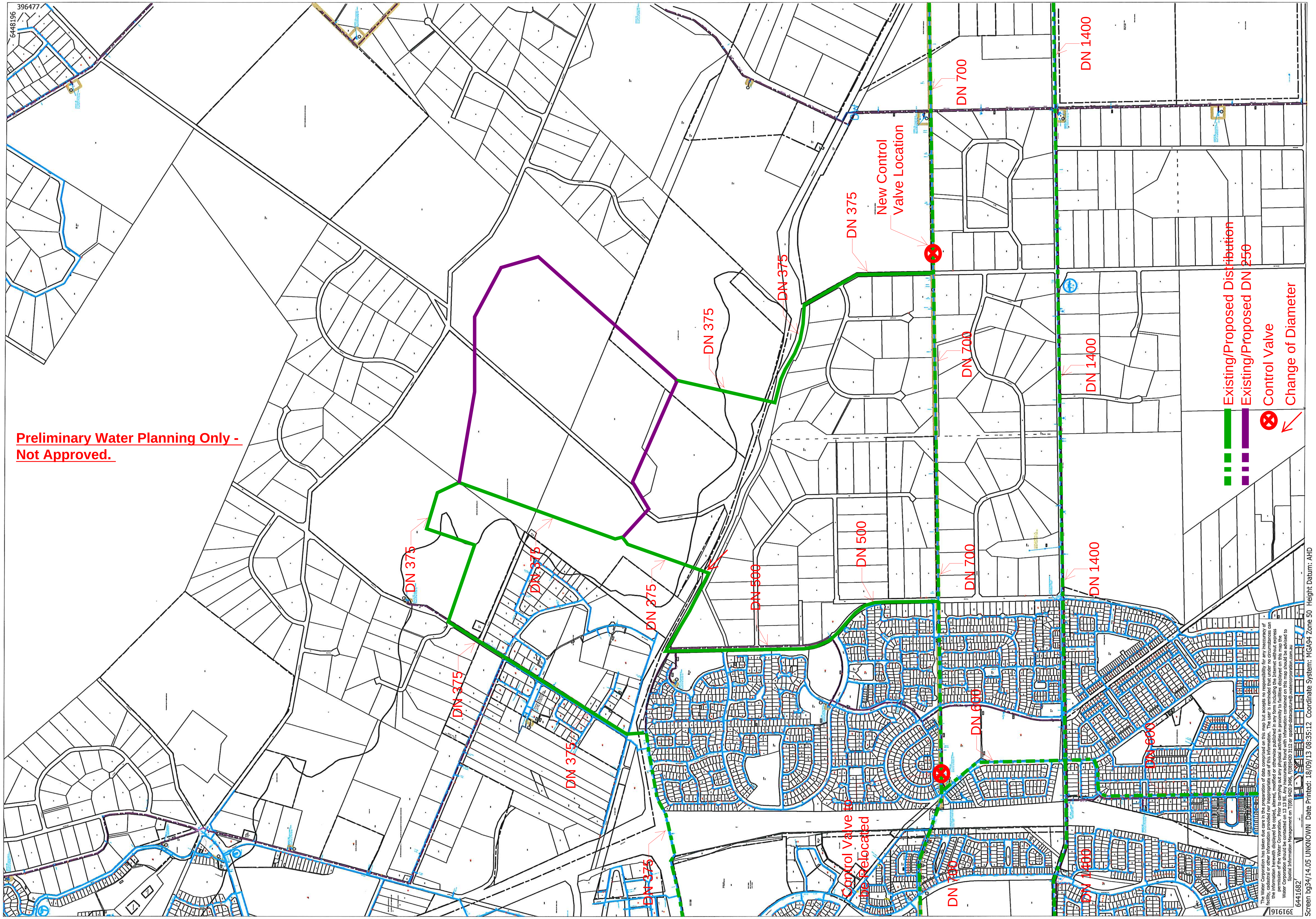
It is anticipated that ATCO Gas will service this development by the internal reticulation of natural gas about the subdivision, utilising a common trench with water reticulation being provided by the developer, connecting to the existing gas mains adjacent to the site.

It is anticipated that a pressure reducing valve will be required to reduce operating pressures at the site to that suitable for residential reticulation.

Appendix 1 – Wastewater Supply Planning



Appendix 2 – Water Supply Planning


Preliminary Water Planning Only -
Not Approved.
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6448196
DN 1400
DN 700
New Control
Valve Location
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DN 375
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DN 600
DN 600
DN 375
Control Valve to
be Relocated
DN 375
DN 700
DN 1400
Existing/Proposed Distribution
Existing/Proposed DN 250
Control Valve
Change of Diameter
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