

LOTS 5, 6, 7 & 8 KEROSENE LANE, BALDIVIS
STRUCTURE PLAN



CERTIFICATION OF APPROVED STRUCTURE PLAN

This Structure Plan is prepared under the provisions of the City of Rockingham Town Planning Scheme No. 2.

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

19 July 2017Date

Signed for and on behalf of the Western Australian Planning Commission



An officer of the Commission duly authorised by the Commission pursuant to section 16 of the *Planning and Development Act 2005* for that purpose, in the presence of:

Witness

19 July 2017Date

19 July 2027Date of Expiry of this Structure Plan

TABLE OF AMENDMENTS TO STRUCTURE PLAN

Amendment No.	Summary of the Amendment	Amendment Type	Date approved by the WAPC

EXECUTIVE SUMMARY

This Structure Plan (SP) has been prepared for the various landholdings being Lots 5, 6, 7 & 8 Kerosene Lane, Baldivis. The land the subject of this SP comprises (4) lots located approximately 10 kilometres east of Rockingham and approximately 42 kilometres south-west of Perth Central Business District. The SP area is within the Perth Metropolitan South-West Corridor and is situated within the municipality of the City of Rockingham (City) and the locality of Baldivis.

This SP provides the rationale, justification and planning framework to guide and facilitate the development of approximately 8.11 hectares of land for urban purposes and has been prepared in accordance with the provisions of Clause 4.2 of the City of Rockingham Town Planning Scheme No. 2 (TPS 2), which requires a structure plan for land zoned 'Development' and as per Schedule 2 Part 4 'Structure Plans' of the *Planning & Development (Local Planning Schemes) Regulations 2015*.

The SP forms part of the Baldivis (North) District Structure Plan (DSP) and is abutting the approved *Lots 14, 15 & 299 Kerosene Lane (Paradiso Estate) Structure Plan* to the east. The proposed SP forms the north-western most part of the DSP area and integrates with the Paradiso Estate development through sharing of public open space (north-south linear parkway) and road connection.

Item	Data	Section number referenced within the Structure Plan Report
Total area covered by the Structure Plan	8.11 hectares	2.2
Area of each land use proposed Residential	4.909 hectares (60.5% of site)	5.1
Total estimated lot yield	135 lots	5.1
Estimated number of dwellings	135 dwellings	5.1
Estimated residential site density	27 dwellings per site hectare	5.1
Estimated Population (average 2.8 people/household)	378 people	5.3
Estimated area and percentage of public open space given over to: - Local Parks	0.492 ha (6.1% within SP site) with 0.153 ha to be provided (via landowner Agreement) from land within surplus POS in adjoining Paradiso Estate. Combined total POS is 0.645 ha which equates to 10% POS. Total of 3 local parks provided in the Structure Plan	7.1

TABLE OF CONTENTS

PART ONE – IMPLEMENTATION

1.0	STRUCTURE PLAN AREA	9
2.0	OPERATION	9
3.0	STAGING	9
4.0	SUBDIVISION & DEVELOPMENT REQUIREMENTS	9
5.0	LOCAL DEVELOPMENT PLAN(S)	10
6.0	OTHER REQUIREMENTS	10

PART TWO – EXPLANATORY SECTION

1.0	INTRODUCTION	11
1.1	Purpose	11
2.0	LAND DESCRIPTION	12
2.1	Location	12
2.2	Land ownership	12
2.3	Existing Land Use	12
2.4	Surrounding Context	13
3.0	PLANNING FRAMEWORK	14
3.1	Draft South Metropolitan Peel Sub-Regional Planning Framework	14
3.2	Directions 2031	14

3.3	Metropolitan Region Scheme	14
3.4	Draft Outer Metropolitan Perth and Peel Sub-Regional Strategy	15
3.5	Liveable Neighbourhoods	15
3.6	City of Rockingham Town Planning Scheme No. 2	16
3.7	City of Rockingham Urban Growth Programme	16
3.8	Baldivis North District Structure Plan	16
3.9	Lots 14, 15 & 299 Kerosene Lane Structure Plan	17
4.0	SITE CONDITIONS & ENVIRONMENT	18
4.1	Topography	18
4.2	Geology and Soils	18
4.3	Hydrology	18
4.4	Acid Sulfate Soils	19
4.5	Flora & Vegetation	19
4.6	Tree Survey	20
4.7	Fauna	20
4.8	Bushfire Management	21
4.9	Parmelia Gas Pipeline	23
5.0	STRUCTURE PLAN	24
5.1	SP Proposed Land Uses	24
5.2	Residential Densities and Yield	24
5.3	Housing Typologies	26
5.4	Use of Detailed Area Plans	26
5.5	Variations to Residential Design Codes	27

5.6	Street Layout	27
5.7	Population & Employment	28
6.0	MOVEMENT NETWORK	30
6.1	Existing Movement Network	30
6.2	Proposed Movement Network - Roads	30
6.3	Proposed Movement Network – Pedestrian/Cyclists	32
6.4	Proposed Movement Network – Public Transport	33
6.5	Street Parking	33
7.0	PUBLIC OPEN SPACE	34
7.1	Public Open Space Provision	34
7.2	Public Open Space Typologies	34
7.3	Public Open Space Schedule	36
8.0	LOCAL WATER MANAGEMENT	37
8.1	Local Stormwater Drainage	37
8.2	1 year, 5 year and 100 year ARI events	37
8.3	Groundwater Management	37
9.0	LANDSCAPING	39
10.0	INFRASTRUCTURE & SERVICING	40
10.1	Wastewater	40
10.2	Water Supply	40
10.3	Power	41
10.4	Telecommunications	41

10.5	Gas	41
10.6	Earthworks	41
10.7	Roads & Pathways	42
10.8	Drainage	42
11.0	STAGING	43
11.1	Staging and Anticipated Timeframes	43
11.2	Development Contributions	43
11.3	Services & Infrastructure	43

APPENDICES

Appendix No.	Document Title	Approval Required or Supporting Document only	Approval Status	Approval Agency
1	Flora & Vegetation Survey	Supporting Document	N/A	N/A
2	Tree Survey	Supporting Document	N/A	N/A
3	Fauna Survey	Supporting Document	N/A	N/A
4	Bushfire Management Plan	Supporting Document – formal approval at subdivision stage	N/A	Department Fire & Emergency Services
5	Pipeline Protection Plan	Approval Required	Yet to be approved for this Structure Plan	APA Pipeline Operator
6	Transport Assessment	Supporting Document	N/A	N/A
7	Local Water Management Strategy	Approval Required	Yet to be approved	Department of Water, City of Rockingham
8	Engineering Servicing Report	Supporting Document	N/A	N/A
9	Pre-lodgement Consultation Table	Supporting Document	N/A	N/A

PART ONE (IMPLEMENTATION)

1.0 STRUCTURE PLAN AREA

This Structure Plan applies to the land contained within the inner edge of the line denoting the structure plan boundary on the Structure Plan Map.

2.0 OPERATION

This Structure Plan comes into effect on the it is approved by the Western Australian Planning Commission.

3.0 STAGING

The Structure Plan is proposed to be developed in a single stage.

4.0 SUBDIVISION & DEVELOPMENT REQUIREMENTS

- a) Residential densities for the structure plan area are the residential densities shown on the Structure Plan Map.
- b) A portion of public open space is to be provided from the public open space credit at the adjacent Lots 14, 15 and 299 Kerosene Lane, Baldivis Structure Plan area (Paradiso Estate) as shown on the Structure Plan Map.
- c) Land use permissibility within the structure plan area shall accord with the corresponding land use classification in the City of Rockingham Town Planning Scheme No. 2.
- d) This structure plan is supported by a Bushfire Management Plan (BMP), *Bushfire Management Plan – Lots 5, 6, 7 and 8 Kerosene Lane, Baldivis*, 2 September 2016, by BioDiverse Solutions, as amended. Any land falling within 100 metres of a bushfire hazard identified in the BMP is designated as a Bushfire Prone Area for the purpose of the Building Code of Australia.
- e) Notifications on Title

The Council shall recommend to the Western Australian Planning Commission that a condition be imposed on the grant of subdivision approval for a notification to be placed on the Certificate of Title to suitably respond to the following:

- That a lot(s) with a bushfire attack level (BAL) rating of 12.5 or higher is within a designed bushfire prone area, subject to a *Bushfire Management Plan* and consequently, additional planning and building requirements may apply to development on the lot.

5.0 LOCAL DEVELOPMENT PLAN(S)

Local Development Plan(s) are to be prepared for lots with one or more of the following attributes:

- a) Abutting public open space; and
- b) With a bushfire attack level of 12.5 or greater.

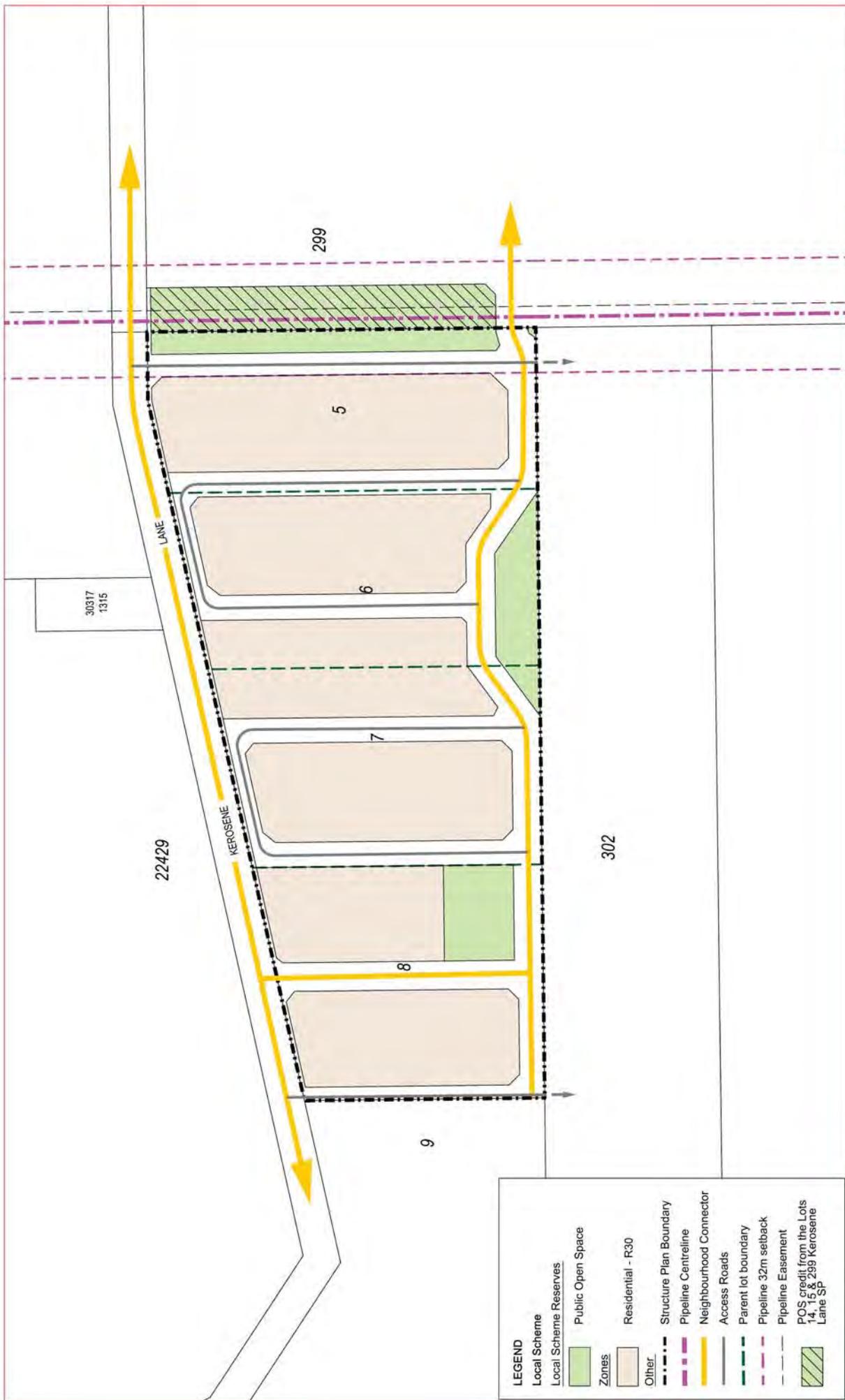
6.0 OTHER REQUIREMENTS

- a) Development Contribution Arrangements

The Structure Plan is subject to the City of Rockingham Development Contribution Area 2.

**STRUCTURE PLAN
LOTS 5-8 KEROSENE LANE
BALDIVIS**

DATE DRAWN: 20/09/21
DRAWN BY: JRM
CHECKED BY: JRM
DATE: 17/07/21
PROJECT: 20000117
KEROSENE LANE
BALDIVIS



LEGEND

- Local Scheme
 - Local Scheme Reserves
 - Public Open Space
 - Zones
 - Residential - R30
 - Other
 - Structure Plan Boundary
 - Pipeline Centreline
 - Neighbourhood Connector
 - Access Roads
 - Parent lot boundary
 - Pipeline 32m setback
 - Pipeline Easement
 - POS credit from the Lots 14, 15 & 299 Kerosene Lane SP

Plan No.: 20684-4
Revision: REV.1
Scale: 1:2000@A3

Scale 4 First Floor 46 Healy Road Osborne Park WA 6117 www.veris.com.au

PART TWO (EXPLANATORY SECTION)

1.0 INTRODUCTION

1.1 Purpose

This report provides the planning rationale for the Structure Plan (SP) prepared for the various landholdings being Lots 5 – 8 Kerosene Lane, Baldivis (herein referred as the “SP area”). **Figure 1** shows the location of the SP area in the context of the locality of Baldivis and proximity to Rockingham and the Kwinana Freeway. An SP is generally required to be prepared and approved prior to subdivision and development of the land in a ‘Development’ zone under TPS 2 and in accordance with the *Planning & Development (Local Planning Schemes) Regulations 2015*.

The SP has been prepared taking into consideration the relevant planning framework and structure planning taking place to the east and south of the SP area. The proposed SP will integrate with the Structure Planning that has already taken place within the DSP area. This will be discussed in further detail in the report.

2.0 LAND DESCRIPTION

2.1 Location

The land the subject of this Structure Plan (SP) comprises (4) lots located approximately 10 kilometres east of Rockingham and approximately 42 kilometres south-west of Perth Central Business District. The SP area is within the Perth Metropolitan South-West Corridor and is situated within the municipality of the City of Rockingham and the locality of Baldivis.

2.2 Land ownership

The SP area contains (4) land parcels (refer to Table 1) with an approximate area of 8.11 hectares in private ownership. **Figure 2** shows the boundaries of the lots that form the SP area and neighbouring context.

Table 1. Land description and area of lots comprising subject site

Lot	Plan/Diagram	Volume	Folio
5	31197	15	95A
6	31197	308	79A
7	31197	1895	381
8	31197	1907	259

2.3 Existing Land Use

The following table provides a brief description of the existing land use for each lot within the SP area. The aerial image provided in Figure 2 shows the subject site and existing development. The proposed SP requires the demolition and removal of existing dwellings and outbuildings to facilitate subdivision for urban development.

Table 2. Existing development within SP area

Lot	Existing Development
5	Existing dwelling, two outbuilding (sheds), parkland cleared in front portion with existing trees (approximately 70% foliage cover) and some understorey grass/tall shrubs in rear area.
6	Parkland cleared in front portion with existing trees (approximately 70% foliage cover) and some understorey grass/tall shrubs in rear area.
7	Existing dwelling and two outbuildings (sheds), parkland cleared for most of lot with existing trees (approximately 30% foliage cover over site) and some scattered understorey grass/tall shrubs throughout.
8	Paddocks and parkland cleared with existing trees (approximately 25% scattered foliage cover) and some scattered understorey grass/tall shrubs.

2.4 Surrounding Context

The SP area is within the locality of Baldivis. **Figure 3** provides an overview of the SP in relation to surrounding development. To the north is remnant vegetation contained in Reserve 22429 on the opposite side of Kerosene Lane. This land is unlikely to be developed and has been reserved as 'Parks and Recreation' under the Metropolitan Region Scheme and identified as Bush Forever Site 356.

To the east is Lot 299, which was historically used as a market garden, and which is currently being urbanised as part of the new *Paradiso Estate*. Approximately 300m to the east of Lot 5 is a newly planned Neighbourhood Commercial Centre, which will include a supermarket (Spudshed), café, offices and shops. Within approximately 6 metres of the eastern boundary of Lot 5 is the *Parmelia Gas Pipeline*, which is a high pressure ethane gas trunk pipeline operated by APA Group. The 12m wide gas pipeline easement corridor is located wholly within the neighbouring Lot 299.

To the west and south, the mostly cleared semi-rural lots (Lot 9 & Lot 1) are proposed to be developed for urban development and is currently undergoing structure planning in consultation with the Proponent. Further to the south is the newly developed (and developing) *Tuart Lakes Lifestyle Village*.

3.0 PLANNING FRAMEWORK

STATE & REGIONAL PLANNING

3.1 *Draft South Metropolitan Peel Sub-Regional Planning Framework*

The Draft South Metropolitan Peel Sub-Regional Planning Framework (SMPSRPF) is an overarching strategic planning instrument that broadly sets out the future settlement pattern for Perth & Peel regions for the next 35 – 40 years to accommodate an expected population of 3.5 million people. The SMPSRPF compliments Directions 2031 by providing four draft sub-regional planning frameworks. The sub-regional frameworks for each sector of the Perth and Peel regions clearly identifies future land uses through urban consolidation, integrated infrastructure and development, co-location of services and the strategic location of employment opportunities.

Under the South Metropolitan Peel Sub-Regional Planning Framework the SP area is identified as 'Urban' with anticipated urban staging within 'Short Term (2015 – 2021)'. The proposed Structure Plan is consistent with the draft SMPSRPF.

3.2 *Directions 2031*

Directions 2031 establishes the vision for the future growth of Perth and Peel regions. It provides a framework in which population growth is to be accommodated. Directions 2031 seeks a 50% increase in the current average residential density of 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 proposed Structure Plan achieves the targets set by Directions 2031 and this will be discussed further in this report.

3.3 *Metropolitan Region Scheme*

The SP area is zoned 'Urban' under the Metropolitan Region Scheme (MRS). The land directly neighbouring the SP area to the south, west and east is also zoned 'Urban' under the MRS. The bushland to the north on the opposite side of Kerosene Lane is reserved as 'Parks and Recreation'.

3.4 *Draft Outer Metropolitan Perth and Peel Sub-Regional Strategy*

The Draft Outer Metropolitan Perth and Peel Sub-Regional Strategy identifies the SP area as part of the “BA1” precinct with an estimated potential for future 3900+ dwellings. The SP area will thus contribute to the overall ‘BA1’ expected dwelling yield in the metropolitan urban expansion strategy. The proposed Structure Plan meets the target density of 15 dwellings per hectare, providing for an estimated 136 dwellings.

3.5 *Liveable Neighbourhoods*

Liveable Neighbourhoods (LN) has been prepared to guide the sustainable development of communities. It addresses both strategic and operational aspects of structure planning and subdivision for both ‘greenfield’ and urban infill sites.

The SP has been designed in accordance with the principles of Liveable Neighbourhoods, in particular, the layout of roads and POS. Consistent with LN, the SP provides a high level of connectivity with good external linkages to cycle, pedestrian and proposed future public transport networks (i.e. Kerosene Lane bus route). The road design in the SP is legible and reduces car travel distances by creating alternative routes. These aspects are further addressed in the report when referring to the indicative Subdivision Concept Plan (**Plan 2**) for the SP area.

LN encourages walkable access to activity nodes and POS. Within the SP, all lots are within 400 metres walking distance from POS areas. This provides residents in the SP with opportunities for active lifestyle and recreation within 5 minutes walking distance from residences.

Consistent with LN, it is important for the SP design to respond to site characteristics and site context. The SP design has taken into consideration the natural topography, surrounding land uses, solar orientation and existing developments. Proposed lots can achieve an E-W or N-S orientation, which provides good opportunity for solar orientation for dwelling design and outdoor living areas. East – west orientated lots are shown in the Subdivision Concept Plan to have lot frontages generally 12.5m – 13.0m, which provides opportunity for dwellings to setback from northern boundary to allow opportunities for natural light and solar access.

Within the SP, lots that face parkland increase opportunity for passive surveillance and interaction with public spaces. Lot shape and proportion of width to depth is considered important and the lots in the SP have been designed to be rectangular in shape with a greater depth than width wherever possible. This ensures ability to develop the lots with high quality housing and builtform and conformity with the Residential Design Codes of Western Australia. Other aspects of LN principles, such as local water management and, diversity of lot sizes and target residential density are addressed further in the SP report.

LOCAL PLANNING

3.6 *City of Rockingham Town Planning Scheme No. 2*

The SP area is zoned 'Development – DA30' under TPS2. As the subject land is englobed undeveloped urban zoned land, it is considered that proper and orderly planning requires the preparation and approval of a Structure Plan, prior to any subdivision and development.

The 'Deemed Provisions' of the *Planning and Development (Local Planning Schemes) Regulations 2015* set out the procedures for the preparation and approval of Structure Plans. This proposed SP has been prepared in accordance with the Regulations and WAPC *Structure Plan Framework 2015*.

Although the Parmelia Gas Pipeline is not located within the SP area, the pipeline is in proximity to the eastern boundary of Lot 5 and the TPS2 requirement for a 32m setback from the centerline to sensitive land uses applies. This has been accommodated for in the proposed SP, where the 32m setback area forms part of POS and road reserve.

3.7 *City of Rockingham Urban Growth Programme*

The City's Urban Growth Programme (UGP) was finalised in 2009 to provide an understanding of the likely pattern of urban growth within the City's municipality consistent with the State's planning direction. The UGP considers existing established areas, population and dwelling statistics, approved Structure Plans and future structure planning areas. The SP area forms part of the urban growth area anticipated by the City for 'Precinct 2' (Baldivis North) area being south of Kerosene Lane.

3.8 *Baldivis North District Structure Plan*

The Baldivis North District Structure Plan (DSP) was finalised in July 2000 and provides for a district level structure plan which provides the framework and sets out the principles for the residential and urban development of Baldivis north of Safety Bay Road. The DSP has been designed with regard to the principles of Liveable Neighbourhoods, including walkable catchments around activity centre nodes.

The DSP identifies a Local Centre to the south-east approximately 400m from Lots 5 & 6 as a key centre that can potentially service the SP area. However, the City has also since the inception of the DSP, approved the redevelopment of the Spudshed supermarket and associated commercial development, which is to form the new *Spudshed Neighbourhood Centre*. The Neighbourhood Centre is located approximately 300m east of Lot 5 and can also service the SP area.

No community infrastructure (i.e. schools or centres) are proposed in the DSP for the SP area. However, the DSP identifies and sets aside a public open space linear north-south parkway which proposes to accommodate the Parmelia Gas Pipeline easement and buffer within POS.

A public primary school site is proposed to the east of Lot 5 within Paradise Estate. The proposed SP is consistent with the DSP and provides for POS within the 32m setback from the pipeline centerline as required to create the north-south linear parkway.

The DSP proposes a Neighbourhood Connector road (being an east-west and then north-south road through Lots 7 & 8) connecting the relatively small street corner commercial centre planned approximately 400m south-east of Lot 5. This intended neighbourhood connector road is no longer possible due to the development of the Tuart Lakes Lifestyle Village, which does not provide for the neighbourhood connector road.

The proposed SP provides for the extension of the east-west Neighbourhood Connector Road that abuts the *Spudshed Neighbourhood Centre* and links with the McDonald Road Neighbourhood Connector Road (as per the DSP). This will be the main internal collector road running parallel with Kerosene Lane. In all other aspects, the proposed SP is consistent with the DSP.

3.9 *Lots 14, 15 & 299 Kerosene Lane Structure Plan*

A Structure Plan has been approved for Lots 14, 15 & 299 Kerosene Lane (*Paradiso Estate*), which neighbours the SP to the east. No direct interface is necessary with this Structure Plan, except that both SPs share (and create) the north-south linear POS parkway which accommodates the *Parmelia Gas Pipeline* easement (and buffer). This is consistent with the DSP. The proposed SP also continues the east-west internal collector road, which will ultimately connect McDonald Road with Kerosene Lane to the west (via proposed road along western boundary of Lot 8). The proposed SP internal collector road gradually downgrades from a Neighbourhood Connector B (17.9m road width) to a Local Access Road C (16.4m road width), as development within the SP is proposed on one side of the road only (north side).

4.0 SITE CONDITIONS & ENVIRONMENT

4.1 Topography

The topography of the SP varies in the range of 22m AHD in the NW portion of Lot 8 to a low area of approximately 8.0m AHD in the south-east corner of Lot 5. Generally the SP area is undulating and sloping to the south of Kerosene Lane, with the sloping topographical feature continuing further south through the SP area into Lot 302.

4.2 Geology and Soils

The SP area is located on the Swan Coastal Plain and is described in the Environmental Geology Map (Geological Survey of WA) as 'S7 being sand derived from Tamala Limestone' and 'LS1 Tamala Limestone'. The geology and soil types found within the SP area are compatible with and can support the proposed urban development.

4.3 Hydrology

Groundwater

Based on the Department of Water *Perth Groundwater Atlas* (2003), the groundwater generally flows in a westerly direction towards the coast and the groundwater table contours are at approximately 3.5m AHD across the middle of the site. Groundwater is approximately 4.5m below the lowest site natural ground level of 8.0m AHD at the south eastern corner of the SP area. This low area is proposed to be filled in order to provide adequate cover for the sewer extension to a minimum 10.0m AHD. This will achieve a minimum approximate 6.5m separation distance to the highest natural groundwater level. The overall depth to groundwater across the SP area ranges approximately 6.5m – 17m AHD.

Surface Water & Wetlands

There are no permanent surface water bodies within the SP area. Sheet drainage across the development site is generally from the north to south, but is limited due to the high permeability and infiltration at source which is characteristic of SP soil geological characteristics.

There are no wetlands within the SP area identified in the DEC database *Geomorphic Wetlands of the Swan Coastal Plain*. Accordingly the SP area is unaffected by any localised surface water features.

4.4 Acid Sulfate Soils

A desktop assessment to determine the presence of Acid Sulfate Soils (ASS) indicates it is unlikely that there be any ASS affecting the SP area. Notwithstanding, any development within the SP will require a preliminary site investigation to be undertaken prior to any subdivision and or development.

Should any development be proposed within areas identified to contain ASS, a detailed geotechnical ASS investigation would be carried out to inform the preparation and approval of an ASS management plan, prior to works being undertaken. This would generally be undertaken as a condition of subdivision approval.

4.5 Flora & Vegetation

The SP area has been semi-cleared and in some places 'parkland cleared' to provide for residential development and semi-rural use. As a result, the vegetation condition of the pre-development vegetation community has been significantly degraded by human activity.

Vegetation condition assessed to the following criteria (Keighery, 1993):

Classification	Vegetation Condition
Pristine	Pristine or nearly so, no obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
Very Good	Vegetation structure altered, obvious signs of disturbance
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate to it
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as being 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs

Keighery, B (1994) *Bushland Plant Survey, Guide to Community Survey for Community, Wildflower Society WA*

In classifying the existing vegetation condition using Keighery (1993), the vegetation within the subject site is classified as being 'Completely Degraded' or 'Degraded to Completely Degraded'.

A Flora & Vegetation Survey (refer to **Appendix 1**) was carried out in Spring 2015. The results of the survey indicated the following:

Flora Values

- There are no conservation significant flora species recorded within the SP area.

Vegetation Values

- Vegetation on the site is considered to be too degraded to have any conservation significance as a vegetation type or complex.
- There is a large presence of non-local native and exotic species, and in particular understorey is generally dominated by weeds.
- There is better quality vegetation of similar ecological type immediately to the north between Kerosene Lane and Kuliya Road, which is protected within Bush Forever Site 356.
- The trees and tall shrubs provide some habitat for native fauna, but are not considered significant habitat (this is further discussed in the Fauna Survey).
- The vegetation within the SP area is not considered to form part of an ecological corridor due to urban development to the south and east.

4.6 *Tree Survey*

A Tree Survey (refer to **Appendix 2**) was conducted in June 2015 to provide an inventory of any significant trees (i.e. trunk >0.5m dia at breast height) within the SP area. Approximately 98 trees were recorded with >0.5m diameter comprising 81 Tuarts, 9 Jarrahs and 8 Standing Dead Trees. Four of the trees contained hollows or sprouts, however only two of the trees contained hollows or sprouts potentially large enough for breeding by Black Cockatoos. In general, Tuarts are the dominant trees within the SP area, with some scattered Jarrahs and non-native trees.

4.7 *Fauna*

A Level 1 Fauna Survey (refer to **Appendix 3**) was conducted with an initial reconnaissance survey carried out in June 2015, followed by a Black Cockatoo breeding survey in September 2015. In general the entire SP area was considered to consist of Disturbed Fauna Habitat due to the absence of an understorey over large sections, altered understorey over the remaining sections, limited connectivity and the presence of dogs which would deter fauna. The results of the Fauna Survey are as follows:

General Fauna

- Biodiversity value of the SP area is considered to be low.
- Southern Brown Bandicoots are present on the site and a trapping and relocation program will be required prior to clearing at subdivision stage.

Targeted Search – Black Cockatoo Habitat

- SP area contains approximately 5.6 hectares of foraging habitat which was classified as Poor Quality Foraging Habitat.
- During September survey no evidence of roosting, breeding or foraging was observed on the site and there is no known evidence of these activities occurring on the site. The risk of a significant impact on quality foraging habitat is considered to be low.
- The northern Bush Forever Site 356 provides a large amount of higher quality foraging and potential breeding habitat immediately to the north of the SP area. The retention of the Bush Forever Site vegetation would lower any impact that clearing of the site would have on local Black Cockatoo population.
- The degree of impact to Forest Red-tailed Black Cockatoos and Carnaby's Black Cockatoos local populations, as a result of clearing and urban development of the SP area, is considered to be low.

4.8 *Bushfire Management*

A Bushfire Management Plan (**Appendix 4**) has been prepared to outline the Bushfire mitigation procedures which are recommended to apply to the proposed subdivision and development of the SP area.

The Bushfire Management Plan (BMP) provides guidance for recommended Bushfire Attack Level (BAL) construction standards at the development stage. At the detailed subdivision stage proposed lots would be designed to ensure that residential development can be provided with a >20m Bushfire Protection Zone.

In accordance with the WAPC draft Guidelines for *Planning in Bush Fire Prone Areas*, the risk of bush fire can be managed in terms of the following:

- A detailed BMP being prepared and implemented by the developer at the subdivision stage;
- Fire hydrants being installed by the developer in accordance with Australian Standards (i.e. fire hydrants every 200m apart on all roads);

- Proposed residential dwellings on individual lots within proximity of bush fire risk areas being constructed to the appropriate BAL in accordance with an approved BMP and AS3959-2009 ("Construction of Houses in Bush Fire Prone Areas") construction standards;
- Detailed assessment for changes to the BAL Assessment can be undertaken by individual owners at development stage due to changes in the landscape. For instance, introduction of new development (i.e. housing and/or clearing of neighbouring properties) which thereby increases opportunities for 'shielding' or reduces the bushfire hazard risk. This may be undertaken at construction stage by an accredited Fire Management Consultant with approval from the local authority;
- Developer undertaking fuel loading controls within future staging areas by managing vegetation (i.e. firebreaks, slashing and mowing);
- Public open space areas will be irrigated by sprinklers;
- Recommended Section 165A of the *Planning and Development Act 2005* notifications on title advising prospective purchasers of the BMP;
- Local Development Plans to refer to BMP and will require affected dwellings to be constructed to the appropriate BAL standard specified in accordance with AS3959-2009.
- A Building Protection Zone (i.e. low fuel loading) of minimum 20 metres is recommended wherever possible from any external housing walls to external vegetated areas with moderate - high bushfire risk;
- Multiple emergency access for residents is provided to the north and east as shown in the Subdivision Concept Plan.
- Developer providing a copy of Bush Fire Management Plan and a copy of the document '*Homeowners Bushfire Survival Manual Guidelines*' to each prospective purchaser affected by bush fire planning requirements.

4.9 *Parmelia Gas Pipeline*

There is a high pressure trunk gas pipeline (Parmelia Gas Pipeline) located approximately 6m east of the western property boundary of neighbouring Lot 299. The pipeline is protected by a 12m wide easement with the pipeline in the centreline of the easement. The easement is wholly contained within the neighbouring Lot 299.

Although the Parmelia Gas Pipeline is not located within the SP area, the pipeline is in proximity to the eastern boundary of Lot 5 and the TPS2 requirement for a 32m setback from the centerline to sensitive land uses applies. This has been accommodated for in the proposed SP, where the 32m setback area forms part of POS and road reserve, and no residential lots are proposed within the 32m setback area.

An AS2885 Pipeline Protection Plan (PPP) (**Appendix 5**) was prepared was the *Lots 14, 15 & 299 Kerosene Lane Local Structure Plan* for Paradiso Estate on the eastern neighbouring land. The PPP does not preclude residential development in proximity to the pipeline up to the 32m setback area.

5.0 STRUCTURE PLAN

5.1 SP Proposed Land Uses

The proposed land uses are identified in the SP Statutory Map (Plan 1) and defined under Part One Clause 4.1 'Land Uses & Permissibility'. This will guide future subdivision and development of the land. Once the SP is adopted 'Deemed Provisions' require the SP be given 'due regard' by decision makers with respect to future subdivision and/or development within the SP area.

5.2 Residential Densities and Yield

The SP ultimately provides for approximately 135 dwellings (at ultimate development) with a base density coding of R30. Proposed development as provided by the SP could accommodate up to approximately 378 people based on an average household of 2.8 persons.

The proposed R30 density provides opportunity for a mix of single dwellings on medium density sized lots, typically ranging 350m² – 390m², with some larger lots above 400m². Table 1 outlines the estimated dwelling yield based on the Subdivision Concept Plan (SCP) shown in **Plan 2**.

Table 1. Estimate of the residential dwelling yield of the SP

RESIDENTIAL LOT TYPE	DENSITY	YIELD	HOUSING TYPES
Medium density residential	R30	135	Single Dwellings
SP Estimated Potential Dwelling Yield		135	

Table 2 provides a snapshot of development statistics based on the SCP and analyses the effectiveness of the based density code of R30 in terms of achieving set target densities under Directions 2031 and Liveable Neighbourhoods.

Although the SCP is indicative only at this SP level of planning (and not the subject of approval), the SP technical reports have been based on the SCP. The SCP provides a point of reference to demonstrate the capability of the proposed SP design over the SP area. The technical investigations undertaken for the SP proposal could therefore provide the basis for future subdivision of the SP area, based on the SCP.

Table 2 demonstrates that the SP design and base density code of R30 delivers approximately 27 dwellings per *site hectare*, which meets the Liveable Neighbourhoods density expectations for the site’s locational context with regard to activity centres and major transport networks. Similarly, the SP delivers approximately 17 dwellings per gross urban hectare, which meets the target density of 15 dwellings per gross urban hectare under Directions 2031.

Table 2 Development Statistics (based on Subdivision Concept Plan)

	Site Outcomes	Target Density
Total SP Area	81,110m ²	-
Area set aside for roads, drainage & POS	32,019m ²	-
Balance area for residential development	49,091m ²	-
Estimate ultimate number of dwellings	135 dwellings	-
Estimated number dwellings per <i>site hectare</i> ¹	27 dwellings/site hectare	Liveable Neighbourhoods 12 – 20 dwellings per site hectare for standard lot layouts; or 20 – 30 dwellings per site hectare for areas within 400m of neighbourhood centres
SP target density per <i>gross urban hectare</i> ²	17 dwellings/hectare	Directions 2031 15 dwellings per gross urban hectare

¹ Liveable Neighbourhoods definition of *site hectare* is the area available for residential development excluding roads, non-residential uses, public open space and drainage areas.

² Directions 2031 definition of *gross urban hectare* is the gross area available for urban development.

5.3 *Housing Typologies*

The SP provides opportunity for low density - medium density housing, with primarily front loaded design, as topographical constraints restrict the development of rear loaded (laneway) lots. Rear loaded lot typology was initially explored in preliminary planning designs, but was dismissed due to difficulties in achieving appropriate grade for laneways servicing rear loaded lots, due to topographical challenges and meeting housing affordability.

Level sites that are terraced reflect the ideal building site to reduce housing cost and create more affordable housing. The use of retaining walls within development will allow for the general landform to be retained, whilst also providing quality homesites and lot sizes consistent with optimal and viable lot yield.

The SCP essentially provides mainly for single dwelling type (front loaded) development on low to medium density size lots, ranging predominantly 350m² – 390m². This range of lot size is sufficient to accommodate a variety of housing built form, including 4 x 2 and 3 x 2 single dwellings, of which can accommodate a diversity of household types, including families, young couples or retirees.

There is a relatively high diversity of existing and proposed housing stock within the Baldivis North area. For instance, immediately to the east of the SP area is the Spudshed Neighbourhood Centre, of which surrounding the centre will be a diversity of housing typologies. These include single, grouped and multiple dwellings mainly catering for smaller household types. Further south neighbouring Lot 302 is the Tuart Lakes Lifestyle Village, which caters for aged and retirement accommodation.

The Paradiso Estate contains a high proportion of low density lots, within the range 400m² – 500m². Paradiso Estate also includes grouped housing (and potential multiple dwelling) sites around the neighbourhood centre. The proposed lots sizes in the SCP provide a complimentary mix towards the overall delivery of new housing in the Baldivis North area.

5.4 *Use of Local Development Plans*

A Local Development Plan (LDP) is likely to be required for certain lots within the SP, such as lots abutting POS, to achieve a desired residential built form outcome. LDPs will provide the mechanism to enable lot design to be linked to a future dwelling, without building development plan/s being submitted at subdivision. This has particular application where design coordination is required to ensure that buildings are suitable for the occupier and the streetscape amenity.

An LDP for the SP can be prepared and approved at subdivision stage, to provide the mechanism for built form development controls to be put in place for a high quality development outcome which maximises the site's potential and makes efficient use of urban zoned land.

5.5 Variations to Residential Design Codes

Variations to the deemed-to-comply provisions of the Residential Design Codes (R-Codes) for medium density single dwelling(s) in the 'Development' zone (as per the WAPC Planning Bulletin 112/2016) is provided under City of Rockingham Planning Policy No. 3.3.22 'Medium-Density Single House Development Standards – Development Zones' (PP 3.3. 22).

PP 3.3.22 makes provision for the WAPC Planning Bulletin 112/2016 'Medium-density single house development standards – Structure Plan areas' (R-MD standards) to be applied, in approved Structure Plans, as a replacement of existing R-Code deemed-to-comply provisions for:

- Building and garage setbacks (clauses 5.12, 5.13 and 5.2.1)
- Open Space (clause 5.14)
- Parking (clause 5.3.3)
- Visual privacy (clause 5.4.1)
- Solar access (clause 5.4.2).

All other R-Code standards will continue to apply, where relevant to single houses. The Structure Plan is included in PP 3.3.22 and the policy provisions will be applied in the assessment of applications for single dwellings.

5.6 Street Layout

The SP proposes a site responsive street network that provides access from proposed structure planning road infrastructure to the east and to existing Kerosene Lane from the north. Connection to the proposed neighbourhood connector road in the east structure planning area will create internal connectivity with external linkages for local vehicle, pedestrian and bicycle modes of transport.

The proposed local access roads is consistent with the local road hierarchy and reinforces legibility once these roads are linked with future development to the south and west under future structure planning.

The SP design provides adequate connections for urban englobo Lots 9 & 302 to the west and south to connect to the existing and proposed street network. Initial discussions with the western and southern landowner have led to the preparation of the SCP. These discussions have also laid down the concepts for provision of necessary infrastructure to facilitate urban development of Lots 9 & 302, which is substantially dependent upon roads and services being brought through the SP area to service Lots 9 & 302.

The wide east-west local access road in the SP meanders around the central POS area, which will be a key centre-piece of development within this area. The location of the POS has been discussed and agreed between the Proponent and the neighbouring landowner of Lot 302.

Due to the location for connection with the neighbourhood connector road in Paradise Estate, and the desire to provide an east-west internal collector road running parallel with Kerosene Lane, it is necessary to meander the road around the POS. The curve in the road will provide for slowing of traffic and create direct sightlines to the POS for road users. This will assist in breaking up any long stretches of straight road, which can encourage traffic speeding and may be monotonous for road users.

To maximise efficiency of urban zoned land suitable for residential development, within Lot 5 the eastern local access road is located within the pipeline 32m buffer, allowing maximisation of the land for residential lots.

Slip roads have been provided adjacent to Kerosene Lane to increase passive surveillance of Kerosene Lane by orientating some of the lots towards the road. This assists in breaking up any solid boundary fencing along Kerosene Lane and increases permeability for pedestrians and cyclists.

Orientation of roads to create north-south neighbourhood blocks will substantially assist efficient urban water management, as the topography and SP area generally slopes from north to south. In addition, the provision of north-south roads provides more direct access to Kerosene Lane (bus route) and opportunity to create east-west orientated lots. For narrow residential lots, with frontage generally 12m – 13m wide, east-west orientated lots are considered superior than north-south orientated lots, as the longer north facing boundary provides for solar access and passive solar design along the full length of the dwelling north side.

The SP proposed roads will ultimately function as a multi-purpose public space, designed to accommodate and balance traffic management with other functions such as community space, safe pedestrian environment, vehicle parking and as an entrance into the residential environment. The width of the proposed roads (to be determined at subdivision stage) will allow for the construction of footpaths consistent with Liveable Neighbourhoods.

5.7 Population & Employment

Based on an average household size of 2.8 persons per dwelling, the SP would result in a residential population of approximately 378 people for the proposed 135 dwellings that could be developed, as shown in the SCP.

The SP area forms the northern-most edge of a new *greenfield* growth area in Baldivis north area. There is an expectation for new urban growth areas to provide for opportunities for local employment, promoting concepts of self-sufficiency as those stated in Liveable Neighbourhoods.

No commercial, community, public use or mixed use land is proposed in the SP, as these land use types have not been identified to be provided in the SP area under the Baldivis North District Structure Plan (DSP).

In terms of local employment opportunities (i.e. within 400m – 800m walking distance) there are areas provided in the DSP, such as the local activity centre to the south-east and future public primary school within the neighbouring Paradiso Estate to the east. In addition, the Spudshed Baldivis Neighbourhood Centre is currently under construction within 400m of Lot 5 to the east, fronting Kerosene Lane within the Paradiso Estate.

Within 10km to the north-west is the Rockingham Regional Centre, which is a strategic employment centre outside of Perth CBD. Opportunities for home-based employment within the SP would exist under the provisions of TPS2 in a 'Residential' zone.

6.0 MOVEMENT NETWORK

6.1 Existing Movement Network

Regional & District Road Network

The SP area is approximately 500m east of Mandurah Road to the west, which is reserved as 'Other Regional Roads' under the Metropolitan Region Scheme and approximately 2.4 kilometres west of Baldivis Road. Mandurah Road and Baldivis Road are both classified under the Main Roads WA (MRWA) regional hierarchy as 'Regional Distributor' roads.

The Kuliya Road interchange with Kwinana Freeway ('Primary Distributor') is approximately 4 kilometres east of the SP area. There is good accessibility to the subject site via these regional and district level roads.

Local Road Network

The SP area currently can only be accessed from the north via Kerosene Lane, with no local access road connections to the south, west or east. Kerosene Lane is classified as an 'Access Road' under the MRWA regional hierarchy and has a posted speed limit of 60km/hr (recently reduced from 80km/hr due to urbanisation along Kerosene Lane).

Kerosene Lane is a single undivided carriageway with an 8 metre wide seal and 3 metre wide unsealed shoulders. No kerbing or formal drainage infrastructure is provided within Kerosene Lane section abutting the SP area.

6.2 Proposed Movement Network - Roads

A Transport Assessment (TA) (**Appendix 6**) has been prepared for the proposed Structure Plan. The TA has been based on the Subdivision Concept Plan contained in this report, which proposes approximately 135 dwellings. Traffic modeling undertaken as part of the TA indicates that intersections with proposed local access roads with Kerosene Lane require no specific treatment of intersections (including turning pockets). There are no safety or unacceptable risks to road users, or operational issues identified as a result of traffic modeling and transport assessment, that cannot be managed through appropriate design protocols.

Roads

Kerosene Lane is proposed to function as a single carriageway (urban standard) 'Neighbourhood Connector A' road connecting the SP development with the regional, district and local road network. The proposed SP will have a Local Access Road C connection to the east linking with Paradiso Estate development and two local road access points from Kerosene Lane (via Lot 8 and via Lot 5).

The Road Hierarchy for the proposed SP (as well as indicative Cross Sections for proposed road types) is provided for in the Transport Assessment (Appendix 6). As shown in the Transport Assessment, proposed roads are to be as follows:

Road Type	Indicative Road Reserve Width
Neighbourhood Connector	17.9m
Local Access Road C	16.4m
Local Access Road D	14.2m
Local Access Road D (one-side development only)	12.9m

The City's standard width for new local access roads is for a minimum 14.2m wide road reserve to accommodate pavement, kerbing, servicing & drainage infrastructure, paths and landscaping. The short slip road connected to the cul-de-sac head in the NW area of the SCP is proposed to be a minimum of 6.0m wide.

The road reserve widths in the SP provide for more land efficient street reserves, including narrower pavement that concurrently promote reduced vehicle speeds, reduced kerb radii and provision for pathways, landscaping, verge treatments, street parking and street trees. Wherever possible, common trenching of services will be provided for, subject to approval by the utility service providers. This can enable the width of road verges to be narrowed by reducing the width of the utilities corridor.

Neighbourhood Connector Road

Provision for the proposed Neighbourhood Connector road, as shown in the Structure Plan, is ultimately be provided from the Structure Plan landholdings and the southern neighbouring Lot 302. Plate 1 shows the road reserve width arrangements within Lots 5 – 8 Kerosene Lane and the southern abutting lot.

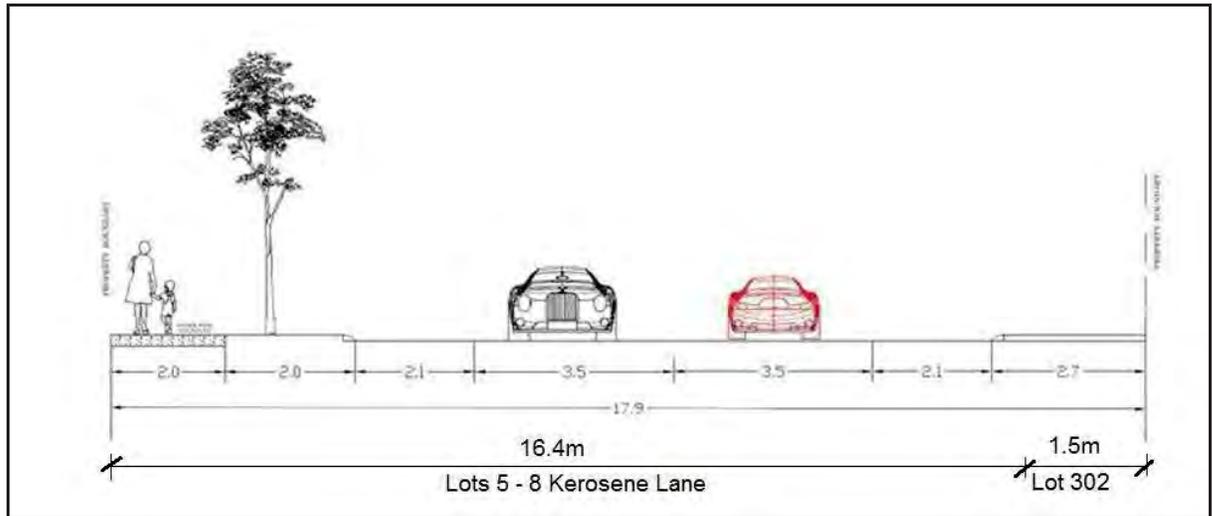


Plate 1. Neighbourhood Connector road indicative cross section

Intersection Treatments

No intersection treatments are proposed in relation to connections with existing and intersections with proposed roads. The existing and proposed local access roads are not expected to carry significant volumes of traffic and will have a sign posted speed limit of 50km/hr. Subsequently this does not necessitate any special intersection treatment.

6.3 *Proposed Movement Network – Pedestrian/Cyclists*

Vehicle speeds on local access streets will be limited through detailed road design measures including reduced pavement width appropriate to traffic volume. Pathways are proposed within the proposed local access roads. **Plan 3** shows the conceptual location for proposed paths linking with the proposed surrounding pathway network for structure planning on neighbouring properties.

The exact location of pathways will be determined in liaison with the City of Rockingham at the subdivision stage. In general, pathways are proposed to be provided on all streets in accordance with the requirements of Liveable Neighbourhoods.

6.4 *Proposed Movement Network – Public Transport*

No public transport facilities are presently located within 400m of the SP area. The nearest bus stop is located in Fifty Road, approximately 2.7km from the SP area. This bus stop services Transperth Route 568 which runs between Warnbro Transit Station and Baldivis.

The Baldivis North District Structure Plan proposes extension of public transport as the suburb of Baldivis becomes increasingly urbanised and matures. It is noted that McDonald Road and Kerosene Lane have been identified (in the *Lots 14, 15 & 299 Kerosene Lane Local Structure Plan*) as a primary bus route in the future.

6.5 *Street Parking*

At this Structure Planning level, no specific provision of on-street parking embayments have been shown within the SP, however, the standard pavement width of local access roads could allow for localised on-street parking, whereby vehicles must pass around parked vehicles. This has been found to assist in traffic calming of streets and is generally acceptable in most residential neighbourhoods where speed limits are between 40 – 50km/hr.

Appropriate consideration for the provision of street parking (where considered suitable) will be given at detailed subdivision design stage and in consultation with the City of Rockingham. In particular, opportunities for formalised on-street parking will be considered around areas of high amenity, such as opposite or adjacent to public open space.

7.0 PUBLIC OPEN SPACE

7.1 Public Open Space Provision

The SP provides for 0.679 hectares of public open space (POS) contained solely within the SP area. This constitutes approximately 8.4% POS, which does not meet the minimum 10.0% POS required by WA Planning Commission under Liveable Neighbourhoods. There is a shortfall of 0.129 hectares in the SP area POS provision, which is to be provided from the surplus POS in the neighbouring approved structure plan to the east.

As outlined in the WAPC endorsed *Lots 14, 15 & 299 Kerosene Lane Local Structure Plan* for Paradiso Estate (neighbouring the SP area to the east), there is a surplus of POS provided within that Structure Plan which could be utilised by the Proponent.

The Proponent of this SP proposal and the proponent of Paradiso Estate have discussed and agreed upon the utilisation of surplus POS within Paradiso Estate for the Proponent's SP for Lots 5 – 8 Kerosene Lane. The area of surplus POS that can be made available for the Proponent's Lots 5 – 8 Local Structure Plan is shown on the Structure Plan Map (Plan 1) and in **Figure 4a** & **Figure 4b** landscaping concept plans for Paradiso Estate. Through the provision of surplus POS from the Paradiso Estate, the SP can meet the required provision of 10% POS, as outlined in Table 4 POS schedule.

Consistent with the DSP, POS within the proposed SP (refer to **Plan 5**) has been provided as a linear parkway (containing the pipeline easement and buffer) which will serve to form a substantial recreational corridor for future residents. The POS linear parkway within Paradiso Estate surplus POS area can be used by future residents within the SP area. For instance, the surplus POS is within 400m of the majority of proposed lots within the SP area. The western-most lots in the SCP have access to a local park within Lot 8. Thus all lots within the SP area have access to POS facilities within 400m walking distance.

Where individual lots within the SP area cannot provide (independently) the required 10% POS quota, a legal agreement between the Proponent and other relevant landowner/s will cover arrangements for the provision and compensation for surplus POS provided for the SP. The minimum 10% POS requirement per landholding within the SP area will be further assessed as part of detailed subdivision design and will negate the requirement for a cash in lieu contribution, for each landowner as applicable, for any shortfall in provision of POS.

7.2 Public Open Space Typologies

With the inclusion of surplus POS from Paradiso Estate (approximately 0.153ha), the SP provides for 0.645 hectares of POS, satisfying the 10% POS requirement. POS areas are proposed to be developed in stages as land is subdivided, with the final design for POS to be determined in liaison with the City as part of subdivision works.

Local Parks

Two local parks are proposed within the SP area as shown in the SCP. The local park POS within Lot 8 is proposed to satisfy the 10% POS requirement for Lot 8 subdivision. This park will contain relatively limited drainage infrastructure comparative to its size and can be developed for active recreation. Wherever possible, retention of significant trees will be provided for in POS areas.



Example of retention of significant trees within POS

The POS within Lots 6 & 7 will form part of a larger local park in future when adjacent Lot 302 to the south is developed. This park will ultimately be relatively large (i.e. almost 1 hectare) in size and can be developed for both active and passive recreational use. The park will serve a multi-purpose function of POS and drainage.

Linear Parkway

The POS parkway incorporating the pipeline easement and buffer to the eastern boundary is proposed with a north-south orientation as per the DSP. The parkway is approximately 40 metres wide. The parkway concept is effective in providing a linear 'greenbelt' interfacing with the Paradiso Estate to the east. It is envisaged that the parkway will contribute towards pedestrian/cyclist movement, recreational pursuits and visual amenity. In addition, the parkway will assist in urban water management by incorporating drainage infrastructure within the pipeline buffer. The parkway will not specifically serve as an ecological corridor for native fauna movement, due to it being "parkland cleared". The SCP shows the potential for the pipeline parkway to extend further south well beyond the SP area as identified in the DSP. The small portion of POS in the SE corner of Lot 5 will form part of this POS parkway.

7.3 Public Open Space Schedule

Table 4. Lots 5 – 8 Kerosene Lane POS Schedule

Calculation of Required POS Provision		
Lot 5	2.026	
Lot 6	2.029	
Lot 7	2.027	
Lot 8	2.029	
Total Site Area (ha)		8.111
Deductions		
Dedicated drainage reserve		
Lot 5 (1:1yr site area basin) – DD1	0.009	
Lot 8 (1:1yr site area basin) – DD3	0.023	
Total Deductions		0.032
Gross Subdivisible area (total area minus deductions)		8.079
Required POS (10%)		0.808
Breakdown of POS Provided		
May comprise:		
- minimum 80 per cent unrestricted POS	0.646	
- Maximum 20 per cent restricted use POS	0.162	
Restricted Public Open Space		
Pipeline easement – Portion Lot 299 (Galati) – PE1	0.129	
Turf/Landscaped Drainage Swale (Lot 6) – DS2	0.017	
Total Restricted POS Credited to a maximum of 20%		0.146
Unrestricted Public Open Space : by function		
<u>Local Park</u>		
Lot 5 – LP1	0.249	
Lot 6 – LP2	0.189	
Lot 7 – LP3	0.028	
Lot 8 – LP4	0.196	
Total Unrestricted POS		0.662
Public open space provision provided		0.808
POS Provision as Percentage of Gross Subdivisible Area		(10%)

Notes

- 1) Final POS calculations will be subject to detailed survey and approved Urban Water Management Plan. A minimum of 10% POS land contribution to be provided at Survey Deposited Plan final approval stage.
- 2) WAPC requires that the POS Schedule calculate the pipeline easement as restricted POS (100% credit) and the pipeline buffer as unrestricted POS (100% credit)
- 3) Pipeline easement restricted use POS (Portion Lot 299) PE1 surplus available 0.236 ha whereas 0.129 ha used by Lots 5 – 8 Kerosene Lane LSP

8.0 LOCAL WATER MANAGEMENT

8.1 Local Stormwater Drainage

A Local Water Management Strategy (LWMS) (**Appendix 7**) has been prepared for the proposed SP based on the SCP. The SP development site has highly permeable sandy soils and adequate separation to ground water. In this instance, the development site is suitable for urban development and on-site infiltration to maximise groundwater recharge.

The proposed development will have the potential to increase the proportion of impervious areas across the site. This in turn will lead to an increase in the volume of stormwater runoff during rainfall events, thereby altering the natural hydrological behaviour of the site.

The proposed roads in the SP have been designed to assist in providing for effective urban water management by facilitating overflow paths towards stormwater infrastructure within POS areas.

All future residential development will be required to contain stormwater on-site. This can be undertaken using standard soak wells and other stormwater disposal techniques, such as directing water run-off to garden beds or use of rainwater tanks.

The LWMS will be used to guide the design and construction of the proposed drainage infrastructure at subdivision stage, under an approved Urban Water Management Plan.

8.2 1 year, 5 year and 100 year ARI events

Table 6 outlines the specific local water management principles for the 1 year, 5 year and 100 year Average Recurrence Interval (ARI) events.

8.3 Groundwater Management

Given the characteristics of the development site (i.e. soil type, hydrology, depth to groundwater etc) the proposed development will not result in any specific requirement for groundwater level controls, such as sub surface drainage and/or fill to be imported, to achieve minimum separation distances to groundwater levels where reticulated sewerage is provided.

The relatively deep groundwater level below the natural sandy surface of the land provides for direct infiltration of stormwater, as close as source as possible. Notwithstanding, as part of the UWMP, adequate pre-treatment measures prior to infiltration to groundwater will be provided to protect groundwater quality.

Table 6 1yr & 5yr & 100yr ARI stormwater management

ARI Event	Local Water Management Principles
1 Year	<p>Accommodated in piped drainage design directed to drainage detention infrastructure in POS areas; and</p> <p>Stormwater contained within each lot prior to discharge/infiltration to groundwater via conventional methods, such as soakwells.</p>
5 Year	<p>Accommodated in piped drainage design directed to drainage detention infrastructure in POS areas.</p>
100 Year	<p>Swale basins constructed within POS areas designed for maximum infiltration;</p> <p>Finished lot levels will be a minimum of 0.5m above the top of 100yr drainage basin infrastructure; and</p> <p>Major storm 100yr stormwater directed away from lots and into POS detention areas.</p>

9.0 LANDSCAPING

The underlining concepts guiding future landscape design within the proposed SP roads and POS areas of the SP are:

- Provision of public facilities which cater primarily for recreational activities to suit the predicted demographic for the locality, including but not limited to active uses and passive uses such as picnics, nature observation, passive contemplation, walking exercise etc;
- Where employed, bio retention swales to collect stormwater runoff, planted with fringing vegetation to provide a nutrient stripping function;
- Integrated path systems to link and create areas suitable for walking, dog walking, cycling, skating and similar;
- Planting in POS and street verges will consist of a mixture of turf, native and dry tolerant species, with an emphasis wherever possible on using indigenous plantings;
- Where verge areas provide opportunity for plantings, diversity of street tree plantings to form strong avenue and high amenity streetscapes; and
- Retention of existing significant trees only wherever possible within POS and road reserves.

A detailed landscaping design and management plan for public open space areas is to be provided as part of subdivision works. Landscape design will minimise water use, with shrub planting to be native or similar. Water harvesting from direct urban stormwater runoff or other sources (i.e. swales, weirs and drainage channels) will be used where possible for passive irrigation purposes. Also where considered appropriate, the use of organic mulches and 'amended earth' techniques will assist in water conservation and reduced irrigation dependency.



Example of retention of significant trees within road reserve

10.0 INFRASTRUCTURE & SERVICING

An Engineering Services Report has been prepared following preliminary investigation and planning for infrastructure and servicing of the SP. The following is a general summary of the report. For the full report refer to **Appendix 8**.

10.1 Wastewater

The SP area is currently not connected to reticulated sewer. Existing dwellings on Lots 5 & 7 are serviced by septic tanks for on-site effluent disposal. Water Corporation sewer infrastructure is currently being extended as part of Paradiso Estate and ultimately sewer extension will be provided to the eastern boundary of Lot 5.

The SP area can be served from the Water Corporation's Baldivis North Pump Station 'McDonald Road' located SE of the SP area. Connection to the pump station would be via extension of the 225mm gravity sewer along the future Maranca Street alignment coming from the eastern adjacent Paradiso Estate.

Water Corporation policy requires developers to extend sewer services to the boundary when extension is planned. Fill will be required to provide cover to the sewer extension across the southern portion of Lot 5 & 6. This sewer will also connect to the neighbouring structure planning area of Lot 9 to the west and Lot 302 to the south.

10.2 Water Supply

At present there is no Water Corporation reticulated water main serving the site. Water supply for the existing dwellings and development is currently from rainwater tanks collected by roof catchment and from groundwater bores.

Water Corporation reticulated water supply infrastructure is currently being extended as part of Paradiso Estate and ultimately reticulated water extension will be provided to the eastern boundary of Lot 5. Similarly with sewer infrastructure, Water Corporation policy requires developers to extend water services to the boundary when extension is planned. Further water extensions through the SP area will ultimately provide reticulated water supply for other structure planning areas within Lots 9 & 302.

10.3 Power

There is existing high and low voltage aerial power lines within the southern verge of Kerosene Lane. Preliminary investigations indicate that there is sufficient power supply capacity in the area to service the proposed SP development.

It is likely that as a requirement of subdivision the existing aerial power lines in the southern verge of Kerosene Lane will need to be relocated and sunk underground along the frontage of the SP site. Underground power reticulation will be extended from the adjacent Paradiso Estate to the east. Any requirements for upgrading and provision of transformer and switch station sites can be determined as part of subdivision works.

10.4 Telecommunications

The SP area can be serviced by the existing telecommunications infrastructure within Kerosene Lane. This infrastructure will need to be extended to service the proposed development, with some upgrading likely to be required. The developer is also required to install National Broadband Network (NBN) 'pipe and pit' to allow for future installation of cables for the NBN. This can be accommodated within common telecommunications trenching.

10.5 Gas

The SP area can potentially be serviced with reticulated gas via extensions to gas infrastructure in the eastern adjacent Paradiso Estate. Reticulated gas infrastructure would be extended to the SP area by ATCO under standard developer arrangements. Arrangements for the provision of reticulated gas supply to the SP area will be further investigated at detailed design stage in consultation with ATCO, as part of subdivision works.

10.6 Earthworks

Substantial earthworking of the site will be required to create level, free draining lots for dwelling construction and provision of roads and services. Extensive low (<1 m) to medium height (<3m) retaining walls will be required due to the undulating site.

Earthworks will involve removal of topsoil, localised cut and fill, followed by stabilisation of finished design levels. Some importation of fill is anticipated to fill the lower southern areas of Lots 5 & 6 for sewer cover. Fill is also likely to be required to raise proposed lots abutting Kerosene Lane to the level of the road. Lots abutting Kerosene Lane will be constructed to the same level as Kerosene Lane to provide amenity and outlook.

Due to the natural fall of the land from north (Kerosene Lane) to south, changes in elevation will be provided for by construction of either retaining walls or batters. The height of retaining walls will vary due to natural ground level differences and wherever possible, the natural topography will remain, though benched. A preliminary Earthworks Plan is provided in **Plan 4**.

Level sites that are terraced reflect the ideal building site to reduce housing cost and create more affordable housing. Retaining walls will be used to provide terraced lots and absorb level differences. Wherever possible, the height of retaining walls will be kept to a minimum and may vary due to natural ground level differences. All retaining walls will be constructed to the City's satisfaction.

10.7 Roads & Pathways

In accordance with City's engineering standards, the roadways will generally be constructed in the conventional manner, with asphalt wearing coarse on a granular base coarse and cast-in-situ concrete kerbing with piped drainage and provision of footpaths. Roads will generally consist of two way single carriageways, with widths of 3.2m – 3.3m. Further geotechnical investigations can confirm the exact design of the roads and drainage infrastructure in consultation with the City.

10.8 Drainage

Stormwater management for the SP development site will be designed to be self-contained. The SP area soils will allow for site soakage, based on its geological characteristics and suitable depth to groundwater. The entire SP area can be accommodated within three drainage catchments, with the low point for each catchment being provided within POS areas. Within the SP drainage design some allowance will be made for stormwater drainage generated in Kerosene Lane.

All urban water management infrastructure will be designed to the standards of the City, with a storage facility to contain the 1 in 100 year stormwater runoff, to be located in proposed POS areas. The Local Water Management Strategy (**Appendix 7**) details the stormwater drainage management plan.

The details for stormwater drainage regarding Urban Water Management flows for the proposed residential development of the SP area will be undertaken at the subdivision and development stage, consistent with the principles of the LWMS.

11.0 STAGING

11.1 Staging and Anticipated Timeframes

It is envisaged that the whole SP landholding area will be earthworked in one contract so as to provide efficiencies in cut to fill and importation of fill. The City has an earthworks embargo during the months of November to March so any substantial earthworks operations should be undertaken outside of the earthworks embargo period, pending timing of approvals. Subdivision and development is likely to be influenced by market demand, however the SP area could be subdivided immediately or in the short term with road access provided from Kerosene Lane through Lots 5 & 8. In discussions with the Proponent of Paradiso Estate, road connection is also proposed to be provided via connection with the east-west neighbourhood connector road (17.9m road reserve) in Paradiso Estate to the east with the proposed SP Local Access Road C.

11.2 Development Contributions

A Development Contribution Plan for the SP area is not required for the provision of key infrastructure as the landowners of Lots 5 – 8 have agreements in place regarding the shared cost and delivery of infrastructure. This includes any pre-funding and construction of all necessary infrastructure and standard necessary upgrades. The landowner of Lots 5 – 8 have also approached the landowners of neighbouring Lots 9 & 302 to the west & south and Lot 299 to the east regarding the coordination of necessary infrastructure provision for new urban development. Thus landowner private agreements will cover the shared cost and timely delivery of infrastructure necessary for urban development.

The SP area is within Development Contribution Area as shown on the TPS 2 Scheme Map as DCA 2. Development Contribution Plan No.2 (DCP 2) applies to all land within the City which is capable of being developed for residential dwellings. The SP area more specifically is contained within the Baldivis North Sub-Area of DCP 2. Contributions towards DCP 2 is applicable for future subdivision and/or development within the SP area.

11.3 Services & Infrastructure

Lots have been designed, wherever possible, to allow development by respective landowners to be undertaken relatively independently. There is general agreement amongst the various landowners within the SP area that earthworks and provision of major trunk services would be undertaken in a single stage to maximise efficiencies and reduce development costs. Should the landowners of the SP area proceed to subdivide concurrently, coordination and sharing of costs for provision of infrastructure (i.e. POS, drainage, roads etc) and servicing would be under a cost sharing agreement. This agreement could be entered into by each landowner and managed by the landowners' project manager as part of the land subdivision process.

PLANS

**SUBDIVISION CONCEPT PLAN
LOTS 5 - 8 KEROSENE LANE
BALDIVIS**

PLAN 2

DATE DRAWN: 21/03/15
DRAWN BY: DAK
CHECKED BY: J.P.
FILE: 10004 sub concept plan 2.dwg
V: 1.0 (DRAFT) - AD
P: 1 (DRAFT) - AD (R)



30317
1315

- LEGEND**
- Solid Wall
 - Existing parent lot boundary
 - Pipeline 32m setback
 - ← Dwelling Orientation
 - Structure Plan Boundary
 - Pipeline

Plan No. : 20864-3
Revision : REV/8

Scale : 1:200 @ A3 1:1000 @ A1

Scale 4 First Floor 48 Hester Road Osborne Park WA 6017 www.whelans.com.au

PATHWAYS & POS NETWORK
LOTS 5 - 8 KEROSENE LANE

PLAN 3

- DATE DRAWN: 14/03/2019
- FILE NO: 13/2018/Development/Planning
- PROJECT NO: 13/2018/0000000000
- PROJECT NAME: KEROSENE LANE
- CREATED BY: JH
- DATE CHECKED: 14/03/2019
- CHECKED BY: JH

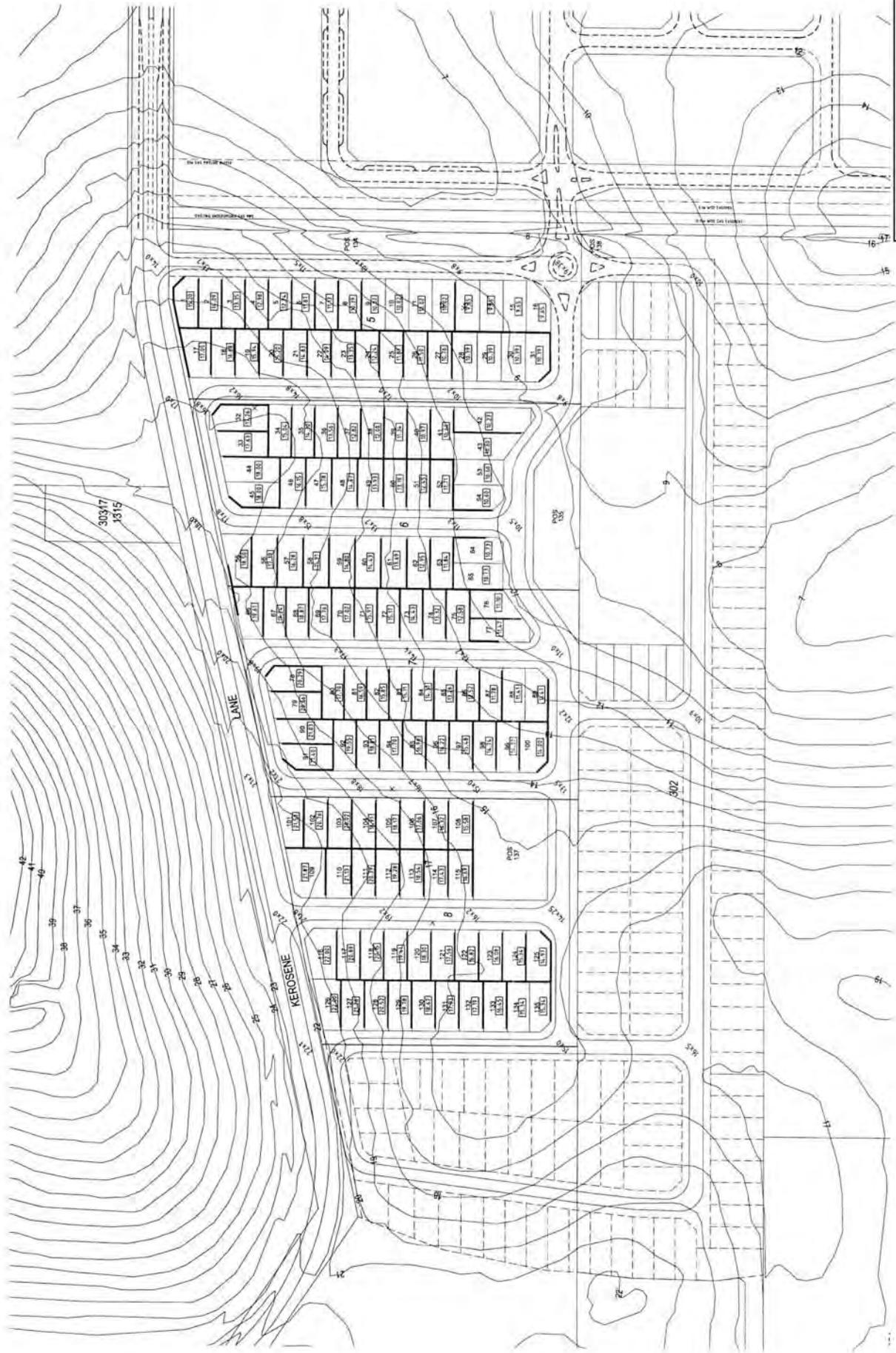


LEGEND

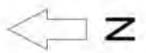
- Structure Plan boundary
- Indicative design (subject to further planning)
- Public Open Space
- Gas Pipeline centraline
- Shared pathway (indicative only)
- Standard Pathway (indicative only)

Plan No.: 20379-19
 Revision: REV/0
 Scale: 1:1500 @ A3



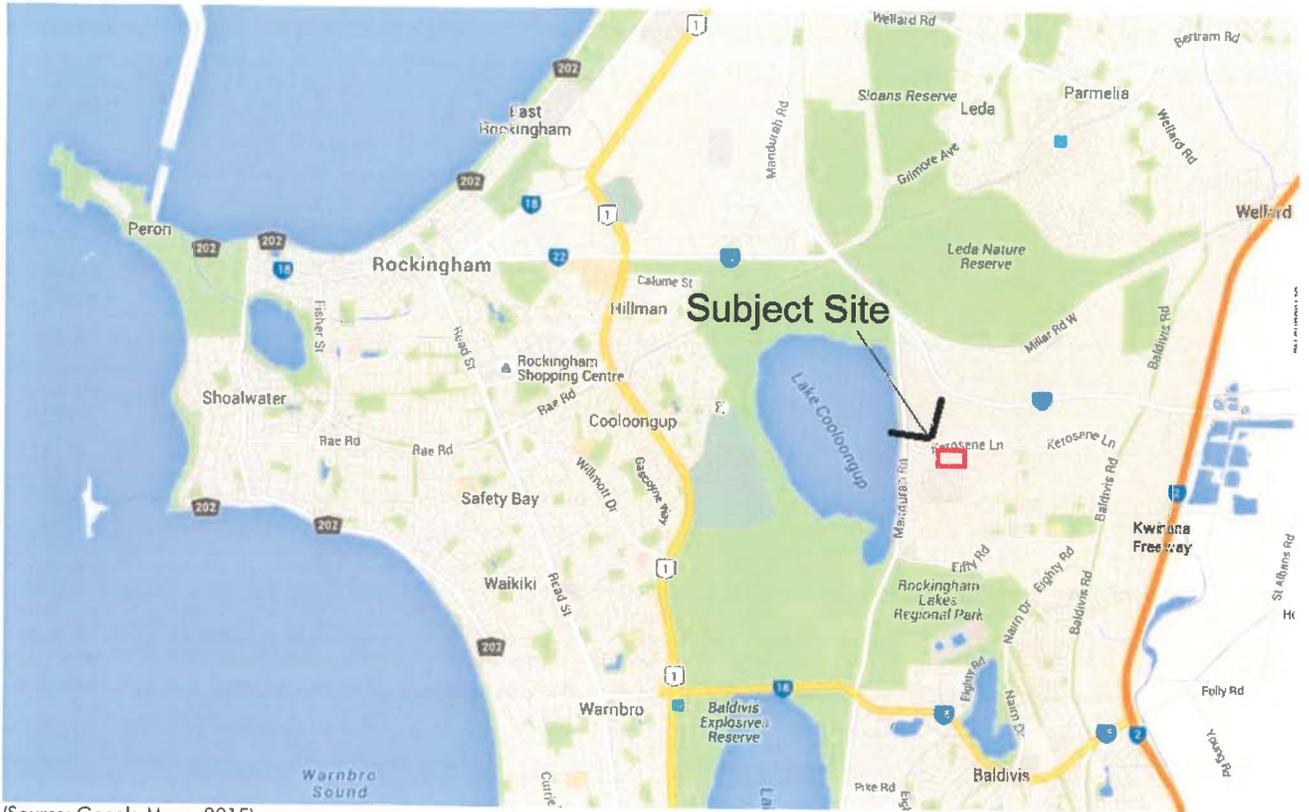


Preliminary Earthwork Plan
 Lots 5 - 8 Kerosene Lane
 PLAN 4



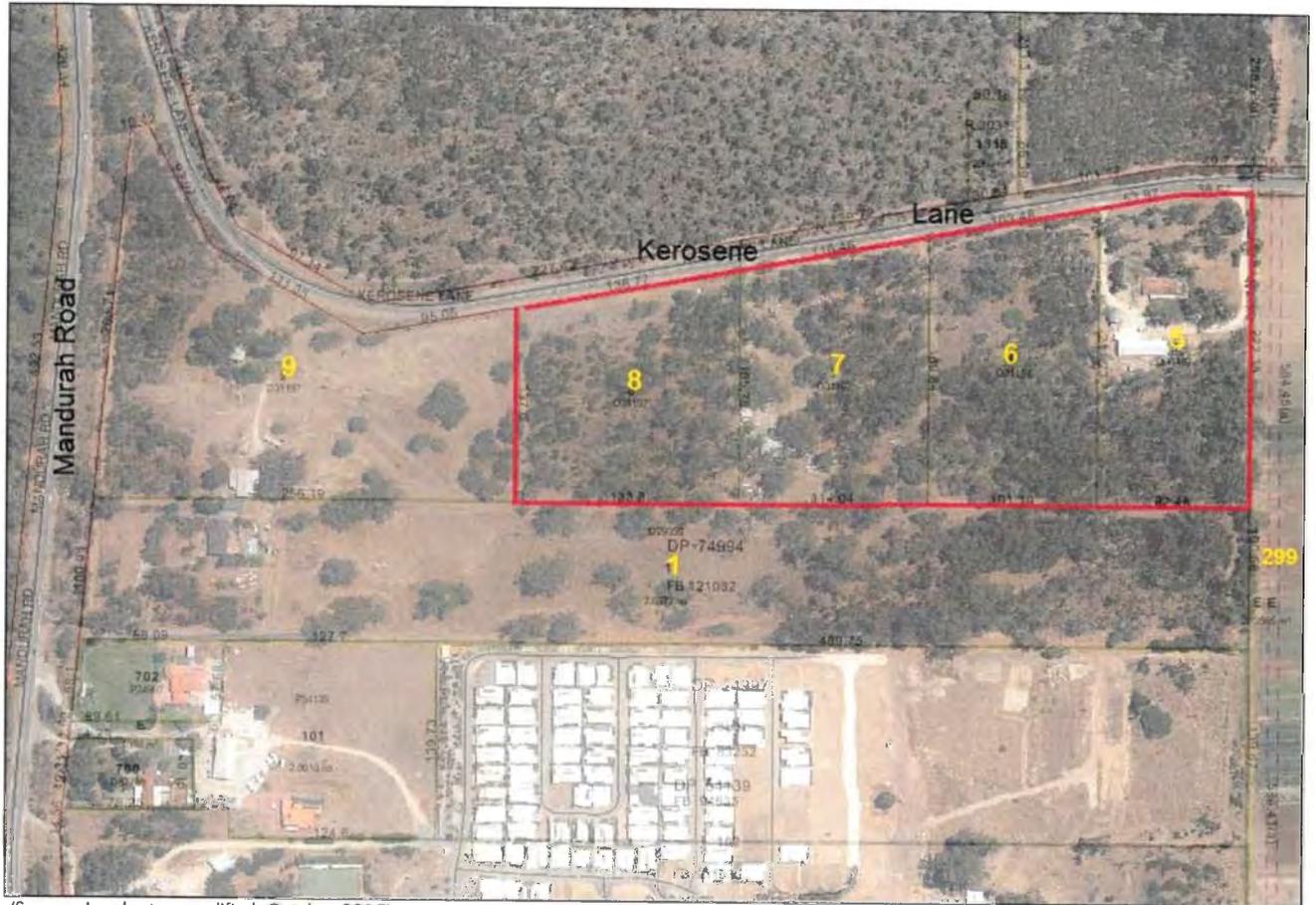
Scale 1:2000 @ A3

FIGURES



(Source: Google Maps, 2015)

FIGURE 1
LOCATION PLAN



(Source: Landgate - modified, October 2015)

FIGURE 2
CADASTRAL/AERIAL PLAN



(Source: Landgate - modified, 2015)

FIGURE 3
SURROUNDING CONTEXT



FIGURE 4a
SURPLUS POS – PARADISO ESTATE

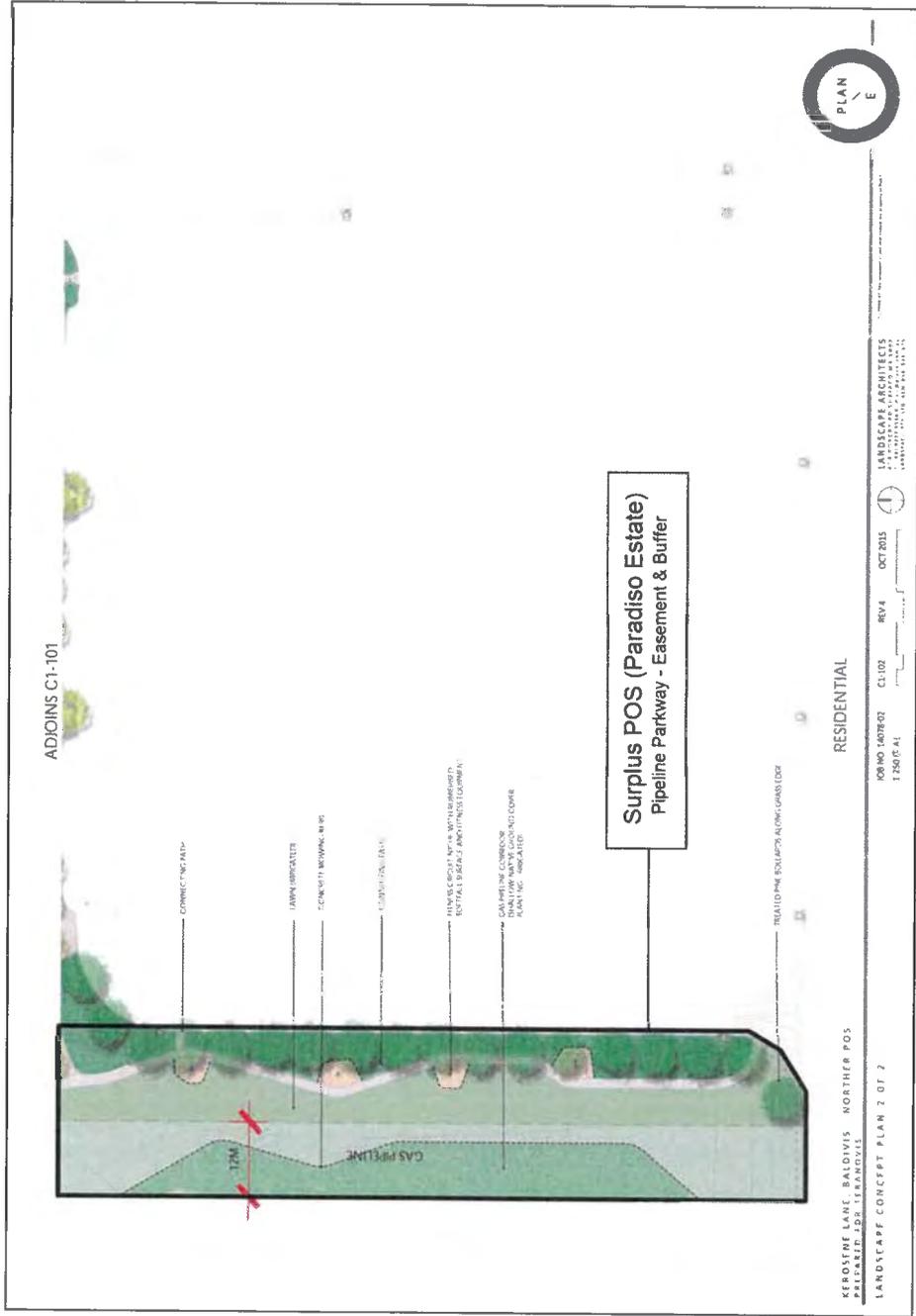


FIGURE 4B
SURPLUS POS – PARADISO ESTATE

APPENDIX 1

FLORA & VEGETATION SURVEY

LOTS 5-8 KEROSENE LANE, BALDIVIS

FLORA AND VEGETATION SURVEY

Prepared for: Terranovis Pty Ltd

Report Date: 21 October 2015

Version: 1

Report No. 2015-225



pgv
ENVIRONMENTAL

CONTENTS

Contents	i
List of Attachments	ii
1 INTRODUCTION	1
1.1 Purpose.....	1
1.2 Scope of Works.....	1
2 EXISTING ENVIRONMENT	2
2.1 Land Use	2
2.2 Topography	3
2.3 Geology and Soils	3
2.4 Hydrology	3
3 FLORA AND VEGETATION	4
3.1 Methodology	4
3.2 Desktop Studies.....	4
3.2.1 Database Searches	4
3.2.2 Likely Occurrence of Significant Flora Species	5
3.3 Survey Conditions.....	6
3.4 Results	7
3.4.1 Flora.....	7
3.4.2 Vegetation	7
3.4.3 Vegetation Condition	9
3.4.4 Conservation Significance of Flora and Vegetation.....	9
4 SUMMARY AND CONCLUSIONS.....	11
5 REFERENCES	12

LIST OF ATTACHMENTS

Tables

- Table 1: Conservation Significant Flora known to occur near the Site
- Table 2: Likelihood of Identified Significant Flora Species occurring on the Site
- Table 3: Statement of Botanical Survey Conditions
- Table 4: Vegetation Condition Rating Scale

Plates

- Plate 1: Historical Aerial Photography of the Site from 1953 (Landgate, 2015a)
- Plate 2: Aerial Photography of the Site from March 2015

Figures

- Figure 1: Site Location
- Figure 2: Site Boundary and Topography
- Figure 3: Vegetation Types
- Figure 4: Vegetation Condition

Appendices

- Appendix 1: DPaW Database Searches
- Appendix 2: Species List
- Appendix 3: Quadrat Data

1 INTRODUCTION

1.1 Purpose

Terranovis Pty Ltd is developing a Local Structure Plan (LSP) for Lots 5-8 Kerosene Lane, Baldivis (the site). The site is 8.11ha in size and approximately 38.5km south of the Perth Central Business District (Figure 1). The site is located in the City of Rockingham and is bound by Kerosene Lane to the north, market gardens to the east, a mostly cleared lot to the west and a lot to the south containing remnant trees (Figure 2).

The site is zoned 'Urban' under the Metropolitan Region Scheme (MRS) and 'Development' under the City of Rockingham Town Planning Scheme No. 2 (TPS2). The site is within Precinct 2 of the proposed Baldivis (North) District Structure Plan which indicates the site to contain residential development consisting of medium density housing.

PGV Environmental was commissioned by Terranovis Pty Ltd to undertake a Level 2 Spring Flora and Vegetation Survey to record the flora and vegetation present on the site.

1.2 Scope of Works

The Level 2 Spring Flora and Vegetation Survey was undertaken in accordance with Guidance Statement 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004) and included the following:

- Desktop search and review of DPaW's Declared Rare and Priority Flora database and Threatened Ecological Communities database;
- Examination of recent aerial photography and contour maps to provisionally identify vegetation types and condition;
- Field survey in spring using quadrats to record native and introduced species as well as a thorough site walkover of any areas of native vegetation;
- Recording of any significant plant species using a hand-held GPS;
- Description and mapping of vegetation types and vegetation condition; and
- Compilation of a flora list.

2 EXISTING ENVIRONMENT

2.1 Land Use

The site consisted of native bushland in 1953 as shown in Plate 1, however Kerosene Lane was already present as a dirt road.

Plate 1: Historical Aerial Photography of the Site from 1953 (Landgate, 2015)



Clearing of sections of the site had commenced by 1965 consisting of small areas in the north of Lots 5 and 6 and the western half of Lot 8, however the vegetation on Lot 8 was regenerating by 1974 (Landgate, 2015a). Dwellings were constructed on Lots 5 and 6 by 1977. The majority of Lot 8 was cleared by 1995 as well as large areas of Lot 7 where a dwelling was constructed (Landgate, 2015a).

Currently Lots 5 (78 Kerosene Lane in Plate 1) and 7 (56 Kerosene Lane in Plate 1) contain dwellings with remnant vegetation, while Lots 6 and 8 are vacant and consist of bushland as shown in Plate 2.

Plate 2: Aerial Photography of the Site from March 2015 (Landgate, 2015)



Land to the east of the site is utilised for market gardens with a locally owned growers market located approximately 320m from the site. Native vegetation in Bush Forever Site 356 is located immediately north of Kerosene Lane opposite Lots 7 and 8. The remaining surrounding land is undeveloped, although a new residential development is being constructed to the south of the southern adjoining lot.

2.2 Topography

The topography on the site slopes upwards in a north-westerly direction ranging from 8m Australian Height Datum (AHD) in the south-eastern corner to 23m AHD in the north-western corner (DoW, 2015) (Figure 2).

2.3 Geology and Soils

The site is mapped on the Spearwood System consisting of Aeolian sand and limestone over sedimentary rocks with sand dunes and plains of yellow deep sands, pale deep sands and yellow/brown shallow sands (DAFWA, 2015).

There are two soil types mapped on the site as describes below (DAFWA, 2015):

- Spearwood S2a Phase (211Sp_S2a) consists of lower slopes (1-5%) of a dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrops; and
- Spearwood S4a Phase (211Sp_S4a) consists of flat to gently undulating sandplain with deep, pale and sometimes bleached sands with yellow-brown subsoils.

The south-eastern section of the site consists of Spearwood S4a Phase soil while the remainder of the site consists of Spearwood S2a Phase soil.

2.4 Hydrology

The groundwater under the site has geological formations that have been grouped into three distinct aquifers:

- Superficial Aquifer (unconfined);
- Leederville Aquifer (confined); and
- Yarragadee north (confined) (DoW, 2015a).

Groundwater flows generally from the east to west under the site. The Perth Groundwater Atlas (DoW, 2015b) shows a snapshot of groundwater levels as measured in May 2003 which are an indication of low groundwater levels and are measured at approximately 3mAHD. The historical maximum groundwater level under the site is at 3 to 4mAHD. The depth to groundwater from the natural surface ranges from approximately 7 to 17m (DoW, 2015b).

There are no surface water features or wetlands on the site.

3 FLORA AND VEGETATION

3.1 Methodology

A desktop study was undertaken for the site using database searches. A flora and vegetation survey of the site was conducted by Dr Paul van der Moezel on 11 September 2015. The survey included sampling from four non-permanent 10m x 10m quadrats as well as a thorough walk through the site. Site coverage was high due to the small size of the site and the degraded nature of the open understorey on most of the site.

3.2 Desktop Studies

3.2.1 Database Searches

A search of the Department of Parks and Wildlife's (DPaW's) Threatened Flora Database, WA Herbarium database and Declared Rare and Priority Flora Species List (Parks and Wildlife, 2015) (Appendix 1) identified 6 Threatened species and 14 Priority plant species that have been recorded within 10km of the site (Table 1).

Table 1: Conservation Significant Flora known to occur near the Site

Species	Common Name	Status Under Wildlife Conservation Act 1950	Status Under EPBC Act 1999
<i>Caladenia huegelii</i>	Grand Spider Orchid	Threatened	Endangered
<i>Diuris micrantha</i>	Dwarf Bee-orchid	Threatened	Vulnerable
<i>Drakaea elastica</i>	Glossy-leaved Hammer Orchid	Threatened	Endangered
<i>Drakaea micrantha</i>	Dwarf Hammer Orchid	Threatened	Endangered
<i>Thelymitra stellata</i>	Star Sun Orchid	Threatened	Endangered
<i>Tribonanthes purpurea</i>	Granite Pink	Threatened	Vulnerable
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i>		Priority 1	
<i>Boronia juncea</i> subsp. <i>juncea</i>		Priority 1	
<i>Acacia benthamii</i>		Priority 2	
<i>Cyathochaeta teretifolia</i>		Priority 3	
<i>Dillwynia dillwynioides</i>		Priority 3	
<i>Pimelea calcicola</i>		Priority 3	
<i>Schoenus capillifolius</i>		Priority 3	
<i>Sphaerolobium calcicola</i>		Priority 3	
<i>Stylidium longitubum</i>	Jumping Jacks	Priority 3	
<i>Thelymitra variegata</i>	Queen of Sheba Orchid	Priority 3	
<i>Aponogeton hexatepalus</i>	Stalked Water Ribbons	Priority 4	
<i>Dodonaea hackettiana</i>	Hackett's Hopbush	Priority 4	
<i>Jacksonia sericea</i>	Waldjumi	Priority 4	
<i>Stylidium ireneae</i>		Priority 4	

3.2.2 Likely Occurrence of Significant Flora Species

Table 2 examines the preferred habitat of each species identified in the database searches and the likelihood of the species listed in Table 1 to occur on the site.

Table 2: Likelihood of Identified Significant Flora Species occurring on the Site

Scientific Name	Preferred Habitat	Likelihood of Presence on site
<i>Caladenia huegelii</i>	Sand or clay loam. Does not survive in disturbed areas.	Possibly due to sandy soils but unlikely due to disturbed nature of most of the site.
<i>Diuris micrantha</i>	Brown loamy clay. Winter-wet swamps, in shallow water	Highly Unlikely due to absence of wet areas
<i>Drakaea elastica</i>	Low-lying situations adjoining winter-wet swamps. Does not survive in disturbed areas	Highly Unlikely due to absence of wet areas.
<i>Drakaea micrantha</i>	Usually found on cleared firebreaks or open sandy patches that have been disturbed in wetter soils.	Highly Unlikely due to absence of wetter soils.
<i>Thelymitra stellata</i>	Sand, gravel, lateritic loam	Unlikely due to absence of suitable soils types.
<i>Tribonanthes purpurea</i>	Seasonally wet soils in moss swards and herbfields among granite rocks	No due to complete absence of suitable habitat.
<i>Acacia lasiocarpa</i> var. <i>bracteolata</i> long peduncle variant	Grey or black sand over clay. Swampy areas, winter wet lowlands	Highly unlikely due to absence of suitable soil types.
<i>Boronia juncea</i> subsp. <i>juncea</i>	Sand. Low scrub	Possible due to sandy soils.
<i>Acacia benthamii</i>	Typically on limestone breakaways	Highly Unlikely due to the absence of limestone breakaways.
<i>Cyathochaeta teretifolia</i>	Grey sand, sandy clay. Swamps, creek edges	Highly Unlikely due to absence of suitable soils types.
<i>Dillwynia dillwynioides</i>	Sandy soils. Winter-wet depressions	Highly Unlikely due to the absence of winter-wet depressions.
<i>Pimelea calcicola</i>	Sand. Coastal limestone ridges.	Possible on sandy soils.
<i>Schoenus capillifolius</i>	Brown mud. Claypans.	Highly Unlikely due to absence of mud and clay.
<i>Sphaerolobium calcicola</i>	White-grey brown sand, sandy clay over limestone, black peaty sandy clay. Tall dunes, winter-wet flats, interdunal swamps, low-lying areas.	Possible on sandy soils.
<i>Stylidium longitubum</i>	Sandy clay, clay. Seasonal wetlands.	Highly Unlikely due to the absence of suitable soil types.
<i>Thelymitra variegata</i>	Sandy clay, sand, laterite.	Possible on sandy soils.
<i>Aponogeton hexatepalus</i>	Mud. Freshwater: ponds, rivers, claypans	No due to absence of water.
<i>Dodonaea hackettiana</i>	Sand. Outcropping limestone	Possible
<i>Jacksonia sericea</i>	Calcareous and sandy soils	Possible on calcareous sandy soils.

Scientific Name	Preferred Habitat	Likelihood of Presence on site
<i>Stylidium ireneae</i>	Sandy loam. Valleys near creek lines, woodland, often with <i>Agonis</i>	No – no creeks or natural <i>Agonis</i> are present on the site

* sourced from Florabase (DPaW, 2014), DoE SPRAT Database (DoE, 2014) as well as the DPaW database searches.

The database searches identified seven species that could possibly occur on the site due to their habitat preference for sandy soils, including one Threatened species (*Caladenia huegelii*) and six Priority species.

A search of the DPaW Threatened and Priority Ecological Community database (Ref 10-0715EC) identified two Threatened and three Priority Ecological Communities that have been recorded within 5km of the site (Appendix 1) as follows:

- SCP 19a ‘Sedgelands in Holocene dune swales of the southern Swan Coastal Plain’ (TEC)
- SCP 19b ‘Woodlands over Sedgelands in Holocene dune swales of the southern Swan Coastal Plain’ (TEC)
- 24 ‘Northern Spearwood shrublands and woodlands’ (Priority 3)
- 25 ‘Southern *Eucalyptus gomphocephala* - *Agonis flexuosa* woodlands’ (Priority 3)
- Walyungup Microbial ‘Microbial community of a coastal saline lake (Lake Walyungup) (Priority 1)

3.3 Survey Conditions

The conditions that the survey was undertaken in are presented in Table 3 in order to assess the adequacy of the survey. In summary, there were no constraints to the survey.

Table 3: Statement of Botanical Survey Conditions

Issue	Constraints (Yes/No); Significant, Moderate or Negligible	Comment
Competency/Experience Of The Consultant Conducting The Survey	No Constraints	Dr Paul Van Der Moezel Has Extensive Survey Experience On The Swan Coastal Plain.
Proportion Of The Flora Identified	No Constraints	The Timing Of The Survey In Early Mid-September Should Have Identified Most Of The Native Species On The Site.
Sources Of Information (Historic/Recent Or New Data)	No Constraints	The Flora Of The Swan Coastal Plain Is Relatively Well Documented.
Proportion Of The Task Achieved And Further Work That May Need To Be Undertaken	No Constraints	No Follow-Up Survey Required.

Issue	Constraints (Yes/No); Significant, Moderate or Negligible	Comment
Timing/Weather/Season/Cycle	No Constraints	The 11 September Survey Was Ideal For Identifying Rare Orchids And Maximising Flowering Of Most Species. Flowering Of <i>Caladenia Huegelii</i> Was Two Weeks' Early In 2015 Therefore The 11 September Time Was Suitable.
Intensity Of Survey (E.G. In Retrospect Was The Intensity Adequate)	No Constraints	Around 4 Hours Was Spent On The Site Which Was Appropriate Given The Small Size And High Disturbance Of The Lots.
Completeness (E.G. Was Relevant Area Fully Surveyed)	No Constraints	
Resources (E.G. Degree Of Expertise Available For Plant Identification)	No Constraints	Experienced Botanist Undertook Plant Identifications On Site.
Remoteness And/Or Access Problems	No Constraints	Easily Traversed On Foot.
Availability Of Contextual (E.G. Bioregional) Information For The Study Area.	No Constraints	Many Botanical References To Refer To On The Swan Coastal Plain In The Perth Metropolitan Region, Particularly Perth's Bush Forever.

Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

3.4 Results

3.4.1 Flora

A total of 65 plant species, including 35 native and 30 introduced were recorded on the site (Appendix 2). The high percentage of introduced species (46%) and very low number of native species on an 8.11ha site was indicative of the overall poor condition of the vegetation. The families with the highest representation were the Fabaceae (Wattles and Peas - 11 species including three introduced), Poaceae (Grasses – 7 species all introduced) and the Asparagaceae (Lilies – 5 species including one introduced). The Myrtaceae and Proteaceae Families were well under-represented in the species list.

The presence of only one orchid species (Pink Fairy Orchid – *Caladenia latifolia*) was also a reflection on the poor condition of the vegetation.

Four 10m x 10m quadrats were sampled on the site (Appendix 3). The species richness in the quadrats ranged from 9 – 20 (average 14.0) which is very low compared to high quality vegetation of similar type.

3.4.2 Vegetation

Vegetation Complexes

The vegetation on the site is part of the Cottesloe Complex – Central and South which is described as a 'Mosaic of woodland of *Eucalyptus gomphocephala* (Tuart) and open forest of *E. gomphocephala* – *E. marginata* (Jarrah) – *Corymbia calophylla* (Marri), closed heath on the limestone outcrops' (Hedde *et al.* 1980).

Vegetation Types

Four vegetation types were recorded on the site in addition to areas around dwellings planted with non-local native and exotic species. A description of each vegetation type is provided below and their distribution on the site is shown on Figure 3.

EgAr *Eucalyptus gomphocephala* (Tuart) Open Forest over *Acacia rostellifera* Tall Shrubland over weeds

This is the main vegetation type occurring in the central and eastern part of the site. Tuart trees dominate up to 15m high and are reasonably dense over most of the area. Jarrah trees are also present but in low densities. The mid storey contains *Acacia rostellifera* in low density and up to 4m high. The understorey is dominated by weed species, particularly Annual Veldtgrass (*Ehrharta calycina*) as well as Fumitory (*Fumaria capreolata*) and *Euphorbia peplus*. Two native climbers, *Hardenbergia comptoniana* and *Clematis linearifolia*, are common in the shrubs. The soils are brown loamy sand. Quadrat K1 is representative of this vegetation type.

EgArBs *Eucalyptus gomphocephala* (Tuart) Open Woodland over *Acacia rostellifera*/*Banksia sessilis* Tall Open Scrub over weeds

This vegetation type occurs on the western and northern ends of the site where limestone is either at the surface or just below. The Tuart trees are less dense than the EgAr vegetation type and in some places almost absent (quadrat K3). The mid-storey contains *Acacia rostellifera* and *Banksia sessilis* (Parrot Bush) in varying densities around 4m tall. *Jacksonia furcellata* is also common in patches. The native understorey is sparse with *Acacia pulchella* and *Macrozamia fraseri* common. Dominant weed species are *Ehrharta longiflora*, *Euphorbia terracina*, *Euphorbia peplus* and *Lupinus cosentinii*. Quadrats K2 and K4 are representative of this vegetation type with Tuart trees present.

Em *Eucalyptus marginata* (Jarrah) Open Woodland over weeds

A small stand of Jarrah trees up to 8m high occurs on Lot 7 with no Tuart trees present. The understorey is completely dominated by Veldtgrass (*Ehrharta calycina*). No quadrat was recorded in this type due to the absence of native understorey species.

Eg *Eucalyptus gomphocephala* (Tuart) trees over manicured lawn

Lot 7 contains native Tuart trees over manicured lawn and with no native understorey.

Floristic Community Types

Floristic Community Types (FCT) are based on the whole floristic composition of the vegetation rather than being determined by soil type and geomorphology (Vegetation Complex) or the nature of the dominant species (Vegetation Types). The FCT level of vegetation is required to identify whether any of the vegetation on the site is a Threatened or Priority Ecological Community.

The vegetation on the site is too degraded to accurately assign a FCT to. The vegetation is most likely representative of FCT 24 'Northern Spearwood shrublands and woodlands' if it were in better condition.

3.4.3 Vegetation Condition

The vegetation condition over the site was assessed using the condition scale adopted in Bush Forever (Table 4). All of the vegetation was either Completely Degraded or Degraded to Completely Degraded due to the sparse or absent native understorey and abundance of weed species (Figure 4).

Table 4: Vegetation Condition Rating Scale

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia, 2000.

3.4.4 Conservation Significance of Flora and Vegetation

Flora

No conservation significant flora species were recorded on the site.

The timing of the survey was considered suitable to identify any potential Threatened or Priority species. The Threatened orchid species *Caladenia huegelii* (Grand Spider Orchid) was observed to be flowering at a reference site a few days prior to the survey on Kerosene Lane.

Vegetation

The vegetation on the site is too degraded to have any conservation significance as a vegetation complex or type. If it were in better condition the vegetation would be representative of the Priority 3 ecological community FCT 24 'Northern Spearwood shrublands and woodlands'. However, the poor quality of the vegetation means that assigning a FCT to the vegetation is not possible.

Better quality vegetation of a similar type occurs immediately to the north of the site between Kerosene Lane and Kulija Road. This area is part of the large Bush Forever site 356 'Lake Cooloongup, Lake Walyungup and Adjacent Bushland, Hillman to Port Kennedy'.

The trees and tall shrubs provide some habitat for native fauna, including Carnaby's Black Cockatoos, but are not considered significant habitat (see PGV Environmental 2015 fauna report).

The vegetation on the site is not part of an ecological corridor due to the developments to the south and east of the site. Any east-west corridor function in this part of Baldivis would occur in the Bush Forever site to the north of Kerosene Lane.

4 SUMMARY AND CONCLUSIONS

The Level 2 Flora and Vegetation Survey of Lots 5-8 Kerosene Lane resulted in the following findings:

- A total of 65 plant species, including 35 native and 30 introduced were recorded on the site during the 11 September survey. The high percentage of introduced species (46%) and very low number of native species on an 8.11ha site was indicative of the overall poor condition of the vegetation.
- Database searches indicated that 7 conservation significant species could occur on the site. However, no conservation significant flora species were recorded during the survey.
- Four 10m x 10m quadrats were sampled on the site. The species richness in the quadrats ranged from 9 – 20 (average 14.0) which is very low compared to high quality vegetation of similar type.
- The vegetation on the site is part of the Cottesloe Complex – Central and South.
- Four vegetation types were recorded on the site in addition to areas around dwellings planted with non-local native and exotic species. Tuart trees were the dominant tree species with occasional Jarrah present. In areas containing shallow limestone Parrot Bush (*Banksia sessilis*) was a common species.
- All of the vegetation was either Completely Degraded or Degraded to Completely Degraded due to the sparse or absent native understorey and abundance of weed species.
- The vegetation on the site is too degraded to accurately assign a FCT to. The vegetation is most likely representative of FCT 24 'Northern Spearwood shrublands and woodlands' if it were in better condition.
- The vegetation on the site is too degraded to have any conservation significance as a vegetation complex or type.
- The vegetation on the site is not part of an ecological corridor.
- Vegetation of similar type and in better condition is contained in Bush Forever site 356 a part of which occurs immediately to the north of the site between Kerosene Lane and Kulija Road.
- Clearing of the site for urban development will not impact on any conservation values for flora and vegetation.

5 REFERENCES

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FIGURES



	Tetrarix Pty Ltd FLOW AND VEGETATION SURVEY LOTS 5-8 KEROSENE LANE, BALDIVIS	
	Drawn: P. van der Merwe	Date: 19 Oct 2015
Job: 10224 Rpt. 2015-225		Revision: A
VEGETATION TYPES		Figure 3

CADASTRAL SOURCE: Landgate, July 2015.
 AERIAL PHOTOGRAPH SOURCE: NearMap, Down March 2015.



		TEURLOOY'S Pty Ltd FLORA AND VEGETATION SURVEY LOTS 5-8 KEROSENE LANE, BALDIVIS	
Drawn: P. van der Meszel	Date: 19 Oct 2015	VEGETATION CONDITION	
Job: 10224 Rpt. 2015-225	Revision: A		

Figure 4

Legend

- - - Site Boundary
- Cadastral Boundary
- Easement Boundary
- Vegetation Condition Boundary
- CD
- Vegetation Condition

Vegetation Condition
 (SOURCE: Bush Forever, Govt. of W.A., 2000)

P - Pristine
 Pristine or nearly so, no obvious signs of disturbance.

Ex - Excellent
 Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.

VG - Very Good
 Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

G - Good
 Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

D - Degraded
 Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

CD - Completely Degraded
 The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

CI - Cleared
 No native vegetation remaining.

CADASTRAL SOURCE: Landgate, July 2015.
 AERIAL PHOTOGRAPH SOURCE: NearMap, Down March 2015.

APPENDIX 1
DPaW Database Searches

Sheet	NameID	Taxon	Cons_Cod	Plant_Desc	Site_Descr	Vegetation	Frequency	Other_Note	Locality	Geocode_Me	Accuracy	Date
6960103	3237	Acacia benthamii	2		Low plain. Grey sand.	Open Jarrah & Tuart woodland. Allocasuarina fraseriana, Banksia attenuata, Kunzea glabrescens, Hibbertia hypericoides.	ca 20 plants.		Lot 203, Stock Road, Stake Hill	GPS	1	31/03/2005 0:00
4080696	14932	Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	1	Erect slender shrub to 1.5 m. Flowers yellow, in full flower.	Grey sand over clay.	Eucalyptus calophylla woodland.		Abundance: scattered in area.	Lowlands; Serpentine River	MAN	0	13/08/1992 0:00
4095251	141	Aponogeton hexatepalus	4	Aquatic bulbous herb 15 cm high.	Seasonal wetland on Pinjarra Plain. Red loam.	Open Melaleuca vinea scrub over Leptocarpus coangustatus dense low sedges.	common.		Bushland remnant W of junction of Mundijong and Duckpond roads (plot duck-3)	GPS	1	7/08/1992 0:00
7332025	16633	Boronia juncea subsp. juncea	1	Shrub to 1 m high x 0.5 m wide. Pink and purple flowers.	Gentle slope with a north aspect. Surface soil is dark brown sandy loam and sub surface soil is dark brown sandy loam. Drainage is poor and wet during winter and spring only with soil being waterlogged at present.	Melaleuca preissiana, M. raphiophylla low open woodland over Astartea scoparia closed heath over Centella asiatica herbland. Excellent to pristine vegetation condition with some weed species affecting the herb layer.	a couple.		Braddock Road, Wellard	GPS	1	2/12/2005 0:00
7332149	16245	Cyathochaeta teretifolia	3	Tufted sedge with height of 1.5 m and width of 1 m.	Gentle slope with a north aspect. Surface soil is dark brown sandy loam and sub surface soil is dark brown sandy loam. Drainage is poor and wet during winter and spring only with soil being waterlogged at present.	Melaleuca preissiana, M. raphiophylla low open woodland over Astartea scoparia closed heath over Centella asiatica herbland. Excellent to pristine vegetation condition with some weed species affecting the herb layer.	locally common.	Outside quadrat.	Braddock Road, Wellard	GPS	1	2/12/2005 0:00
7858736	16245	Cyathochaeta teretifolia	3		Black peat.	Melaleuca preissiana, Eucalyptus rudis subsp. rudis, Pteridium esculentum			Lot 100, Treeby Rd, Anketell	GPS	0	24/10/2007 0:00
4981588	12938	Diuris micrantha	T						Medina	AUTO	3	24/09/1984 0:00
1157647	4763	Dodonaea hackettiana	4	Erect shrub, ca 1.5 m high. Perennial, erect shrub, 4 m high x 3 m wide. Orange flowers. Reproductive	Level, but disturbed sand. Plain. Reserve. Lake upland. Beelair Regional Park. Grey dry sand. Soil disturbed 20 years ago.		rare.	Population structure: 50% in bud, 100% flowering. With many alien	The Spectacles, near Medina	MAN	4	22/04/1986 0:00
7104588	4763	Dodonaea hackettiana	4			Tall trees with Eucalyptus rudis and paperbarks.	6-20 plants in 10 m x 10 m area.		About 40 m S of Osprey Drive and just E of the drain going under Osprey Drive (which is W of Parkes Road); Yangebup	GPS	1	16/10/2003 0:00

Sheet	NameID	Taxon	Cons_Cod e	Plant_Desc	Site_Descr	Vegetation	Frequency	Other_Note	Locality	Geocode_ Me	Accuracy	Date
6097774	4763	<i>Dodonaea hackettiana</i>	4	Slender tall shrub 4/5 m high. In fruit.	Dune, grey sand.	Acacia rostellifera tall shrubland over Melaleuca systema.	scattered.		Woodman Point Nature Reserve, Coogee	GPS	1	28/10/2001 0:00
5437784	4027	<i>Jacksonia sericea</i>	4	Prostrate shrub 10 cm high, 2 m wide; sterile, only a few spiny branchlets.	Limestone ridge, brown orange sand with outcropping limestone over Tamala limestone.	Mixed Low Heath C of Grevillea preissii, Rhagodia baccata and Melaleuca acerosa.	locally abundant.		Lot 4 Mandurah Road, Singleton (Bushplan Site 395)	GPS	1	30/06/1999 0:00
5437768	4027	<i>Jacksonia sericea</i>	4	Prostrate shrub 10 cm high, 2 m wide; old fruit; reflexed peduncles, no spiny branchlets; could be	Limestone ridge, brown- orange sand with outcropping limestone over Tamala limestone.	Mixed Low Heath C of Grevillea preissii, Rhagodia baccata and Melaleuca acerosa.	locally abundant.		Lot 4 Mandurah Road, Singleton (Bushplan Site 395)	GPS	1	30/06/1999 0:00
6511570	4027	<i>Jacksonia sericea</i>	4	Prostrate shrub, buds and orange flowers.					Bushland area in pasture N of Madora Road. c. 1 km E of Fremantle Road	TOPO	2	1/12/1995 0:00
3464008	20348	<i>Sphaerolobium calicicola</i>	3	Erect multi- stemmed shrub 20- 30 cm tall. In full flower. Flowers	Tall dunes, grey-white sand over white sand.	Low open heath of Jacksonia/Olearia axillaris and Acacia lasiocarpa.	rare in area.		Lake Walyunup, Rockingham	MAN	0	23/10/1993 0:00
7746865	17850	<i>Stylidium ireneae</i>	4						Kwinana	UNK	3	2/12/2004 0:00
4555708	7756	<i>Stylidium longitubum</i>	3	Delicate annual herb.	Soil: Brown sand. Topography/drainage: Seasonally wet poorly drained flat. Geomorphology: Swamp deposits - holocene.	Vegetation: Melaleuca raphiophylla Low Forest B over exotic Very Open Low Grass over Lotus sauevolens, Stylidium longitubum Herbs over Lepidosperma longitudinale Tall Sedges.			Remnant bushland near Hymus Swamp in SW corner of Lowlands property (M105), 11 km WNW of Serpentine (plot hymus05).	GPS	1	6/11/1993 0:00
4622316	28354	<i>Synaphea</i> sp. Serpentine (G.R. Brand 103)	T	Low shrub 20 cm high x 50 cm wide, flowers yellow.	Pinjarra Plain, sumpland. Red brown loam.	Marri Woodland with Eucalyptus calophylla, Phyllanthus calycinus, Mesomelaena tetragona.			Bushland at intersection Duckpond and Mundijong Roads	MAN	0	15/08/1991 0:00

Popid	Nameid	Taxon	ConsStatu	WARank	PopNumb	SubPopCo	Location	District	Vesting	Purpose1	Purpose2	CountDate	Method	MatureCo	JuvenileC	SeedlingC	LiveTotal	PlantType	AreaOccu	inFlower	Populatio
92886	14932	Acacia lasiocarpa var. bracteolata long peduncle variant(G.J.Keighery 5026)	1	4	4		Lowlands; Serpentine River.	PERTH HILLS	UNKNOWN			13/08/1992 0:00		0	0	0	0			Y	
84412	141	Aponogeton hexatpalus	4	7	7		ca 250m WWW of Mundijong Rd & Duckpond Rd Inc.	SWAN COASTAL	UNKNOWN			10/08/1992 0:00	ESTMT	150	150	150	150			Y	
84399	141	Aponogeton hexatpalus	4	22	22		ca 600m S of Orton Rd on Johnson Rd. W side. W side of swamp, almost adj drain on E side.	SWAN COASTAL	NON	UCL		16/09/1993 0:00	ESTMT	0	100	100	100			N	
84405	141	Aponogeton hexatpalus	4	28	28		PRI Lot. 200. Duckpond reserve, enr Duckpond Rd & Mundajong Rd, Peel Estate.	SWAN COASTAL	PRI			5/11/1997 0:00		0	0	0	0			N	
84970	1596	Caladenia huegelii	T	CR	9		West of Johnson Road, 200m west and then 120m south of intersection (roundabout) of Holden Close (extension of Orton Road). Opposite Johnson Rd and Orton Rd intersection.	SWAN COASTAL	RDL	UCL		1/10/2004 0:00		0	0	0	0			N	
84937	1596	Caladenia huegelii	T	CR	24		Lowlands farm. ca 1km SW of shed	SWAN COASTAL	PRI			28/07/1991 0:00	ESTMT	7	5	7	7			N	
93210	16245	Cyathochaeta teretifolia	3	25	25		Private Property, No. 52 Braddock Rd, Wellard (in possible wetland ca.360m N-NNE of Braddock-Levington Rd intersection - EXTRAPOLATED), Kwinana	SWAN COASTAL	PRI			2/12/2005 0:00		0	0	0	0			N	
86764	3863	Dillwynia dillwynioides	3	4	4		Seasonal wetland adjoining Hymus Swamp. Ca 2 km N of Karnup Rd, at approx 1 km W of the junction with Yangetti Rd.	SWAN COASTAL	PRI			15/06/1994 0:00		0	0	0	0			N	
101444	12938	Diuris micrantha	T	VU	1	A	UCL, Lot 9206. Johnson Road, Bertram. Population occurs within swamp on western side of Johnson Road approximately 630m south of Holden and Johnson intersection, and approximately 70m west of eastern boundary fence	SWAN COASTAL	NON	UCL		20/09/2010 0:00	ACT_IND	6	0	0	0	PLANTS	3.75	Y	HEALTHY
101445	12938	Diuris micrantha	T	VU	1	B	UCL. Ca 600m S of Orton Rd on Johnson Rd. W side. On W side of drain (previously known as Lot 1201, State Housing Commission).	SWAN COASTAL	NON	UCL		24/09/2002 0:00		0	0	0	0			N	
87256	4763	Dodonaea hackettiana	4	15	15		Near the Spectacles, Peel Estate. W side of Johnson Rd, 1 km N of Thomas Rd.	SWAN COASTAL	PRI			5/01/1987 0:00	ESTMT	3	3	3	3			N	
87261	4763	Dodonaea hackettiana	4	20	20		PRI Lot. 88. Woodman Point Nature Reserve, Coogee.	SWAN COASTAL	PRI			28/10/2001 0:00		0	0	0	0			N	
87263	4763	Dodonaea hackettiana	4	22	22		NON Lot. 459. About 40m S of Ospery Drv & just E of the drain going under Ospery Drv (which is W of Parkes Rd); Yangebup. Beelair Regional Park.	SWAN COASTAL	NON	UCL		16/10/2003 0:00	UNKNOW	12	12	12	12			Y	
85073	1639	Drakeaea elastica	T	CR	30		Private property, Lot 2 Lowlands Rd, Mardella (Lowlands Farm), S from Wilkinson Road/Serpentine River junction. Within 'Hymus Swamp' along the 'Dampier to Bunbury Natural Gas Pipeline Corridor'. Both sides of gas pipeline.	SWAN COASTAL	PRI			29/09/2005 0:00	ACT_IND	54	54	54	54			N	
89296	7756	Styidium longitubum	3	14	14		PRI Lot. 2. Remnant bushland near Hymus Swamp in SW ctr of lowlands property (M105). 11km WNW of Serpentine (plot hmyus05).	SWAN COASTAL	PRI			6/11/1993 0:00		0	0	0	0			N	
89306	7756	Styidium longitubum	3	23	23		PRI Lot. 305. Braddock Rd, Wellard.	SWAN COASTAL	PRI			17/11/1995 0:00		0	0	0	0			N	

Taxon	Status	Rank	IUCNCriteria	EPBC	DPaWRegion	DPaWDistrict	Distribution	FloweringPeriod	RecoveryPlan
<i>Aponogeton hexatepalus</i>	4				SWAN,SWST	SWAN COASTAL,PERTH HILLS,WELLINGTON,BLACKWOOD	Perth, Pinjarra, Capel, Bunbury, Boyanup, Nannup, Bertram, Mundijong	Aug-Sep	
<i>Boronia juncea</i> subsp. <i>juncea</i>	1				SWAN,SWST	SWAN COASTAL,BLACKWOOD	Myalup, Wellard	Apr	
<i>Cyathochaeta teretifolia</i>	3				SWAN,WARR	FRANKLAND,SWAN COASTAL	Whiteman Park, Lake Gngangara, Ellenbrook, Muchea, Denbarker, Yelverton, Wellard, Mundijong	Dec	
<i>Dillwynia dillwynioides</i>	3				SWAN	SWAN COASTAL	Harvey, Pinjarrah, Yunderup, Gingin, Perth, Karnup, Mundijong, Serpentine	Aug-Oct	
<i>Diuris micrantha</i>	T	VU	D1	VU	SWAN,SWST	SWAN COASTAL,PERTH HILLS,WELLINGTON	Medina, Yarloop, Yunderup, Manjimup, Bowelling, Meelon, Bertram	Aug-Oct	
<i>Dodonaea hackettiana</i>	4				SWAN	SWAN COASTAL	Wattleup, Thompson Lake, Kings Park, Jandakot, Bibra Lake-The Spectacles, Gingin, Peron, Baldiavis, Beeliar, Baldiavis, Harry Waring Marsupial Reserve	Jul-Oct	
<i>Pimelea calcicola</i>	3				SWAN	SWAN COASTAL	Yanchep N.P., Burns Beach, Yalgorup N.P., Rockingham, Henderson, Beaconsfield	Sep-Nov	
<i>Schoenus capillifolius</i>	3				SWAN,SWST,WHTB	GREAT SOUTHERN,CENTRAL WHEATBELT,SWAN COASTAL,PERTH HILLS,WELLINGTON	Upper Swan, Kenwick, Waterloo, Beauford River, Beverley, Goomalling, Carousel Swamp, Pearce, Waroona, Karnup, Baldiavis	Sep-Nov	
<i>Sphaerobolium calcicola</i>	3				SCST,SWAN	ALBANY,SWAN COASTAL	Yalgorup, Yanchep, Safety Bay, Myalup, Denmark	Jun/Sep-Nov	
<i>Stylidium ireneae</i>	4				SWAN,SWST	SWAN COASTAL,WELLINGTON,BLACKWOOD	Waroona, Lane Poole, Serpentine Dam, North Dandalup, Augusta, Kwinana	Oct-Nov	
<i>Stylidium longitubum</i>	3				SWAN,SWST,WHTB	GREAT SOUTHERN,SWAN COASTAL,WELLINGTON,BLACKWOOD	Upper Swan, Bullsbrook, Bunbury, Midland, Busseton, Arthur River, Jandakot, Mundijong, Karnup	Nov	
<i>Thelymitra stellata</i>	T	EN	D; C2a	EN	MWST,SWAN,WHTB	MOORA,GREAT SOUTHERN,PERTH HILLS	Perth-Three Springs, Pinjarra, Dumbleyung, Corrigin, Bungendore Park, Unnamed Shire Reserve 34155, Hartfield Rd, Mt Peron, Jurien Bay, Mt Lesueur NP, Arthur River, Coomalloo NR, Julimar, Chittering, Armadale	Oct-Nov	
<i>Thelymitra variegata</i>	3				SCST,SWAN,SWST,WARR,WHTB	FRANKLAND,ALBANY,GREAT SOUTHERN,SWAN COASTAL,BLACKWOOD	Baldiavis, Capel, Albany, Hyden, Mt Lindesay	Aug-Sep	
<i>Tribonanthes purpurea</i>	T	VU	C2a(i)	VU	SCST,SWAN,WHTB	ALBANY,GREAT SOUTHERN,PERTH HILLS	Pingaring, Hillman T/S, Mt Dale, Albany	Aug	

OCC_UNIQUE	COM_ID	COM_NAME	CT_DESC	S_ID_COUNT	FIRST_S_ID	LAST_S_ID	BUFFER	OCC_CONFID	BDY_ID
591	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	5	IP14-07	MYIP14-13	2000	No	334
596	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	IP14-08		2000	No	335
942	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	IP14-01		2000	No	339
598	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	IP14-03		2000	No	340
1908	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	IP14-04		2000	No	341
889	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	5	IP14-09CENTRE	IP14-PLOT3	2000	No	342
888	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	2	IP14-10NORTH	IP14-10SOUTH	2000	No	343
594	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	IP14-02		2000	No	344
593	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	3	IP14 PLOT1	IP14-06	2000	No	346
605	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	COOL15		2000	No	348
603	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	COOL14		2000	No	349
606	SCP19a	Sedgeland in Holocene dune swales of the southern Swan Coastal Plain	Critically Endangered	1	MYCOOL01		2000	No	360
640	SCP19a	Sedgeland in Holocene dune swales of the southern Swan Coastal Plain	Critically Endangered	1	Waluyungup01		2000	No	361

OCC_UNIQUE	COM_ID	COM_NAME	CT_DESC	S_ID_COUNT	FIRST_S_ID	LAST_S_ID	BUFFER	OCC_CONFID	BDY_ID
919	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	Walyungup02		2000	No	362
26	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	COOL09		2000	No	363
920	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	Walyungup03		2000	No	364
922	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	2	Walyungup04	Walyungup05	2000	No	365
1949	SCP19a	Sedgeland in Holocene dune swales of the southern Swan Coastal Plain	Critically Endangered	1	Walyungup06		2000	No	608
1950	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	Walyungup07		2000	No	609
1951	SCP19b	Woodlands over sedgeland in Holocene dune swales of the southern Swan Coastal Plain (original description; Gibson et al. (1994).	Critically Endangered	1	Walyungup08		2000	No	610
2641	SCP24	Northern Spearwood shrublands and woodlands	Priority 3	2	KERO01	KERO02	500	No	1487
2652	SCP24	Northern Spearwood shrublands and woodlands	Priority 3	1	COOL08		500	No	1490
2653	SCP24	Northern Spearwood shrublands and woodlands	Priority 3	2	COOL02	COOL03	500	No	1491
4332	Walyungup Microbial	Microbial community of a coastal saline lake (Lake Walyungup)	Priority 1	6	Walyungup05	WalyungupSite03	2000	No	2611
4424	SCP25	Southern Eucalyptus gomphocephala-Agonis flexuosa woodlands	Priority 3	1	leda01		500	No	0
3119	SCP25	Southern Eucalyptus gomphocephala-Agonis flexuosa woodlands	Priority 3	1	SEW5		200	No	0

APPENDIX 2

Species List

SPECIES LIST – Lot 5-8 Kerosene Lane, Baldivis

* = Introduced species

GYMNOSPERMS

CYCADACEAE

Macrozamia fraseri

MONOCOTYLEDONS

ASPARAGACEAE

Acanthocarpus preissii

**Asparagus asparagoides*

Dichopogon capillipes

Sowerbaea laxiflora

Thysanotus patersonii

ASPHODELACEAE

**Trachyandra divaricata*

COLCHICACEAE

Burchardia congesta

CYPERACEAE

Lepidosperma leptostachyum

Lepidosperma pubisquameum

HAEMODORACEAE

Conostylis aculeata

Conostylis candicans

HEMEROCALLIDACEAE

Dianella revoluta var. *divaricata*

Tricoryne elatior

ORCHIDACEAE

Caladenia latifolia

POACEAE

**Avena fatua*

**Briza maxima*

**Bromus diandrus*

**Ehrharta calycina*

**Ehrharta longiflora*

**Eragrostis curvula*

**Lolium perenne*

RESTIONACEAE

Desmocladus flexuosus

DICOTYLEDONS

ANACARDIACEAE

**Schinus terebinthifolius*

APIACEAE

Trachymene pilosa

APOCYNACEAE

**Gomphocarpus fruticosus*

ASTERACEAE

**Hypochaeris glabra*

**Taraxacum officinale*

**Ursinia anthemoides*

BRASSICACEAE

**Brassica tournefortii*

CARYOPHYLLACEAE

**Cerastium glomeratum*

CASUARINACEAE

Allocasuarina fraseriana

Allocasuarina humilis

DILLENIACEAE

Hibbertia hypericoides

EUPHORBIACEAE

**Euphorbia peplus*

**Euphorbia terracina*

FABACEAE

**Acacia iteaphylla*
Acacia pulchella
Acacia rostellifera
**Chamaecytisus palmensis*
Daviesia divaricata
Gompholobium tomentosum
Hardenbergia comptoniana
Jacksonia furcellata
Kennedia prostrata
**Lupinus cosentinii*
Templetonia retusa

GERANIACEAE

**Geranium molle*
**Pelargonium capitatum*

MYRTACEAE

Calothamnus quadrifidus (possibly planted)
Eucalyptus gomphocephala
Eucalyptus marginata

OXALIDACEAE

**Oxalis corniculata*
**Oxalis pes-caprae*

PAPAVERACEAE

**Fumaria capreolata*

PHYLLANTHACEAE

Phyllanthus calycinus

PRIMULACEAE

**Lysimachia arvensis*

PROTEACEAE

Banksia sessilis
Hakea lissocarpha

RANUNCULACEAE

Clematis linearifolia

RHAMNACEAE

Cryptandra mutila

SCROPHULARIACEAE

**Verbascum virgatum*

SOLANACEAE

Solanum nigrum

VALERIANACEAE

**Centranthus macrosiphon*

VERBENACEAE

**Lantana camara*

APPENDIX 3

Quadrat Data

QUADRAT K1

50 387433 E 6425795 N

Vegetation: *Eucalyptus gomphocephala* (Tuart) Open Forest over *Acacia rostellifera* Tall Shrubland over weeds
Condition: Completely Degraded
Soil Type: Brown loamy sand
Landform: Flat



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Eucalyptus gomphocephala</i>	15	40
<i>Acacia rostellifera</i>	4	10
* <i>Fumaria capreolata</i>	0.5	<1
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.4	<1
<i>Caladenia latifolia</i>	0.4	<1
* <i>Ehrharta calycina</i>	0.3	80
* <i>Briza maxima</i>	0.3	2
<i>Macrozamia fraseri</i>	0.3	<1
* <i>Euphorbia peplus</i>	0.2	5
<i>Clematis linearifolia</i>	Climber	10
<i>Hardenbergia comptoniana</i>	Climber	5
<i>Arthropodium capillipes</i>	dormant	<1

* introduced species

QUADRAT K2

50 387356 E 6425890 N

Vegetation: *Eucalyptus gomphocephala* (Tuart) Open Woodland over *Acacia rostelifera*/*Banksia sessilis* Tall Open Scrub over weeds
Condition: Completely Degraded
Soil Type: Orange-brown loamy sand, shallow limestone
Landform: top of small rise



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Eucalyptus gomphocephala</i>	10	5
<i>Acacia rostelifera</i>	4	30
<i>Banksia sessilis</i>	4	25
<i>Jacksonia furcellata</i>	1.4	1
<i>Acacia pulchella</i>	1	<1
* <i>Ehrharta longiflora</i>	0.7	70
<i>Cryptandra mutila</i>	0.6	<1
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.6	<1
* <i>Lantana camara</i>	0.4	<1
* <i>Euphorbia terracina</i>	0.3	1
* <i>Centranthus macrosiphon</i>	0.2	20
* <i>Fumaria capreolata</i>	0.2	2
* <i>Euphorbia peplus</i>	0.2	2
* <i>Lupinus cosentinii</i>	0.1	<1
<i>Hardenbergia comptoniana</i>	climber	1

* introduced species

QUADRAT K3

50 387070 E 6425834 N

Vegetation: *Eucalyptus gomphocephala* (Tuart) Open Woodland over *Acacia rostellifera*/*Banksia sessilis* Tall Open Scrub over weeds

Condition: Completely Degraded

Soil Type: Orange/brown loamy sand, shallow limestone

Landform: sloping gently up to the north



Quadrat (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Acacia rostellifera</i>	3	25
<i>Banksia sessilis</i>	3	25
<i>Acacia pulchella</i>	1	2
* <i>Ehrharta longiflora</i>	0.8	75
<i>Macrozamia fraseri</i>	0.6	<1
* <i>Euphorbia terracina</i>	0.5	1
* <i>Lupinus cosentinii</i>	0.5	<1
* <i>Pelargonium capitatum</i>	0.3	<1
* <i>Oxalis pes-caprae</i>	0.2	60

* introduced species

QUADRAT K4

50 387107 E 6425760 N

Vegetation: *Eucalyptus gomphocephala* (Tuart) Woodland over *Banksia sessilis*/*Jacksonia furcellata* Tall Shrubland over weeds
Condition: Degraded
Soil Type: Orange/brown loamy sand
Landform: Lower slope



Quadrat (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
<i>Eucalyptus gomphocephala</i>	12	15
<i>Banksia sessilis</i>	4	10
<i>Jacksonia furcellata</i>	3.5	15
<i>Macrozamia fraseri</i>	1.2	1
* <i>Ehrharta longiflora</i>	1	60
<i>Gompholobium tomentosum</i>	0.5	<1
<i>Dianella revoluta</i> var. <i>divaricata</i>	0.5	<1
<i>Sowerbaea laxiflora</i>	0.4	1
* <i>Euphorbia terracina</i>	0.4	1
<i>Acacia pulchella</i>	0.4	<1
* <i>Ehrharta calycina</i>	0.3	5
* <i>Euphorbia peplus</i>	0.3	4
<i>Caladenia latifolia</i>	0.3	<1
* <i>Trachyandra divaricata</i>	0.3	<1
* <i>Briza maxima</i>	0.3	<1
* <i>Lysimachia arvensis</i>	0.2	1
<i>Trachymene pilosa</i>	0.1	<1

<i>*Hypochaeris glabra</i>	Flat	<1
<i>Hardenbergia comptoniana</i>	Climber	2
<i>Clematis linearifolia</i>	Climber	2

* introduced species

APPENDIX 2 TREE SURVEY

APPENDIX 5
Significant Tree Survey Results

Lots 5-8 Kerosene Lane, Baldiivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
7	1	Tuart (<i>Eucalyptus gomphocephala</i>)	387181	6425881	1432	11	520		Sprouting
7	2	Tuart (<i>Eucalyptus gomphocephala</i>)	387198	6425878	1433	12	1000		Good condition
7	3	Tuart (<i>Eucalyptus gomphocephala</i>)	387235	6425883	1434	7	570		Damaged - Fair Condition
7	4	Tuart (<i>Eucalyptus gomphocephala</i>)	387256	6425904	1435	11	720	370	Good condition
7	5	Tuart (<i>Eucalyptus gomphocephala</i>)	387240	6425901	1436	11	530		Good condition
7	6	Tuart (<i>Eucalyptus gomphocephala</i>)	387265	6425898	1437	11	500	80	Good condition
7	7	Tuart (<i>Eucalyptus gomphocephala</i>)	387274	6425897	1438	12	570		Good condition
7	8	Tuart (<i>Eucalyptus gomphocephala</i>)	387275	6425872	1439	11	670	500	Good condition
7	9	Tuart (<i>Eucalyptus gomphocephala</i>)	387246	6425857	1440	11	1100		Good condition
7	10	Tuart (<i>Eucalyptus gomphocephala</i>)	387260	6425862	1441	11	500		Good condition
7	11	Tuart (<i>Eucalyptus gomphocephala</i>)	387215	6425849	1442	12	570	500/300	Good condition, two main trunks
7	12	Tuart (<i>Eucalyptus gomphocephala</i>)	387179	6425852	1444	10	660	440	Good condition
7	13	Tuart (<i>Eucalyptus gomphocephala</i>)	387172	6425826	1445	11	1200		Two hollows, not suitable for Black Cockatoos
7	14	Tuart (<i>Eucalyptus gomphocephala</i>)	387176	6425821	1446	10	800		Good condition
7	15	Standing Dead Tree	387190	6425823	1447	6	1100		Good condition
7	16	Tuart (<i>Eucalyptus gomphocephala</i>)	387212	6425823	1448	10	540		Good condition
7	17	Tuart (<i>Eucalyptus gomphocephala</i>)	387222	6425822	1449	10	530		Good condition
7	18	Tuart (<i>Eucalyptus gomphocephala</i>)	387246	6425835	1450	11	750		Good condition
7	19	Tuart (<i>Eucalyptus gomphocephala</i>)	387264	6425821	1451	12	500		Good condition
7	20	Tuart (<i>Eucalyptus gomphocephala</i>)	387273	6425830	1452	12	550		Good condition
7	21	Tuart (<i>Eucalyptus gomphocephala</i>)	387272	6425812	1453R	11	600	280	Close together
7	22	Tuart (<i>Eucalyptus gomphocephala</i>)	387272	6425811	1453L	11	530		
7	23	Tuart (<i>Eucalyptus gomphocephala</i>)	387272	6425810	1453M	11	500		Good condition
7	24	Tuart (<i>Eucalyptus gomphocephala</i>)	387271	6425803	1454	12	550		Good condition
7	25	Tuart (<i>Eucalyptus gomphocephala</i>)	387262	6425792	1455	11	550		Good condition
7	26	Tuart (<i>Eucalyptus gomphocephala</i>)	387252	6425788	1456	11	500	340	Good condition
7	27	Tuart (<i>Eucalyptus gomphocephala</i>)	387248	6425795	1457	10	520	420	Wire
7	28	Jarraah (<i>Eucalyptus marginata</i>)	387271	6425767	1458	9	520	470/350/280	Good condition
7	29	Jarraah (<i>Eucalyptus marginata</i>)	387279	6425752	1459	9	500		Good condition

Lots 5-8 Kerosene Lane, Baldivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
7	30	Jarraah (<i>Eucalyptus marginata</i>)	387277	6425734	1460	8	550	490/360	Good condition
7	31	Tuart (<i>Eucalyptus gomphocephala</i>)	387236	6425739	1461	11	630	530/280/ 170	Good condition
7	32	Tuart (<i>Eucalyptus gomphocephala</i>)	387236	6425748	1462	8	580	220/200	White trunk
7	33	Tuart (<i>Eucalyptus gomphocephala</i>)	387236	6425748	1463	7	600		Leaning
7	34	Tuart (<i>Eucalyptus gomphocephala</i>)	387239	6425774	1464	11	610	550	Leaning
7	35	Standing Dead Tree	387215	6425768	1465	10	750		Near house
7	36	Tuart (<i>Eucalyptus gomphocephala</i>)	387221	6425794	1466	11	630	450	Good condition
7	37	Tuart (<i>Eucalyptus gomphocephala</i>)	387202	6425772	1467R	11	1750		Good condition
7	38	Tuart (<i>Eucalyptus gomphocephala</i>)	387202	6425771	1467L	10	550		Good condition
7	39	Tuart (<i>Eucalyptus gomphocephala</i>)	387179	6425773	1468	10	500	450	Chopped
7	40	Tuart (<i>Eucalyptus gomphocephala</i>)	387171	6425769	1470	10	800	400	Good condition
7	41	Tuart (<i>Eucalyptus gomphocephala</i>)	387180	6425755	1469	9	550	200	Good condition
7	42	Tuart (<i>Eucalyptus gomphocephala</i>)	387196	6425755	1523	7	530	110/70	Good condition
7	43	Tuart (<i>Eucalyptus gomphocephala</i>)	387191	6425737	1471	11	600	600	Good condition
5	44	Tuart (<i>Eucalyptus gomphocephala</i>)	387389	6425923	1472	8	960		Good condition
5	45	Tuart (<i>Eucalyptus gomphocephala</i>)	387455	6425913	1473	8	940	110	Good condition
5	46	Tuart (<i>Eucalyptus gomphocephala</i>)	387458	6425870	1474	10	580	270/80	secondary branch dead
5	47	Tuart (<i>Eucalyptus gomphocephala</i>)	387465	6425826	1475	12	700		Good condition
5	48	Tuart (<i>Eucalyptus gomphocephala</i>)	387462	6425833	1476	11	520	300	Good condition
5	49	Standing Dead Tree	387456	6425813	1477	11	650		Good condition
5	50	Tuart (<i>Eucalyptus gomphocephala</i>)	387451	6425813	1478	12	560	280	Good condition
5	51	Tuart (<i>Eucalyptus gomphocephala</i>)	387439	6425826	1480	11	530	320	Leaning
5	52	Tuart (<i>Eucalyptus gomphocephala</i>)	387434	6425828	1479L	11	530		Good condition
5	53	Tuart (<i>Eucalyptus gomphocephala</i>)	387430	6425830	1479R	10	650		Good condition
5	54	Tuart (<i>Eucalyptus gomphocephala</i>)	387434	6425792	1481	11	1770		Large tree, contains potential spout
5	55	Tuart (<i>Eucalyptus gomphocephala</i>)	387435	6425787	1482	11	710	190/180/ 110	Good condition
5	56	Tuart (<i>Eucalyptus gomphocephala</i>)	387426	6425769	1483	11	850	720/430	Good condition
5	57	Tuart (<i>Eucalyptus gomphocephala</i>)	387413	6425780	1485	8	640	50	Good condition
5	58	Tuart (<i>Eucalyptus gomphocephala</i>)	387417	6425747	1486	10	750		Good condition

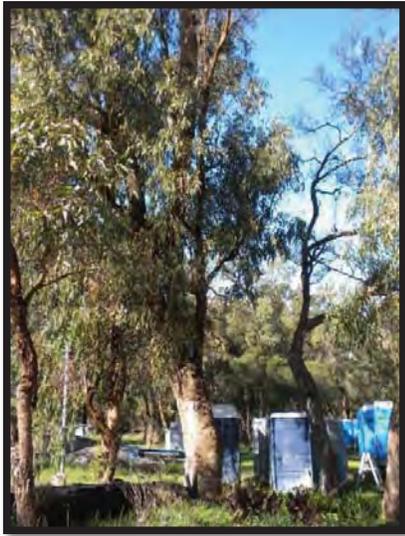
Lots 5-8 Kerosene Lane, Baldivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
5	59	Tuart (<i>Eucalyptus gomphocephala</i>)	387436	6425753	1487	12	1170		Good condition
5	60	Tuart (<i>Eucalyptus gomphocephala</i>)	387444	6425746	1488	12	660	70	Good condition
5	61	Tuart (<i>Eucalyptus gomphocephala</i>)	387472	6425749	1489	12	2860		Massive
5	62	Standing Dead Tree	387458	6425764	1490R	10	570		Good condition
5	63	Jarrah (<i>Eucalyptus marginata</i>)	387459	6425776	1490L	11	940		Good condition
5	64	Standing Dead Tree	387450	6425770	1491	7	670		Good condition
5	65	Tuart (<i>Eucalyptus gomphocephala</i>)	387472	6425783	1492	11	1570		Good condition
6	66	Tuart (<i>Eucalyptus gomphocephala</i>)	387285	6425899	1493	11	880		Good condition
6	67	Tuart (<i>Eucalyptus gomphocephala</i>)	387314	6425892	1494	12	580	500/430/ 240	Good condition
6	68	Tuart (<i>Eucalyptus gomphocephala</i>)	387310	6425882	1495	9	730	240	Good condition
6	69	Tuart (<i>Eucalyptus gomphocephala</i>)	387312	6425880	1496	10	600	420/400	Bull ants
6	70	Tuart (<i>Eucalyptus gomphocephala</i>)	387305	6425876	1497	9	900		Burnt
6	71	Jarrah (<i>Eucalyptus marginata</i>)	387331	6425841	NA	5	520		Good condition
6	72	Jarrah (<i>Eucalyptus marginata</i>)	387276	6425798	1498	10	990	550/550/ 540/350/ 290	Good condition
6	73	Jarrah (<i>Eucalyptus marginata</i>)	387285	6425783	1499	11	650		Good condition
6	74	Jarrah (<i>Eucalyptus marginata</i>)	387299	6425767	1500	9	580	230/170	Good condition
6	75	Jarrah (<i>Eucalyptus marginata</i>)	387318	6425736	1501	10	670	9 x 50-100	Good condition
6	76	Tuart (<i>Eucalyptus gomphocephala</i>)	387344	6425728.5	1502	12	760	670	Good condition
6	77	Tuart (<i>Eucalyptus gomphocephala</i>)	387343	6425802	1503	12	1520		Good condition
6	78	Standing Dead Tree	387352	6425814	1504	6	660	360	Good condition
6	79	Tuart (<i>Eucalyptus gomphocephala</i>)	387376	6425811	1505	9	750	50	Good condition
6	80	Tuart (<i>Eucalyptus gomphocephala</i>)	387380	6425840	1506	10	820	300/ 4x<200	Good condition
6	81	Tuart (<i>Eucalyptus gomphocephala</i>)	387382	6425866	1507	11	590	560	Good condition
6	82	Standing Dead Tree	387363	6425891	1508	7	530		Good condition
6	83	Tuart (<i>Eucalyptus gomphocephala</i>)	387346	6425902	1509	8	530	500/4x100	Good condition
6	84	Tuart (<i>Eucalyptus gomphocephala</i>)	387350	6425905	1510	8	1050	100/80	Good condition
6	85	Standing Dead Tree	387377	6425904	1511	8	660	560/560/ 4x<50	Small hollows

Lots 5-8 Kerosene Lane, Baldivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
8	86	Tuart (<i>Eucalyptus gomphocephala</i>)	387056	6425744	1512	9	660	640	Good condition
8	87	Tuart (<i>Eucalyptus gomphocephala</i>)	387079	6425733	1513	10	1150		Good condition
8	88	Tuart (<i>Eucalyptus gomphocephala</i>)	387090	6425739	1514	11	800	440	Good condition
8	89	Tuart (<i>Eucalyptus gomphocephala</i>)	387102	6425732	1515	11	640	2x<50	Good condition
8	90	Tuart (<i>Eucalyptus gomphocephala</i>)	387098	6425755	1516	10	530	390	Leaning
8	91	Tuart (<i>Eucalyptus gomphocephala</i>)	387102	6425780	1517	11	1100	200	Good condition
8	92	Tuart (<i>Eucalyptus gomphocephala</i>)	387100	6425803	1521	11	1280	220/50/50	Very large tree with hollows
8	93	Tuart (<i>Eucalyptus gomphocephala</i>)	387127	6425785	1518	10	560	370/230	Good condition
8	94	Tuart (<i>Eucalyptus gomphocephala</i>)	387136	6425777	1519	10	570	350/270/160	Good condition
8	95	Tuart (<i>Eucalyptus gomphocephala</i>)	387143	6425779	1520	11	800		Good condition
8	96	Tuart (<i>Eucalyptus gomphocephala</i>)	387143	6425755	1522	11	850		Good condition
8	97	Tuart (<i>Eucalyptus gomphocephala</i>)	387137	6425846	1524	12	640		Good condition
8	98	Tuart (<i>Eucalyptus gomphocephala</i>)	387116	6425845	1531	10	500		Good condition

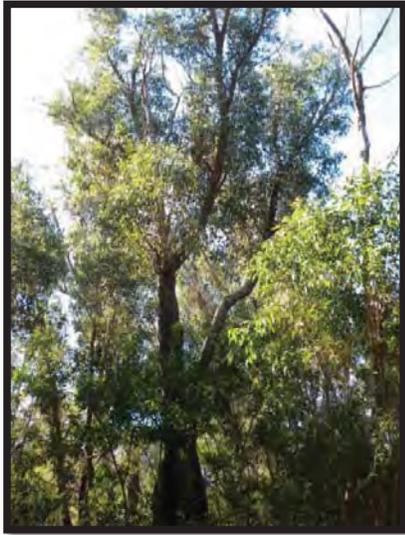
Lots 5-8 Kerosene Lane, Baldivis



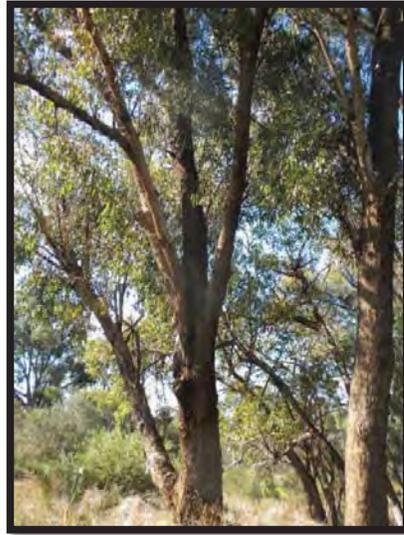
Tree 1



Tree 2



Tree 3



Tree 4



Tree 5



Tree 6

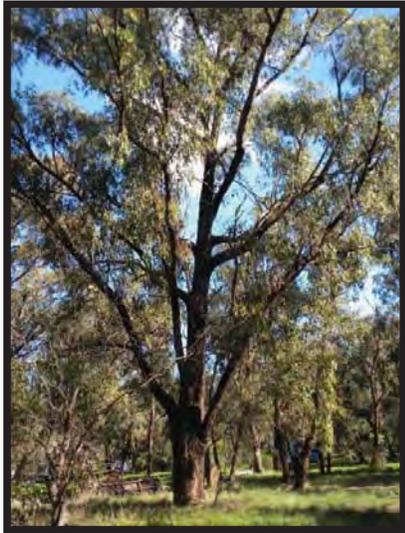
Lots 5-8 Kerosene Lane, Baldivis



Tree 7



Tree 8



Tree 9



Tree 10



Tree 11



Tree 12

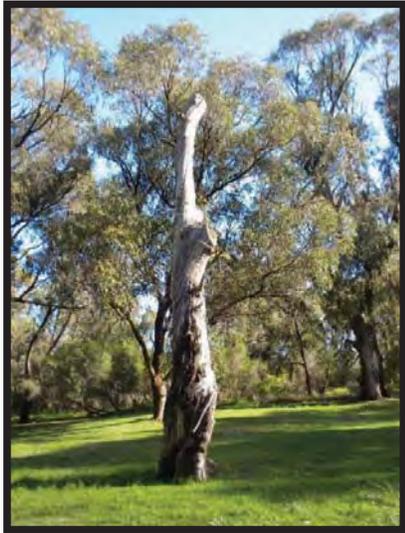
Lots 5-8 Kerosene Lane, Baldivis



Tree 13



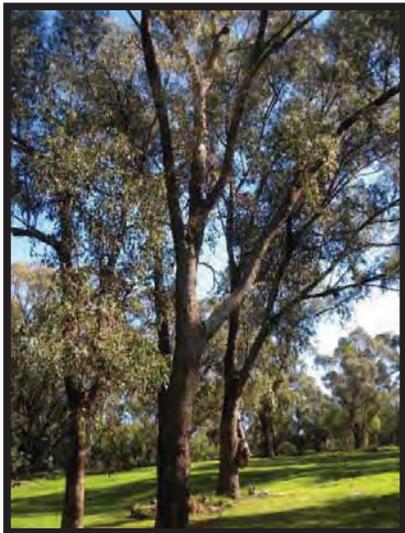
Tree 14



Tree 15



Tree 16



Tree 17

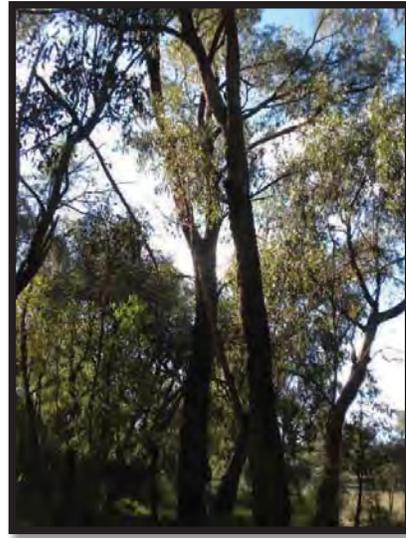


Tree 18

Lots 5-8 Kerosene Lane, Baldivis



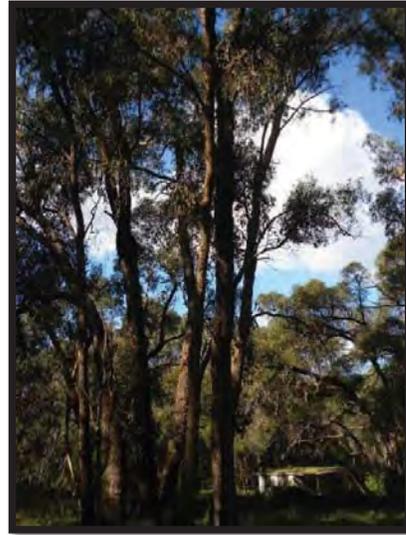
Tree 19



Tree 20



Tree 21 (right) Tree 22 (left) Tree 23 (middle)



Tree 24

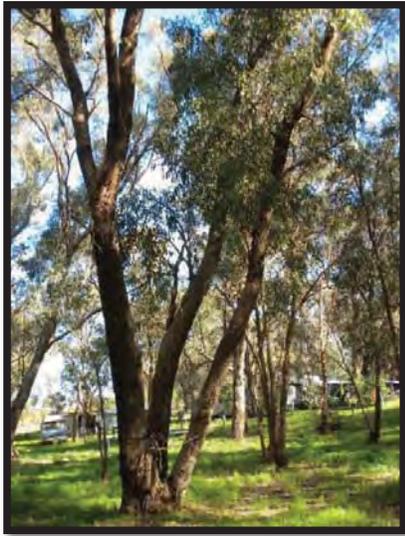


Tree 25

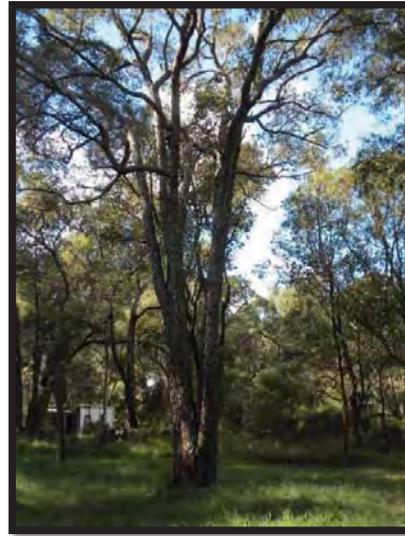


Tree 26

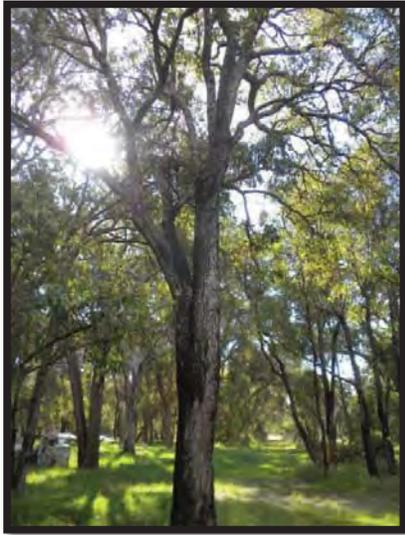
Lots 5-8 Kerosene Lane, Baldivis



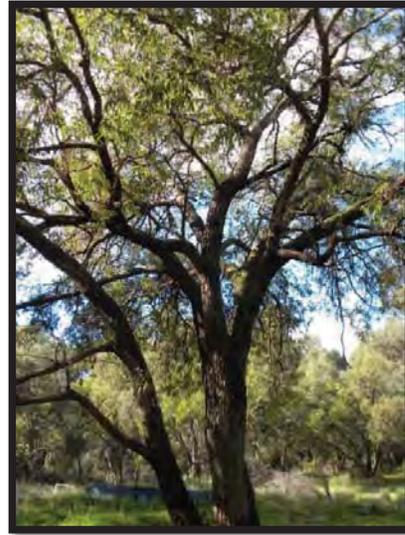
Tree 27



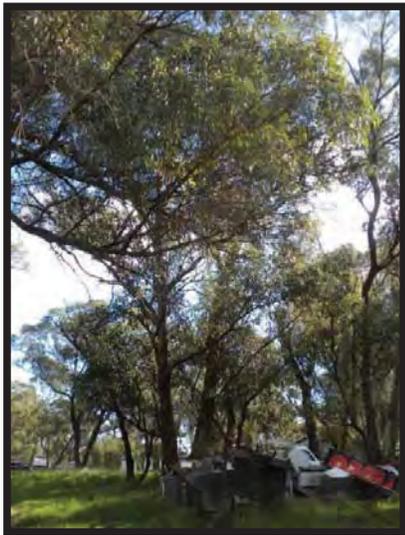
Tree 28



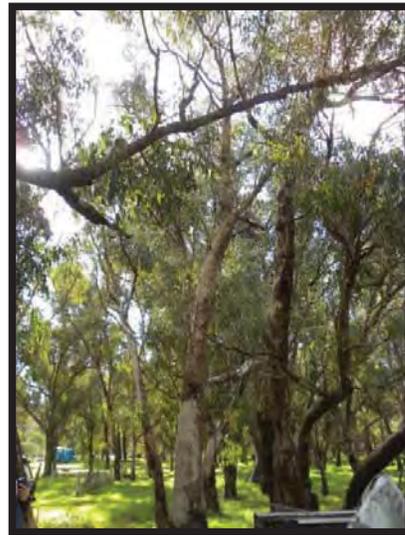
Tree 29



Tree 30



Tree 31

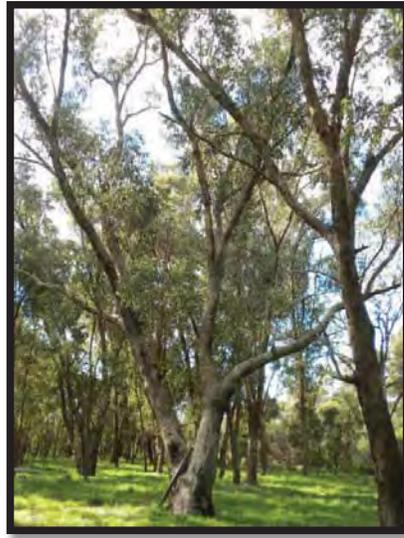


Tree 32

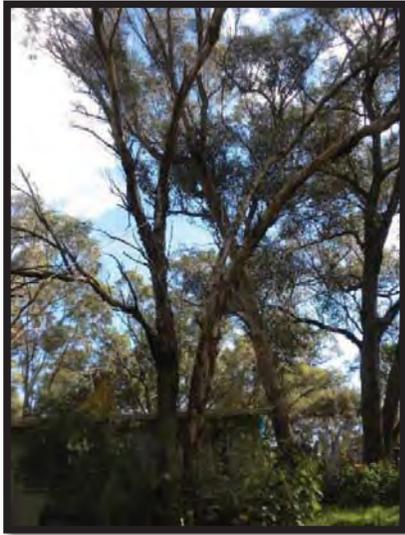
Lots 5-8 Kerosene Lane, Baldivis



Tree 33



Tree 34



Tree 35



Tree 36



Tree 37 (right) Tree 38 (left)



Tree 39

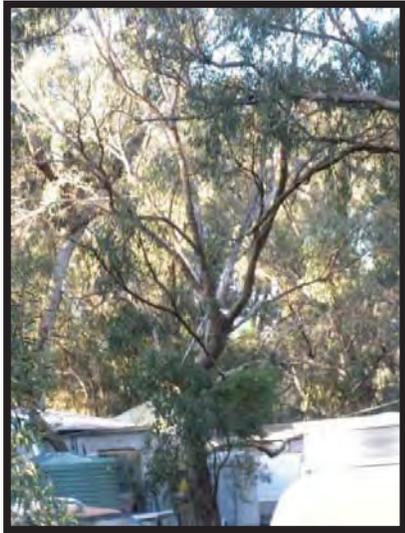
Lots 5-8 Kerosene Lane, Baldivis



Tree 40



Tree 41



Tree 42



Tree 43



Tree 44

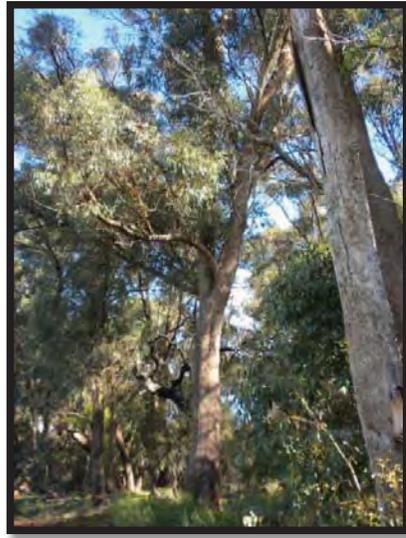


Tree 45

Lots 5-8 Kerosene Lane, Baldivis



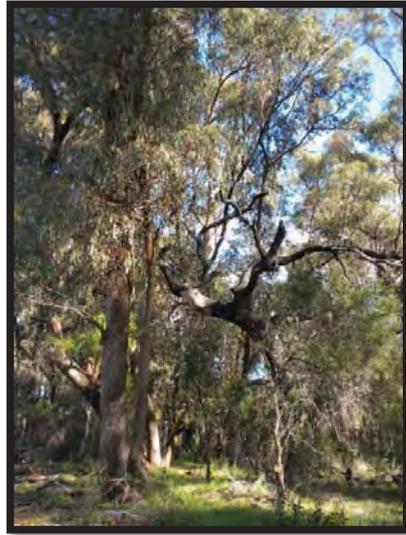
Tree 46



Tree 47



Tree 48



Tree 49



Tree 50



Tree 51

Lots 5-8 Kerosene Lane, Baldivis



Tree 52 (left) Tree 53 (right)



Tree 54



Tree 55



Tree 56



Tree 57



Tree 58

Lots 5-8 Kerosene Lane, Baldivis



Tree 59



Tree 60



Tree 61



Tree 62 (right) Tree 63 (left)



Tree 64



Tree 65

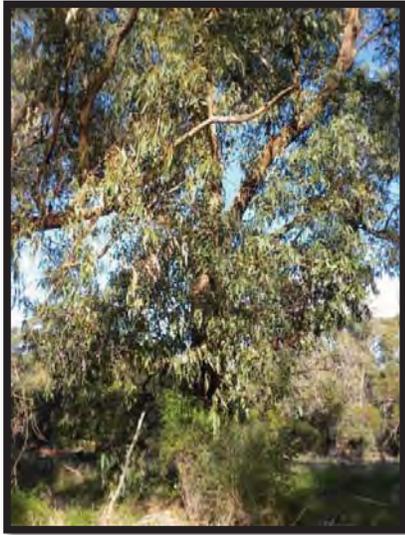
Lots 5-8 Kerosene Lane, Baldivis



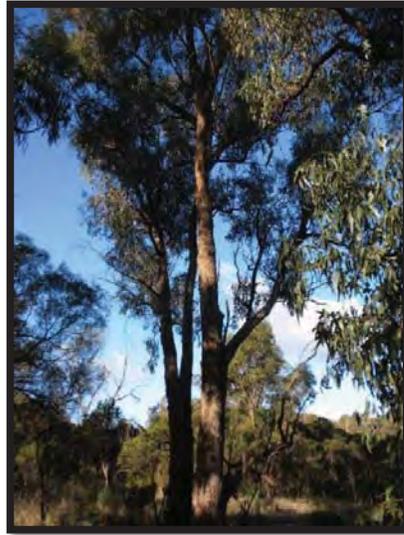
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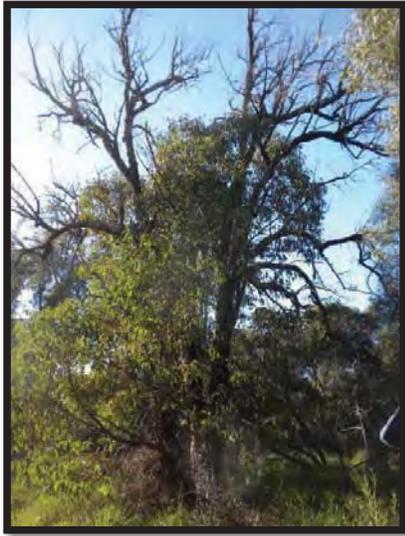
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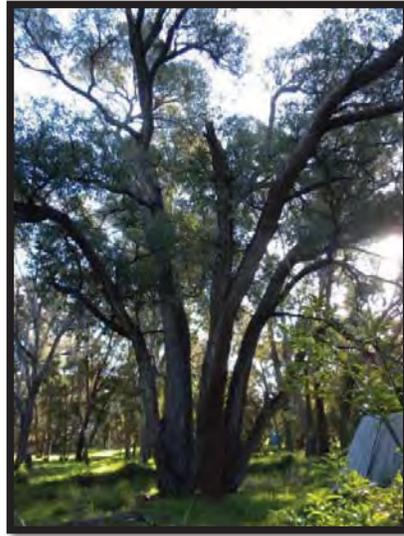
Tree 68



Tree 69

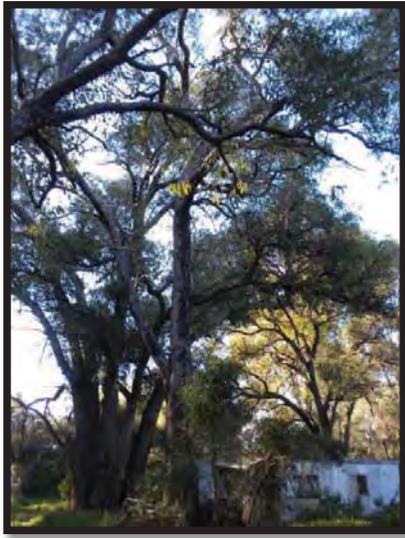


Tree 70

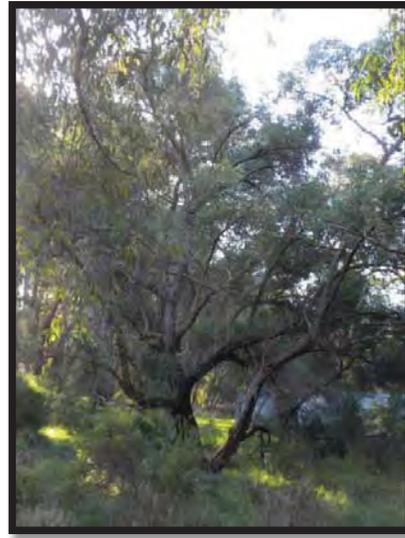


Tree 72

Lots 5-8 Kerosene Lane, Baldivis



Tree 73



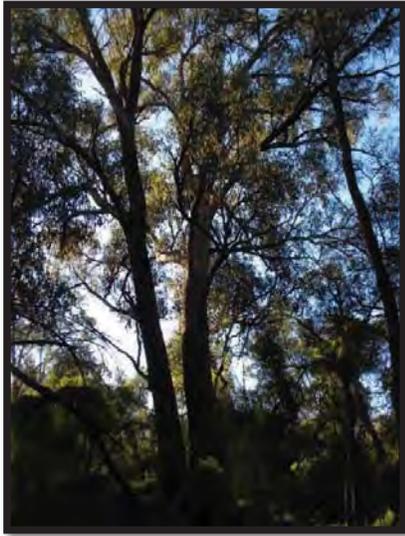
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Tree 75



Tree 76

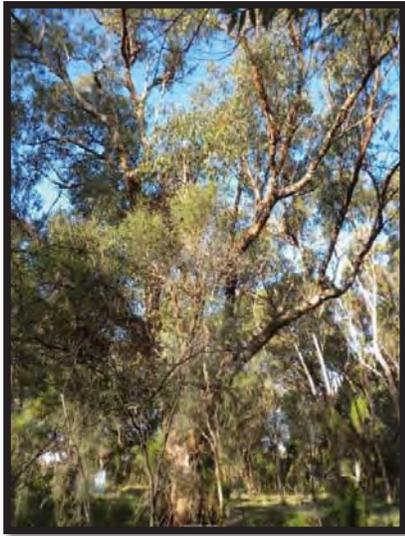


Tree 77



Tree 78

Lots 5-8 Kerosene Lane, Baldivis



Tree 79



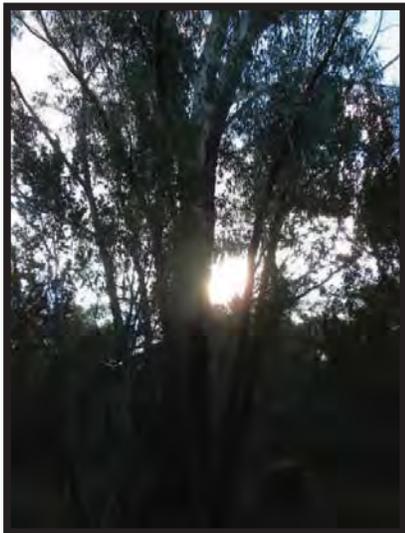
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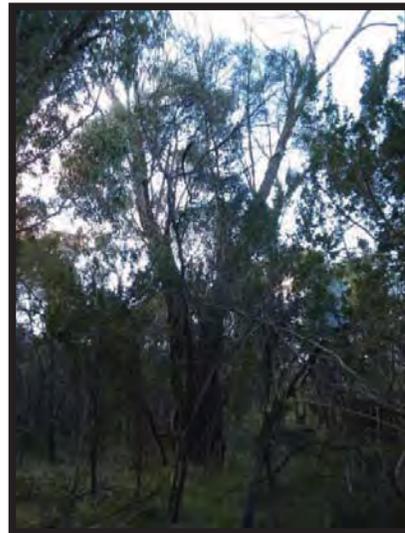
Tree 81



Tree 82



Tree 83



Tree 84

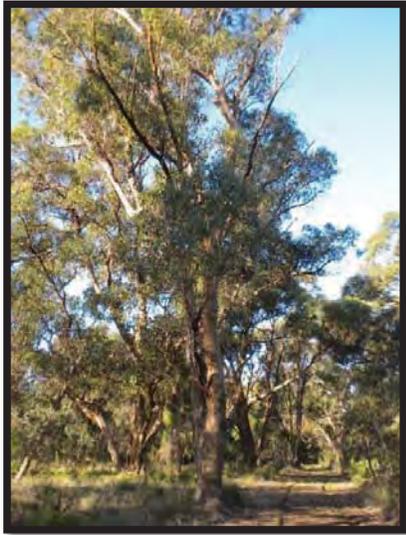
Lots 5-8 Kerosene Lane, Baldivis



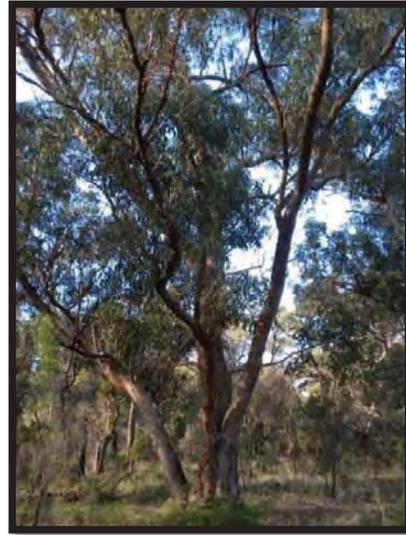
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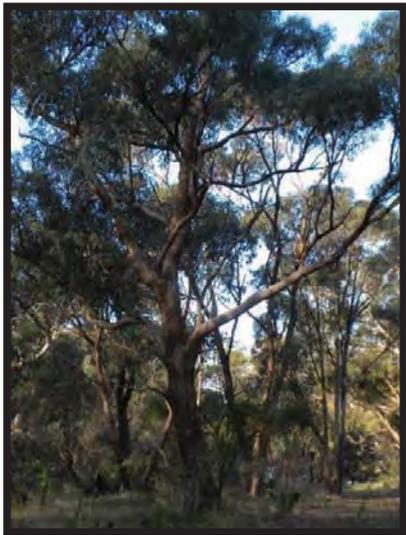
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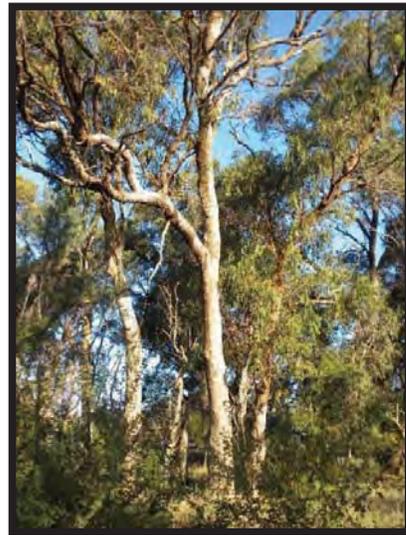
Tree 87



Tree 88



Tree 89

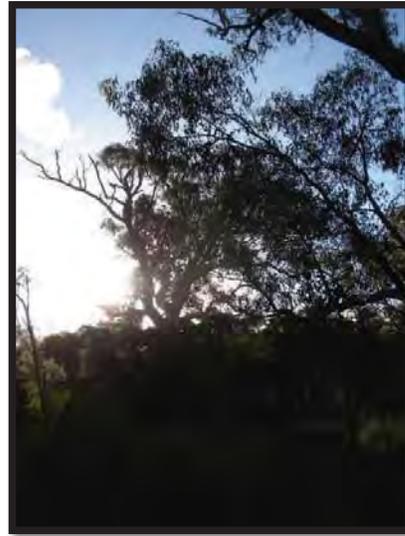


Tree 90

Lots 5-8 Kerosene Lane, Baldivis



Tree 91



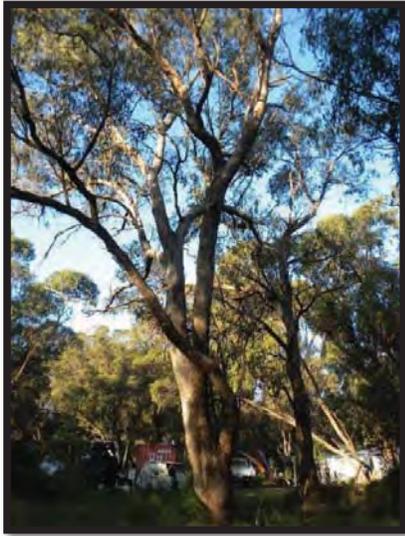
Tree 92



Tree 93



Tree 94

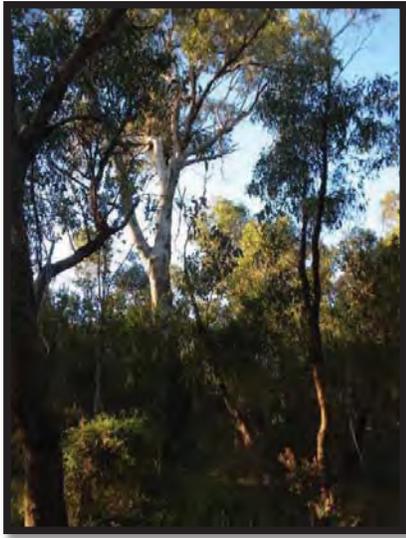


Tree 95

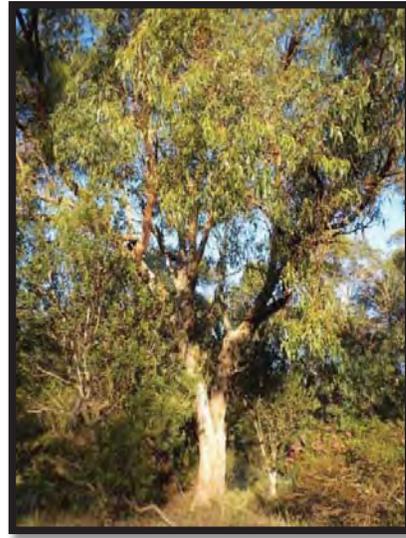


Tree 96

Lots 5-8 Kerosene Lane, Baldivis



Tree 97



Tree 98

APPENDIX 3 FAUNA SURVEY

LOTS 5-8 KEROSENE LANE, BALDIVIS

LEVEL 1 FAUNA SURVEY AND TARGETED SEARCH

Prepared for: Terranovis Pty Ltd

Report Date: 13 October 2015

Version: 2

Report No. 2015-215



PGV
ENVIRONMENTAL

CONTENTS

Contents	i
List of Attachments	iii
1 INTRODUCTION	1
1.1 Background.....	1
1.2 Scope of Works.....	1
1.2.1 Level 1 Fauna Survey	1
1.2.2 Targeted Search.....	1
2 EXISTING ENVIRONMENT	2
2.1 Past and Existing Land Use	2
2.2 Surrounding Land Use	3
2.3 Topography	3
2.4 Geomorphology and Soils	3
2.5 Hydrology	3
2.5.1 Groundwater	3
2.5.2 Surface Water and Wetlands	3
2.6 Flora and Vegetation	3
3 FAUNA	6
3.1 Methodology	6
3.2 Database Search Results	6
3.3 Fauna Habitat	7
3.4 Conservation Significant Species.....	8
3.5 Biodiversity Value.....	15
4 BLACK COCKATOOS	16
4.1 Black Cockatoo Species	16
4.1.1 Carnaby’s Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	16
4.1.2 Baudin’s Black Cockatoo (<i>Calyptorhynchus baudinii</i>).....	16
4.1.3 Forest Red-tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>).....	16
4.2 Methodology of Targeted Search.....	16
4.3 Black Cockatoo Habitat	17
4.3.1 Habitat definitions.....	17
4.3.2 Foraging.....	17
4.3.3 Roosting.....	20

4.3.4	Breeding	20
4.4	Regional Context	21
4.5	Significance of Impact	22
4.6	Black Cockatoo Referral Guidelines	25
5	SUMMARY AND CONCLUSIONS.....	29
6	REFERENCES	31

LIST OF ATTACHMENTS

Tables

- Table 1: Vegetation Condition Rating Scale
- Table 2: List of Fauna Species Identified from Database Searches
- Table 3: Likelihood of Conservation Significant Species occurring on the Site
- Table 4: Foraging Value Rating Matrix
- Table 5: Bush Forever Sites within 5km that contain Black Cockatoo Habitat (Government of Western Australia, 2000)

Plates

- Plate 1: Historical Aerial Photography of the Site from 1953 (Landgate, 2015a)
- Plate 2: Aerial Photography of the Site from March 2015
- Plate 3: Trees over a Cleared Understorey on the Site
- Plate 4: Vegetation on the Site in Good Condition
- Plate 5: Tuarts (*Eucalyptus gomphocephala*) on the Site
- Plate 6: A Jarrah (*Eucalyptus marginata*) on the Site
- Plate 7: Parrot Bush (*Banksia sessilis*) on the Site

Figures

- Figure 1: Site Location
- Figure 2: Site Boundary and Topography
- Figure 3: Black Cockatoo Foraging Habitat and Significant Trees

Appendices

- Appendix 1: DPaw Threatened Fauna Database Search Results
- Appendix 2: Protected Matters Search Tool Results
- Appendix 3: Naturemap Database Search Results
- Appendix 4: Conservation Codes
- Appendix 5: Significant Tree Survey Results
- Appendix 6: Subdivision Concept Plan (Whelans Town Planning)

1 INTRODUCTION

1.1 Background

Terranovis Pty Ltd is developing a Local Structure Plan (LSP) for Lots 5-8 Kerosene Lane, Baldivis (the site). The site is approximately 8.11ha in size and approximately 38.5km south of the Perth Central Business District (Figure 1). The site is located in the City of Rockingham and is bound by Kerosene Lane to the north, market gardens to the east, a mostly cleared lot to the west and a lot to the south containing remnant trees (Figure 2).

The site is zoned 'Urban' under the Metropolitan Region Scheme (MRS) and 'Development' under the City of Rockingham Town Planning Scheme No. 2 (TPS2). The site is within Precinct 2 of the proposed Baldivis (North) District Structure Plan which indicates the site to contain residential development consisting of medium density housing.

PGV Environmental was commissioned by Terranovis Pty Ltd to undertake a Level 1 Fauna Survey and a targeted search to identify the possibility of the site supporting Black Cockatoo species that are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

1.2 Scope of Works

1.2.1 Level 1 Fauna Survey

The Level 1 Fauna Survey was undertaken in accordance with Guidance Statement 56: *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004).

The survey included:

- Desktop searches and review of DPaW's Threatened Fauna database and the Commonwealth EPBC Act Listed Fauna;
- Field survey to identify fauna habitat types and quality; and
- Description and mapping of fauna habitat.

1.2.2 Targeted Search

The three listed species of Black Cockatoo are:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) (Endangered);
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) (Vulnerable); and
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (Vulnerable).

The Targeted Search for Black Cockatoos utilising the site was conducted by PGV Environmental to:

- Describe the Black Cockatoo habitat on the site;
- Assess the impact of the proposed residential development on the Black Cockatoos; and
- Ascertain whether referral of the proposed residential development is required under the EPBC Act.

2 EXISTING ENVIRONMENT

2.1 Past and Existing Land Use

The site consisted of native bushland in 1953 as shown in Plate 1, however Kerosene Lane was already present as a dirt road.

Plate 1: Historical Aerial Photography of the Site from 1953 (Landgate, 2015a)



Clearing of sections of the site had commenced by 1965 consisting of small areas in the north of Lots 5 and 6 and the western half of Lot 8, however the vegetation on Lot 8 was regenerating by 1974 (Landgate, 2015a). Dwellings were constructed on Lots 5 and 6 by 1977. The majority of Lot 8 was cleared by 1995 as well as large areas of Lot 7 where a dwelling was constructed (Landgate, 2015a).

Currently Lots 5 (78 Kerosene Lane in Plate 1) and 7 (56 Kerosene Lane in Plate 1) contain dwellings with remnant vegetation, while Lots 6 and 8 are vacant and consist of bushland as shown in Plate 2.

Plate 2: Aerial Photography of the Site from March 2015



2.2 Surrounding Land Use

Land to the east of the site is utilised for market gardens with a Spudshed located approximately 320m from the site. Native vegetation in Bush Forever Site 356 is located immediately north of Kerosene Lane opposite Lots 7 and 8. The remaining surrounding land is undeveloped, although a new residential development is being constructed to the south of the southern adjoining lot.

2.3 Topography

The topography on the site slopes upwards in a north-westerly direction ranging from 8m Australian Height Datum (AHD) in the south-eastern corner to 23m AHD in the north-western corner (Figure 2) (DoW, 2015).

2.4 Geomorphology and Soils

The site is mapped on the Spearwood System consisting of Aeolian sand and limestone over sedimentary rocks with sand dunes and plains of yellow deep sands, pale deep sands and yellow/brown shallow sands (DAFWA, 2015).

There are two soil types mapped on the site as describes below (DAFWA, 2015):

- Spearwood S2a Phase (211Sp_S2a) consists of lower slopes (1-5%) of a dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrops; and
- Spearwood S4a Phase (211Sp_S4a) consists of flat to gently undulating sandplain with deep, pale and sometimes bleached sands with yellow-brown subsoils.

The south-eastern section of the site consists of Spearwood S4a Phase soil while the remainder of the site consists of Spearwood S2a Phase soil.

2.5 Hydrology

2.5.1 Groundwater

There is no detailed groundwater information available for the area. However, the aquifers underneath the site are shallow and the groundwater contours indicate that the groundwater flows in a south-westerly direction under the site (DoW, 2015).

2.5.2 Surface Water and Wetlands

There are no surface water features or wetlands on the site.

2.6 Flora and Vegetation

Native trees occur over the majority of the site, with Tuarts (*Eucalyptus gomphocephala*) being the dominant trees, while some Jarrahs (*Eucalyptus marginata*) are scattered through the site. There are also non-native trees located on the site, mainly surrounding the dwellings.

The condition of the vegetation on the site was assessed by PGV Environmental on 22 June 2015 according to the Bush Forever rating scale shown in Table 1.

Table 1: Vegetation Condition Rating Scale

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia, 2000.

Lots 5 and 7 contain occupied dwellings and the vegetation in the northern half of Lot 5 as well as the entire Lot 7 is in Completely Degraded Condition. These areas consist of native and non-native trees over a cleared understorey as well as completely cleared areas (Plate 3). The southern half of Lot 5 and the majority of Lots 6 and 8 contain vegetation in Good Condition with these areas containing some understorey species, as shown in Plate 4, although there are still weed species present.

Plate 3: Trees over a Cleared Understorey on the Site

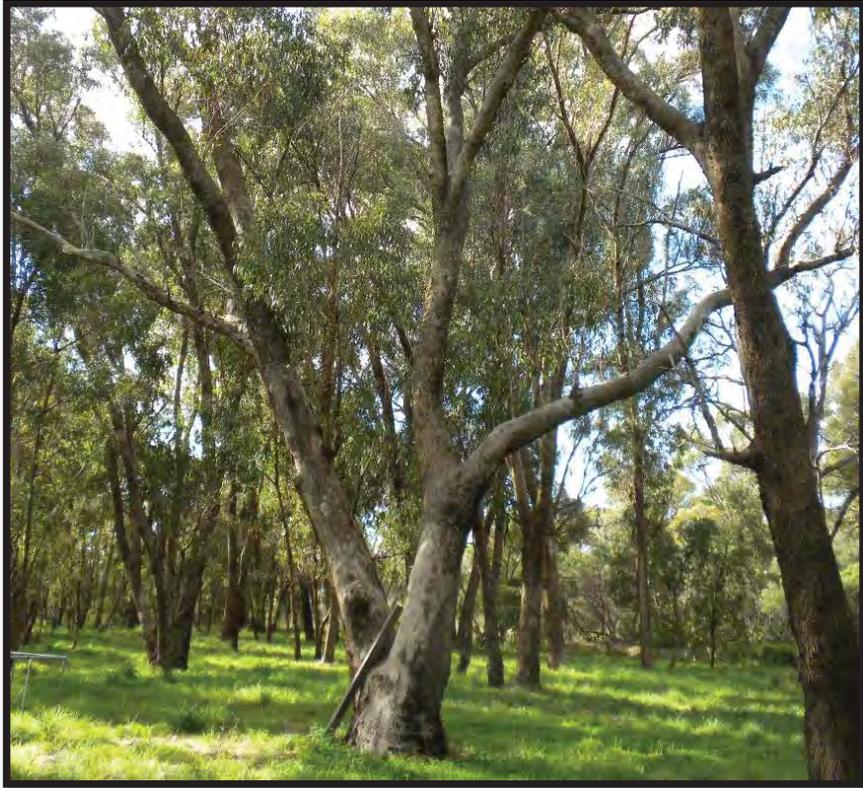
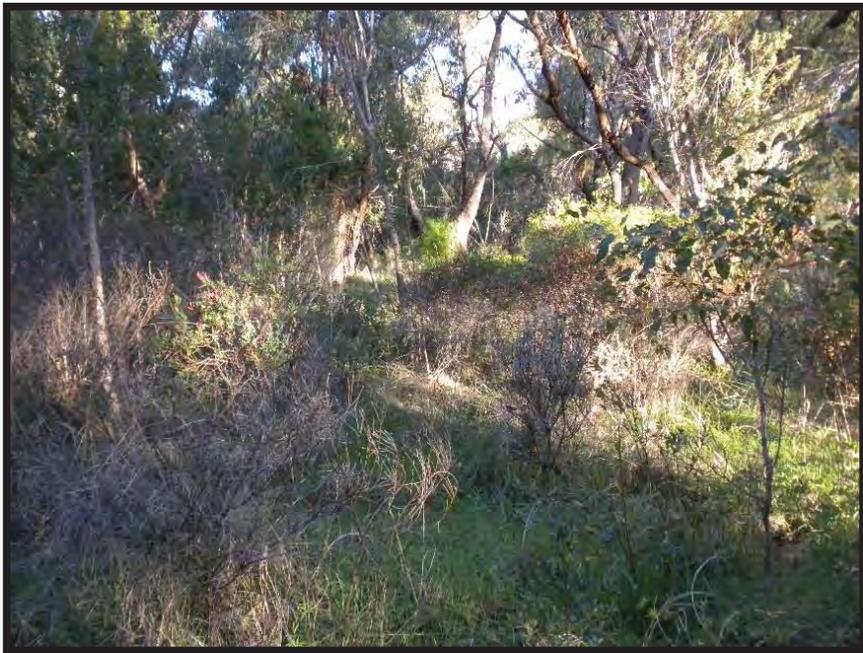


Plate 4: Vegetation on the Site in Good Condition



3 FAUNA

3.1 Methodology

Desktop studies were undertaken to identify the fauna habitats on the site and any evidence of conservation significant species being present on the site. An initial site reconnaissance survey was conducted by PGV Environmental on 22 June 2015. The inspection included a thorough walk over the site. Given the size of the site, open understorey and ease of access, site coverage was high. A follow-up survey to examine potential Black Cockatoo breeding in trees with hollows was undertaken on 11 September 2015.

3.2 Database Search Results

A search of the DPaw Threatened Fauna Database (Parks and Wildlife, 2015) (Appendix 1), the Protected Matters Search Tool (Appendix 2) and the Naturemap database search (Appendix 3) indicates that 45 species that are listed as rare or priority have been located in the vicinity of the site. Table 2 lists the species identified in these database searches.

Table 2: List of Fauna Species Identified from Database Searches

Scientific Name	Common Name	Status under Wildlife Cons. Act	Status under EPBC Act
<i>Bettongia penicillata ogilbyi</i>	Woylie	Schedule 1	Endangered
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Schedule 1	Endangered
<i>Calidris canutus</i>	Red Knot	Schedule 1	Migratory/Marine
<i>Calidris ferruginea</i>	Curlew Sandpiper	Schedule 1	Critically Endangered/ Migratory/Marine
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black Cockatoo	Schedule 1	Vulnerable
<i>Calyptorhynchus baudinii</i>	Baudin's Black Cockatoo	Schedule 1	Vulnerable
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	Schedule 1	Endangered
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	Schedule 1	Vulnerable
<i>Leipoa ocellata</i>	Malleefowl	Schedule 1	Vulnerable
<i>Numenius madagascariensis</i>	Eastern Curlew	Schedule 1	
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	Schedule 1	Vulnerable
<i>Rostratula australis</i> (also listed as <i>Rostratula benghalensis</i>)	Australian Painted Snipe	Schedule 1	Endangered/ Marine/Migratory
<i>Setonix brachyurus</i>	Quokka	Schedule 1	Vulnerable
<i>Tiliqua rugosa konowi</i>	Bobtail Lizard (Rottnest Is.), Shingleback	Schedule 1	
<i>Actitis hypoleucos</i>	Common Sandpiper	Schedule 3	
<i>Apus pacificus</i>	Fork-tailed Swift	Schedule 3	Migratory/Marine
<i>Ardea alba</i> (also listed as <i>Ardea modesta</i>)	Eastern Great Egret	Schedule 3	Migratory/Marine
<i>Ardea ibis</i>	Cattle Egret	Schedule 3	Migratory/Marine
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Schedule 3	Migratory/Marine
<i>Calidris melanotos</i>	Pectoral Sandpiper	Schedule 3	Migratory/Marine
<i>Calidris ruficollis</i>	Red-necked Stint	Schedule 3	Migratory/Marine
<i>Calidris subminuta</i>	Long-toed Stint	Schedule 3	Migratory/Marine
<i>Charadrius dubius</i>	Little Ringed Plover	Schedule 3	Migratory/Marine

Scientific Name	Common Name	Status under Wildlife Cons. Act	Status under EPBC Act
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	Schedule 3	Marine
<i>Limosa lapponica</i>	Bar-tailed Godwit	Schedule 3	Migratory/Marine
<i>Limosa limosa</i>	Black-tailed Godwit	Schedule 3	Migratory/Marine
<i>Merops ornatus</i>	Rainbow Bee-eater	Schedule 3	Migratory/Marine
<i>Philomachus pugnax</i>	Ruff	Schedule 3	Migratory/Marine
<i>Plegadis falcinellus</i>	Glossy Ibis	Schedule 3	
<i>Sterna dougallii</i>	Roseate Tern	Schedule 3	Migratory/Marine
<i>Tringa glareola</i>	Wood Sandpiper	Schedule 3	Migratory/Marine
<i>Tringa nebularia</i>	Common Greenshank	Schedule 3	
<i>Tringa stagnatilis</i>	Marsh Sandpiper, Little Greenshank	Schedule 3	Migratory/Marine
<i>Falco peregrinus</i>	Peregrine Falcon	Schedule 4	
<i>Neelaps calonotos</i>	Black-striped Snake	Priority 3	
<i>Ixobrychus minutus</i>	Little Bittern	Priority 4	
<i>Macropus irma</i>	Western Brush Wallaby	Priority 4	
<i>Oxyura australis</i>	Blue-billed Duck	Priority 4	
<i>Puffinus carneipes</i>	Flesh-footed Shearwater	Priority 4	Migratory/Marine
<i>Thinornis rubricollis</i> (also listed as <i>Charadrius rubricollis</i>)	Hooded Plover	Priority 4	Marine
<i>Isoodon obesulus fusciventer</i>	Southern Brown Bandicoot, Quenda	Priority 5	
<i>Charadrius ruficapillus</i>	Red-capped Plover		Marine
<i>Himantopus himantopus</i>	Black-winged Stilt		Marine
<i>Pandion haliaetus</i> (also listed as <i>Pandion cristatus</i>)	Eastern Osprey		Migratory/Marine
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet		Marine

DPaW classifies fauna under five different Priority codes and rare and endangered fauna are classified under the *Wildlife Conservation (Specially Protected Fauna) Notice 2014* into four schedules of taxa (DPaW, 2014). These are outlined in Appendix 4.

3.3 Fauna Habitat

Two fauna habitats were recorded on the site as shown in Plates 3 and 4 above. These are described as:

- Parkland trees over a cleared understorey; and
- Trees with a mixed native and non-native understorey.

Fauna habitat can be assessed using a number of factors including; the size of the habitat, the level of habitat connectivity, availability of specific resources (e.g. tree hollows) and overall vegetation quality. The habitat was assessed according to the following categories (Coffey Environments, 2009):

High Quality Fauna Habitat – *These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.*

Very Good Fauna Habitat - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.

Good Fauna Habitat – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.

Disturbed Fauna Habitat – These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, contain weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.

Highly Degraded Fauna Habitat – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Faunal assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.

The parkland trees over a cleared understorey consists of Disturbed Fauna Habitat due to the total absence of an understorey. The trees with a mixed native and non-native understorey also consists of Disturbed Fauna Habitat due to the altered understorey, limited connectivity it provides and the presence of dogs which would deter native fauna.

3.4 Conservation Significant Species

Outlined in Table 3 is a short description of each of the species that were identified in the DPaW database searches and Protected Matters Search Tool search in Table 2 above and the likelihood of each species to be present on the site.

Table 3: Likelihood of Conservation Significant Species occurring on the Site

Scientific Name	Common Name	Habitat	Likelihood to occur on the site
<i>Bettongia penicillata ogilbyi</i>	Woylie	The Woylie habitat types ranged from forest to grassland, coastal and inland. During the day the Woylie shelters under patches of dense undergrowth, logs and rock-cavities and occasionally in burrows (DoE, 2014).	Unlikely - absence of preferred habitat
<i>Botaurus poiciloptilus</i>	Australasian Bittern	The Australasian Bittern occurs mainly in densely vegetated freshwater wetlands and, rarely, in estuaries or tidal wetlands (DoE, 2014).	No – no wetlands on site

Scientific Name	Common Name	Habitat	Likelihood to occur on the site
<i>Calidris canutus</i>	Red Knot	In Australasia the Red Knot mainly inhabit intertidal mudflats, sandflats and sandy beaches of sheltered coasts, in estuaries, bays, inlets, lagoons and harbours; sometimes on sandy ocean beaches or shallow pools on exposed wave-cut rock platforms or coral reefs (DoE, 2014).	No – suitable habitat not present
<i>Calidris ferruginea</i>	Curlew Sandpiper	Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms (DoE, 2014).	No – suitable habitat not present
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black Cockatoo	Forest Red-tailed Black Cockatoos frequent the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (SEWPaC, 2012). It nests in tree hollows with a depth of 1-5m, that are predominately Marri (<i>Corymbia calophylla</i>), Jarrah (<i>Eucalyptus marginata</i>) and Karri (<i>E. diversicolor</i>) and it feeds primarily on the seeds of Marri (SEWPaC, 2012).	Possible but no breeding observed in Jarrahs with hollows and no Marri for foraging
<i>Calyptorhynchus baudinii</i>	Baudin's Black Cockatoo	Baudin's Black-Cockatoo mainly occurs in eucalypt forests, especially Jarrah (<i>E. marginata</i>), Marri (<i>Corymbia calophylla</i>), also Karri (<i>E. diversicolor</i>) forest, often feeding in the understorey on proteaceous trees and shrubs, especially banksias (SEWPaC, 2012).	Highly unlikely – outside common distribution range
<i>Calyptorhynchus latirostris</i>	Carnaby's Black Cockatoo	Carnaby's Cockatoo is found in the south-west of Australia from Kalbarri through to Ravensthorpe. It has a preference for feeding on the seeds of <i>Banksia</i> , <i>Dryandra</i> , <i>Hakea</i> , <i>Eucalyptus</i> , <i>Grevillea</i> , <i>Pinus</i> and <i>Allocasuarina</i> spp. It is nomadic often moving toward the coast after breeding. It breeds in tree hollows that are 2.5 – 12m above the ground and have an entrance 23-30cm with a depth of 1-2.5m. Nesting mostly occurs in smooth-barked trees (e.g. Salmon Gum, Wandoo, Red Morrell) (SEWPaC, 2012).	Possible – foraging habitat located on site however on the edge of breeding range
<i>Dasyurus geoffroii</i>	Chuditch, Western Quoll	The Chuditch have been known to occupy a wide range of habitats including woodlands, dry sclerophyll forests, riparian vegetation, beaches and deserts. They are opportunistic feeders, and forage on the ground at night, feeding on invertebrates, small mammals, birds and reptiles (DoE, 2014).	Highly unlikely – no recent records, disturbed site conditions and feral and domestic predators

Scientific Name	Common Name	Habitat	Likelihood to occur on the site
<i>Leipoa ocellata</i>	Malleefowl	Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards in mallee bushland (DoE, 2014).	No - suitable habitat not present and no Malleefowl nests were observed
<i>Numenius madagascariensis</i>	Eastern Curlew	The Eastern Curlew is most commonly associated with sheltered coasts, especially estuaries, bays, harbours, inlets and coastal lagoons, with large intertidal mudflats or sandflats, often with beds of seagrass. Occasionally, the species occurs on ocean beaches (often near estuaries), and coral reefs, rock platforms, or rocky islets (DoE, 2014).	No – suitable habitat not present
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	The Western Ringtail Possum is a medium sized nocturnal marsupial. This species occurs in and near coastal Peppermint Tree (<i>Agonis flexuosa</i>) forest and Tuart (<i>Eucalyptus gomphocephala</i>) dominated forest with a Peppermint Tree understorey (DoE, 2014).	No – suitable habitat not present
<i>Rostratula australis</i> (also listed as <i>Rostratula benghalensis</i>)	Australian Painted Snipe	The Australian Painted Snipe has been recorded at wetlands in all states of Australia but is most common in eastern Australia. It generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. It also uses inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include a cover of vegetation, including grasses (DoE, 2014).	No – suitable habitat not present
<i>Setonix brachyurus</i>	Quokka	Quokkas were originally very common on the Swan Coastal Plain, however, their distribution is now limited to Rottnest Island and a few isolated areas in the south-west of WA. On the mainland, they prefer densely vegetated areas around wetlands and streams, whereas on Rottnest Island they inhabit low scrubby coastal vegetation where water is not readily available year-round (DoE, 2014).	No – suitable habitat not present
<i>Tiliqua rugosa konowi</i>	Bobtail Lizard (Rottnest Is.), Shingleback	<i>Tiliqua rugosa konowi</i> is restricted to Rottnest Island, WA, on pale sands and limestones supporting low woodland/heathland associations (Reptile Trader, 2015).	No – not present on mainland
<i>Actitis hypoleucos</i>	Common Sandpiper	The Common Sandpiper is mostly found around muddy margins or rocky shores. Generally the species forages in shallow water and on bare soft mud at the edges of wetlands (DoE, 2014).	No – suitable habitat not present

Scientific Name	Common Name	Habitat	Likelihood to occur on the site
<i>Apus pacificus</i>	Fork-tailed Swift	The Fork-tailed Swift is almost exclusively aerial and is not known to breed in Australia. They are seen in inland plains but sometimes above foothills or in coastal areas. They often occur over cliffs and beaches and also over islands and sometimes well out to sea. They also occur over settled areas, including towns, urban areas and cities (DoE, 2014).	Possible aerial visitor
<i>Ardea alba</i> (also listed as <i>Ardea modesta</i>)	Eastern Great Egret	The Eastern Great Egret has been reported in a wide range of wetland habitats and usually frequents shallow waters (DoE, 2014). This species feeds on fish, insects, crustaceans, molluscs, frogs, lizards, snakes and small birds and mammals (DoE, 2014).	No – suitable habitat not present
<i>Ardea ibis</i>	Cattle Egret	The Cattle Egret occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands with breeding in Western Australia recorded in the far north in Wyndham in colonies in wooded swamps such as mangrove forests (DoE, 2014). This species forages away from water on low lying grasslands, improved pastures and croplands generally in areas that have livestock eating insects, frog, lizards and small mammals (DoE, 2014).	Highly unlikely – site does not contain preferred habitat
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	The Sharp-tailed Sandpiper prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation (DoE, 2014).	No – suitable habitat not present
<i>Calidris melanotos</i>	Pectoral Sandpiper	The Pectoral Sandpiper prefers shallow fresh to saline wetlands and is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands (DoE, 2014).	No – suitable habitat not present
<i>Calidris ruficollis</i>	Red-necked Stint	The Red-necked Stint is mostly found in coastal areas, including in sheltered inlets, bays, lagoons and estuaries with intertidal mudflats, often near spits, islets and banks and, sometimes, on protected sandy or coralline shores (DoE, 2014).	No – suitable habitat not present
<i>Calidris subminuta</i>	Long-toed Stint	The Long-toed Stint prefers shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire (DoE, 2014).	No – suitable habitat not present
<i>Charadrius dubius</i>	Little Ringed Plover	The Little-ringed Plover prefers bare or sparsely vegetated sandy and pebbly shores of shallow standing freshwater pools, lakes or slow-flowing rivers (Birdlife, 2014a).	No – suitable habitat not present

Scientific Name	Common Name	Habitat	Likelihood to occur on the site
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	The White-bellied Sea-Eagle is found in coastal habitats with large areas of open water, especially those close to the sea-shore. This species feeds opportunistically on a variety of fish, birds, reptiles, mammals and crustaceans, and on carrion and offal (DoE, 2014).	No – suitable habitat not present
<i>Limosa lapponica</i>	Bar-tailed Godwit	The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays (DoE, 2014).	No – suitable habitat not present
<i>Limosa limosa</i>	Black-tailed Godwit	The subspecies <i>Limosa limosa</i> subsp. <i>melanuroides</i> is the only one recorded in Australia. It is found mainly in coastal habitats such as large intertidal sandflats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. It is often found around beds of seagrass and, sometimes, in nearby saltmarsh (DoE, 2014).	No – suitable habitat not present
<i>Merops ornatus</i>	Rainbow Bee-eater	Populations that breed in northern Australia are considered to be resident, and in many northern localities the Rainbow Bee-eater is present throughout the year (DoE, 2014). The Rainbow Bee-eater nests in a burrow dug in the ground. It is found across the better-watered parts of WA including islands preferring lightly wooded, sandy country near water (DoE, 2014).	Possible intermittent visitor to the site
<i>Philomachus pugnax</i>	Ruff	The Ruff is found on generally fresh, brackish or saline wetlands with exposed mudflats at the edges and is found in terrestrial wetlands including lakes, swamps, pools, lagoons, tidal rivers, swampy fields and floodlands (DoE, 2014).	No – suitable habitat not present
<i>Plegadis falcinellus</i>	Glossy Ibis	The Glossy Ibis is the smallest ibis known in Australia. This species preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation (DoE, 2014).	No – suitable habitat not present
<i>Sterna dougallii</i>	Roseate Tern	The Roseate Tern is a migratory coastal seabird that feeds by plunge diving. This species breeds in sites surrounded by walls and rocks or in the shelter of vegetation (in temperate regions) (Birdlife International, 2014d).	No – suitable habitat not present
<i>Tringa glareola</i>	Wood Sandpiper	The Wood Sandpiper uses well-vegetated, shallow, freshwater wetlands, such as swamps, billabongs, lakes, pools and waterholes. They are typically associated with emergent, aquatic plants or grass, and dominated by taller fringing vegetation, such as dense stands of rushes or reeds, shrubs, or dead or live trees, especially Melaleuca and River Red Gums <i>Eucalyptus camaldulensis</i> and often with fallen timber (DoE, 2014).	No – suitable habitat not present

Scientific Name	Common Name	Habitat	Likelihood to occur on the site
<i>Tringa nebularia</i>	Common Greenshank	The Common Greenshank is a wader and does not breed in Australia. This species can be found in many types of wetlands and has the widest distribution of any shorebird in Australia. This species typically feeds on molluscs, crustaceans, insects, and occasionally fish and frogs (DoE, 2014).	No – suitable habitat not present
<i>Tringa stagnatilis</i>	Marsh Sandpiper, Little Greenshank	The Marsh Sandpiper lives in permanent or ephemeral wetlands of varying salinity, including swamps, lagoons, billabongs, salt pans, saltmarshes, estuaries, pools on inundated floodplains, and intertidal mudflats and also regularly at sewage farms and saltworks (DoE, 2014).	No – suitable habitat not present
<i>Falco peregrinus</i>	Peregrine Falcon	The Peregrine Falcon is found in a variety of habitats but nests on high cliff ledges or artificial structures. It feeds primarily on small-medium sized birds, but occasionally taking insects, such as moths, cicadas and locusts (Birdlife Australia, 2012).	Possible intermittent visitor to the site
<i>Neelaps calonotos</i>	Black-striped Snake	The Black-striped snake has a limited distribution, inhabiting areas with sandy soils that support heathlands and Banksia/Eucalypt Woodlands (Nevill, 2005) on the Swan Coastal Plain generally in the lower west coast from Lancelin to Mandurah (Storr et al, 1999).	Highly unlikely – outside of distribution range
<i>Ixobrychus minutus</i>	Little Bittern	Little Bitterns frequent terrestrial freshwater wetlands that have dense emergent vegetation but can also use artificial wetlands, even in built-up areas. Little Bitterns eat small, aquatic invertebrates and tadpoles, and nest in dense vegetation over water (Garnett et al., 2000).	No – suitable habitat not present
<i>Macropus irma</i>	Western Brush Wallaby	The Western Brush Wallaby is a medium sized marsupial and its optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets (DEC, 2012b).	Highly unlikely – preferred habitat not present
<i>Oxyura australis</i>	Blue-billed Duck	The Blue-billed Duck is found on terrestrial wetlands in temperate regions, that are freshwater to saline, and may be natural or artificial. It nests in rushes, sedges, Lignum <i>Muehlenbeckia cunninghamii</i> and paperbark <i>Melaleuca</i> (Birdlife International, 2015). The species is almost completely aquatic, and is seldom seen on land. Non-breeding flocks, often with several hundred individuals, congregate on large, deep open freshwater dams and lakes in autumn. The daylight hours are spent alone in small concealed bays within vegetation or communally in large exposed rafts far from the shore (Birds in Backyards, 2015).	No – suitable habitat not present

Scientific Name	Common Name	Habitat	Likelihood to occur on the site
<i>Puffinus carneipes</i>	Flesh-footed Shearwater	The Flesh-footed Shearwater mainly occurs in the subtropics over continental shelves and slopes and occasionally inshore waters. Burrows are situated in areas that provide a clear flight-path for birds to enter and exit their colonies (DoE, 2014).	No – suitable habitat not present
<i>Thinornis rubricollis</i> (also listed as <i>Charadrius rubricollis</i>)	Hooded Plover	The Hooded Plover primarily inhabits sandy, ocean beaches, with the highest densities on beaches with large amounts of beach-washed seaweed that are backed by extensive open dunes. In Western Australia the species also inhabits inland and coastal salt lakes (Birdlife International 2014b).	No – suitable habitat not present
<i>Isoodon obesulus fusciventer</i>	Southern Brown Bandicoot, Quenda	Southern Brown Bandicoots are small grey marsupials that prefer dense scrub (up to one metre high), often in or near swampy vegetation. Their diet includes invertebrates (including earthworms, adult beetles and their larvae), underground fungi, subterranean plant material, and very occasionally, small vertebrates (DEC, 2012a).	Present – conical diggings typical to the species observed on site
<i>Charadrius ruficapillus</i>	Red-capped Plover	The Red-capped Plover is found in wetlands, especially in arid areas, and prefers saline and brackish waters (Birdlife Australia, 2014b).	No – suitable habitat not present
<i>Himantopus himantopus</i>	Black-winged Stilt	The Black-winged Stilt is found near coastal lagoons and shallow freshwater or brackish pools with extensive areas of mudflats, salt meadows, salt pans, coastal marshes and swamps (Birdlife International, 2014a).	No – suitable habitat not present
<i>Pandion haliaetus</i> (also listed as <i>Pandion cristatus</i>)	Eastern Osprey	Ospreys occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They feed on fish, especially mullet where available, and rarely take molluscs, crustaceans, insects, reptiles, birds and mammals (DoE, 2014).	No – suitable habitat not present
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	The Red-necked Avocet occurs in wetland areas including bogs, marshes, swamps and Permanent Saline, Brackish or Alkaline Lakes (Birdlife International, 2014c).	No – suitable habitat not present

Species identified in the database searches possibly present on the site were:

- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*): Discussed in Section 4.
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*): Discussed in Section 4.
- Forked-tailed Swift (*Apus pacificus*): An aerial species that may occasionally fly over the site, however it is not reliant on the site for survival and as it is also located over settled areas residential development will not have a significant impact on this species.
- Rainbow Bee-eater (*Merops ornatus*): It may be an intermittent visitor, however it is only present in south-western Australia for parts of the year and it does not rely on the site for survival.

- Peregrine Falcon (*Falco peregrinus*): It may be an intermittent visitor, however breeding habitat is not present on the site and it does not rely on the site for survival.
- Southern Brown Bandicoot (*Isoodon obesulus fusciventer*): Conical diggings typical to the species were observed on site during the site visit in June 2015. As a Priority 5 species their presence does not restrict development, however a trapping and relocation program will be required prior to clearing.

3.5 Biodiversity Value

The Environmental Protection Authority's (EPA) (2002) *Terrestrial Biological Surveys as an Element of Biodiversity Protection Position Statement No. 3* indicated an ecological assessment of a site must consider its biodiversity value at the genetic, species and ecosystem levels; and its ecological functional value at the ecosystem level.

From a fauna perspective, the vegetation within the site is considered to be Disturbed Fauna Habitat as there is no understorey present over more than half of the site, the remaining area has an altered understorey and the site does not provide linkage between bushland areas. The trees provide habitat for birds, however there is likely to be a paucity of native mammals present.

The pet dogs located on Lots 5 and 7 would deter most ground-dwelling native species. Feral species such as cats, foxes and rabbits are also likely to be present in the area and would impact on the fauna assemblage on the site.

It is not possible to assess the biodiversity value at a genetic level based on the information available.

4 BLACK COCKATOOS

4.1 Black Cockatoo Species

4.1.1 Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)

Carnaby's Black Cockatoo is found in the south-west of Australia from Kalbarri through to Ravensthorpe. It has a preference for feeding on the seeds of *Banksia*, *Dryandra*, *Hakea*, *Eucalyptus*, *Grevillea*, *Pinus* and *Allocasuarina* spp. It is nomadic, often moving toward the coast after breeding. It breeds in tree hollows that are 2.5 – 12m above the ground and have an entrance of 23-30cm with a depth of 1-2.5m. Nesting mostly occurs in smooth-barked trees (e.g. Salmon Gum, Wandoo, Red Morrell). Eggs are laid from July to October, with incubation lasting 29 days (DoE, 2014).

The site is within the modelled distribution for Carnaby's Black Cockatoos, however it is outside of the predicted breeding range (SEWPaC, 2012).

4.1.2 Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)

Baudin's Black Cockatoo is most common in the far south-west of Western Australia. It is known to breed from the southern forests north to Collie and east to near Kojonup. Baudin's Black Cockatoo is typically found in vagrant flocks and utilises the taller, more open Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) woodlands where it feeds mainly on Marri seeds and various Proteaceous species (Johnstone and Kirkby, 2011).

The site is outside the modelled distribution for Baudin's Black Cockatoos (SEWPaC, 2012). Therefore habitat specific to this species has not been investigated further in this assessment.

4.1.3 Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)

Forest Red-tailed Black Cockatoos are endemic to the humid to sub-humid south-west of Western Australia (SEWPaC, 2012). The range of Forest Red-tailed Black Cockatoos is bound by Gingin in the north to Mt Helena, Christmas Tree Well, West Dale, North Bannister, Mt Saddleback, Kojonup, Rocky Gully, upper King River and Green Range (east of Albany) (SEWPaC, 2012; DoE, 2014). It nests in tree hollows with a depth of 1-5m, that are predominately Marri, Jarrah and Karri (*E. diversicolor*) and it feeds primarily on the seeds of Marri and Jarrah (Johnstone and Kirkby, 2011).

The site is within the modelled distribution for Forest Red-tailed Black Cockatoos (SEWPaC, 2012).

4.2 Methodology of Targeted Search

PGV Environmental undertook the Black Cockatoo Habitat Assessment in accordance with the *EPBC Act referral guidelines for three threatened Black Cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii Forest red-tailed Black Cockatoo (vulnerable) Calyptorhynchus banksii naso* (SEWPaC, 2012) (Black Cockatoo Referral Guidelines) and the methodology that is outlined in the SPRAT Database for each of the Black Cockatoo species for Black Cockatoo Habitat Assessments.

An initial site visit was undertaken by PGV Environmental on 22 June 2015. The site was traversed on foot and information on Black Cockatoo foraging, roosting and breeding habitat was assessed.

The quality of the vegetation was determined in the context of foraging habitat for Black Cockatoos. During the site visit a search for feeding signs or feeding debris such as 'chewed' Jarrah nuts was undertaken.

The site was also searched for evidence of roosting including areas of droppings, moulted feathers, feather down or clippings from branches under trees.

Breeding habitat is defined in the Black Cockatoo Referral Guidelines as trees of species known to support breeding within the range of the Black Cockatoo species which either have a suitable nest hollow OR are of a suitable diameter at breast height (DBH) to develop a nest hollow. For most tree species the suitable DBH is 500mm. Tuart and Jarrah are species known to support breeding for Black Cockatoo species. A Significant Tree Survey assessment was undertaken to identify trees within the site that have a DBH of 500mm or greater. The location, species, tree trunk DBH and any other important descriptive information about each suitable tree located within the site was recorded. The presence of hollows or spouts was also recorded. Any hollows or spouts found were assessed from the ground and therefore those deemed suitable for breeding by Black Cockatoos may not be suitable upon closer inspection.

A follow-up survey was undertaken to assess trees with hollows for evidence of breeding activity on 11 September 2015. The survey visited all trees identified in the initial survey as containing hollows large enough for Black Cockatoos to breed and looking for signs of birds in the hollows during the day or on the trees exhibiting typical breeding activity.

4.3 Black Cockatoo Habitat

4.3.1 Habitat definitions

'Foraging habitat' for Black Cockatoos is determined from the plant species that are present on the site and evidence of feeding such as direct observation of birds or by chewed nuts and cones. 'Roosting habitat' is usually evident due to the presence of Black Cockatoos on the site in the evening and early morning and of scat under the roosting area. 'Breeding habitat' is defined as trees of species known to support breeding within the range of the species which either have a suitable nest hollow OR have a DBH of 500mm or greater.

4.3.2 Foraging

The only native species that are recognised as foraging habitat for Black Cockatoos that were recorded on the site during the site visit consisted of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Parrot Bush (*Banksia sessilis*). Tuarts are not a primary food source of Forest Red-tailed Black Cockatoos (Johnstone and Kirkby, 2011), however Carnaby's Black Cockatoos may occasionally feed on the flowers (Valentine and Stock, 2008). Carnaby's Black Cockatoos and Forest Red-tailed Black Cockatoos both feed on Jarrah seeds (Johnstone and Kirkby, 2011; Valentine and Stock, 2008). Carnaby's Black Cockatoos will feed on the seeds, flowers and nectar of *Banksia* species, including the Parrot Bush present on the site, while this is not a food source for Forest Red-tailed Black Cockatoos (SEWPaC, 2012).

Tuarts, as shown in Plate 5, are the dominant trees located throughout the site while some Jarrahs are scattered through the site (Plate 6). The Parrot Bush is located in the northern section of Lot 6

(Plate 7). Therefore the majority of the site contains vegetation consisting of foraging species. The area of the site containing foraging habitat is approximately 5.43ha (Figure 3).

Plate 5: Tuarts (*Eucalyptus gomphocephala*) on the Site

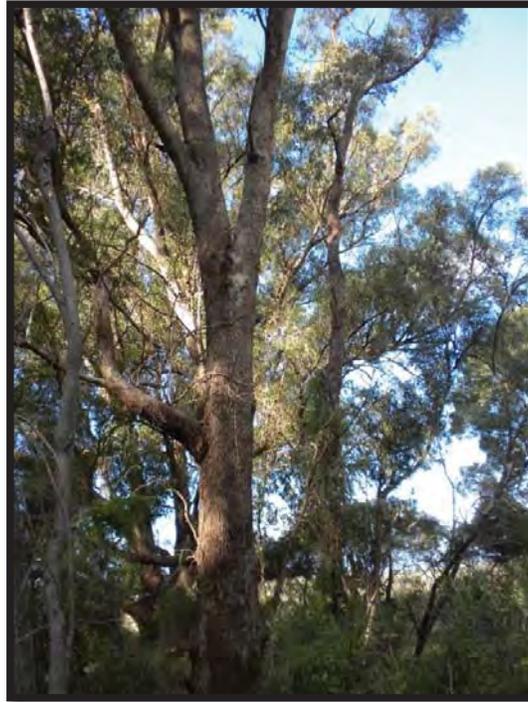


Plate 6: A Jarrah (*Eucalyptus marginata*) on the Site

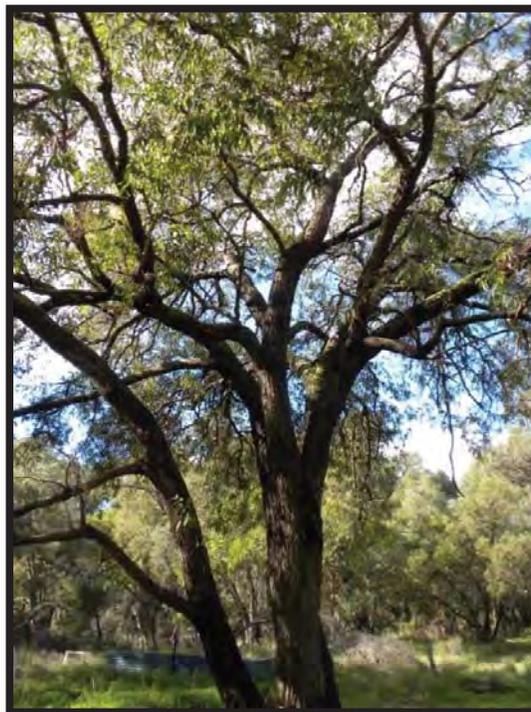
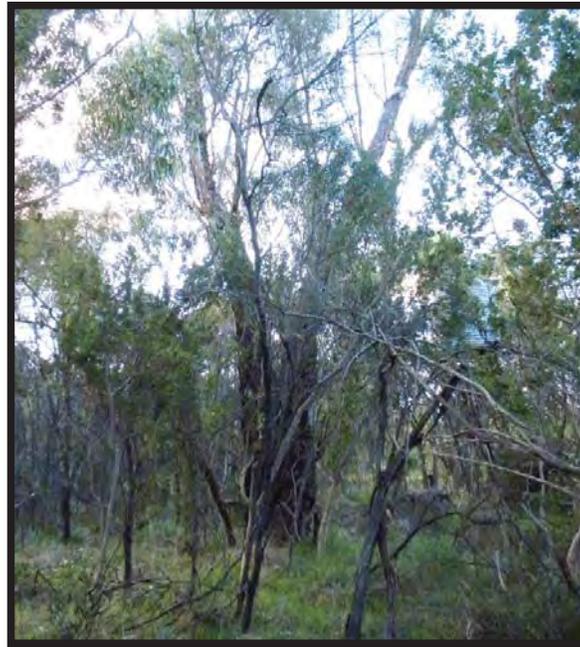


Plate 7: Parrot Bush (*Banksia sessilis*) on the Site



If utilising the site, Forest Red-tailed Black Cockatoos would forage predominantly on the Jarrah seeds while Carnaby's Black Cockatoos may also forage on Jarrah seeds, Tuart flowers and Parrot Bush seeds, flowers and nectar. There was no evidence found of foraging by Black Cockatoos on the site during the site visit by PGV Environmental.

The Black Cockatoo Referral Guidelines refer to the quality of the foraging habitat as an important characteristic in determining the significance of the impact. However, there is no guidance as to how the quality is determined in the Black Cockatoo Referral Guidelines other than specifying that 'quality' foraging habitat refers to the use of the habitat by Black Cockatoos rather than the overall quality of the vegetation which would normally be described using understorey as well as tree canopy. In the absence of any guidance on determining foraging habitat quality PGV Environmental developed a foraging habitat matrix that rates the quality on the basis of the energy resource of the vegetation types, the condition of the vegetation and whether or not foraging has been observed in each vegetation type on the site (Table 4). PGV Environmental has used the matrix in several assessments previously and in referrals under the EPBC Act.

Table 4: Foraging Value Rating Matrix

Vegetation Type	Vegetation Condition	Foraging Observed	Foraging Value
High Resource eg. Banksia woodland Marri Woodland mixed Jarrah/Banksia mixed Jarrah/Marri	VG-E	Y	Excellent
		N	Very Good
	G	Y	Very Good
		N	Good
	D-CD	Y	Good
		N	Good
Medium Resource eg. Jarrah woodland Parrot Bush Heath	VG-E	Y	Very Good
		N	Good
	G	Y	Good
		N	Poor
	D-CD	Y	Good
		N	Poor
Low Resource eg. Mixed Tuart/Jarrah Woodland Tuart woodland	VG-E	Y	Good
		N	Poor
	G	Y	Good
		N	Poor
	D-CD	Y	Good
		N	Poor

According to the Foraging Value Rating Matrix the mixed Tuart and Jarrah woodland located on the site is rated as a Low Resource vegetation type for foraging by Black Cockatoos. Applying the vegetation conditions on the site and the fact that no foraging evidence was observed the Foraging Value is Poor across the Tuart and Jarrah woodland on the site. The small area of the site containing Parrot Bush is rated as a Medium Resource vegetation type and applying the Good Vegetation Condition and no foraging evidence the Foraging Value is Poor within this area of the site. Therefore the site contains approximately 5.43ha of Poor Foraging Value Habitat for Black Cockatoos.

4.3.3 Roosting

The site does not contain a known roosting site for Carnaby's Black Cockatoos (DoP, 2011). No evidence of the site being utilised as roosting habitat by Black Cockatoos was observed during the site visit.

4.3.4 Breeding

Black Cockatoos are known to breed in hollows of large eucalypts, including Tuart and Jarrah trees. The site is on the edge of the breeding/non-breeding habitat for Carnaby's Cockatoos but has not been recorded as a breeding site for Carnaby's Black Cockatoos (DoP, 2011).

The Black Cockatoo Referral Guidelines define trees of certain species with a DBH of 500mm or greater as breeding habitat regardless of the presence or not of hollows. The theory behind this definition is the concept that while the trees may not currently contain hollows they are mature enough that in

the next 50 years or so a hollow might form and be of use to Black Cockatoos for the purposes of breeding.

The PGV Environmental survey recorded 98 trees that are classified as potential breeding habitat. These trees consisted of 81 Tuarts, nine Jarrahs and eight Standing Dead Trees. Within the Black Cockatoo Referral Guidelines both Tuart and Jarrah trees are considered breeding habitat for Carnaby’s Black Cockatoos, however Tuarts are not considered breeding habitat for Forest Red-tailed Black Cockatoos.

PGV Environmental recorded four of the 98 trees on the site with hollows or spouts. Three of these trees were Tuarts and one was a Standing Dead Tree (SDT). Two of these trees contained small hollows unsuitable for Black Cockatoos, one contained a large hollow and one contained a potential spout. Therefore only two trees on the site are currently potentially suitable for breeding and they are both Tuarts (Tree Number 54 and 92). No evidence of breeding by Black Cockatoos was observed in these trees by PGV Environmental in September 2015.

The details of the significant trees on the site are in Appendix 5 and are shown on Figure 3.

4.4 Regional Context

To assist in determining the significance of any impact on Black Cockatoo habitat on the site an assessment of Black Cockatoo habitat within the vicinity of the site was undertaken.

There are four Bush Forever sites that occur within 5km of the site containing vegetation considered to be habitat for Black Cockatoos. The total area of these Bush Forever sites is 2651.6ha. Three of the sites contain potential foraging and breeding habitat for Black Cockatoos and Site 418 contains potential breeding habitat for Carnaby’s Black Cockatoos. The sites are described below in Table 5.

Table 5: Bush Forever Sites within 5km that contain Black Cockatoo Habitat (Government of Western Australia, 2000)

Bush Forever Site	Area (ha) of Bushland	Proximity to the Site	The Vegetation Types within the Bush Forever Sites that Consist of Black Cockatoo Habitat	Potential Foraging and/or Breeding Habitat
Lake Cooloongup, Lake Walyungup and Adjacent Bushland, Hillman to Port Kennedy Site 356	1617.5	Directly opposite Kerosene Lane to the north and also app. 315m to the west of the site	1) <i>Banksia attenuata</i> and <i>B. menziesii</i> Low Woodland; 2) <i>Eucalyptus gomphocephala</i> , <i>E. marginata</i> and <i>Banksia attenuata</i> Open Forest; 3) <i>Grevillea vestita</i> Closed Heath; 4) <i>Eucalyptus gomphocephala</i> Woodland to Forest; and 5) <i>Banksia littoralis</i> Low Woodland.	Foraging and Breeding

Bush Forever Site	Area (ha) of Bushland	Proximity to the Site	The Vegetation Types within the Bush Forever Sites that Consist of Black Cockatoo Habitat	Potential Foraging and/or Breeding Habitat
Leda and Adjacent Bushland, Leda Site 349	959.8	App. 1.32km north of the site	1) <i>Eucalyptus marginata</i> , <i>E. gomphocephala</i> and <i>Allocasuarina fraseriana</i> Woodland; 2) <i>Banksia menziesii</i> , <i>Eucalyptus marginata</i> and <i>Allocasuarina fraseriana</i> Low Woodland; 3) <i>Banksia attenuata</i> and <i>B. grandis</i> Low Woodland; 4) <i>Banksia attenuata</i> and <i>B. menziesii</i> Low Woodland with scattered emergent <i>Eucalyptus gomphocephala</i> ; 5) <i>Eucalyptus gomphocephala</i> Open Forest; 6) <i>Corymbia calophylla</i> Open Forest; and 7) <i>Eucalyptus rudis</i> Low Open Forest to Low Forest.	Foraging and Breeding
Folly Pool, Baldivis Site 418	15.5	App. 2.92km south-east of the site	1) <i>Eucalyptus rudis</i> Woodland over <i>Melaleuca raphiophylla</i> Low Forest.	Breeding
Doghill Road Bushland, Baldivis Site 369	58.8	App. 4.7km south-east of the site	1) <i>Banksia attenuata</i> , <i>B. menziesii</i> and <i>Allocasuarina fraseriana</i> Low Woodland; 2) Scattered <i>Eucalyptus marginata</i> and/or <i>Eucalyptus gomphocephala</i> over <i>Banksia</i> species Low Woodland.	Foraging and Breeding

4.5 Significance of Impact

According to the EPBC Act Significant Impact Guidelines 1.1 (DoE, 2013), the significance of the impact on Black Cockatoos depends on the sensitivity, value and quality of the environment and the intensity, duration, magnitude and geographic extent of the impacts. The category of listing (for example; Endangered, Vulnerable or Migratory) determines the significant impact criteria for listed flora and fauna species and ecological communities.

A proposed Subdivision Concept Plan for the site prepared by Whelans Town Planning (Appendix 6) indicates that there will be some Public Open Space (POS) located on the site with the balance developed for housing and roads. The landscaping treatment of these POS areas is not known and a Local Structure Plan has not been finalised. Therefore this Assessment assumes all of the foraging and potential breeding trees on the site would be cleared for residential development. Using this assumption the clearing would result in approximately 5.43ha of Poor Foraging Value Habitat and 98 potential breeding trees being cleared.

The following assessment of the significance of the potential clearing of habitat for Carnaby's and Forest Red-tailed Black Cockatoos is provided below.

Carnaby's Black Cockatoo (Endangered)

The impact of clearing on Carnaby's Black Cockatoos has been assessed against the criteria set out in the Significant Impact Guidelines 1.1 for the impact on an Endangered species and is shown below:

- *Lead to a long-term decrease in the size of a population*

There was no evidence that the site supports breeding or roosting of Carnaby's Black Cockatoos and there are large areas of Bush Forever sites within 5km consisting of foraging and potential breeding habitat, therefore clearing of the site will not result in this outcome.

- *Reduce the area of occupancy of the species*

Clearing of the site will not result in a reduction of any known breeding and roosting habitat and the 5.43ha of foraging habitat that will be cleared consists only of Poor Value Foraging Habitat. There is also approximately 2651.6ha of Black Cockatoo habitat within 5km of the site located in Bush Forever sites and therefore clearing of the site will not result in this outcome.

- *Fragment an existing population into two or more populations*

Clearing of the site is unlikely to fragment a population of Carnaby's Black Cockatoos into sub-populations due to the Bush Forever sites in the area providing linkages consisting of large areas of Black Cockatoo habitat. Carnaby's Black Cockatoos can fly large distances between foraging areas. Clearing of the site will therefore not result in this outcome.

- *Adversely affect habitat critical to the survival of a species*

There was no evidence of breeding or roosting by Carnaby's Black Cockatoos on the site. The two trees that contained potentially suitable hollows and the approximate 5.43ha of Poor Value Foraging Habitat is not considered to be critical to the survival of the species due to the large amount of foraging and potential breeding habitat within 5km of the site, therefore clearing of the site would not result in this outcome.

- *Disrupt the breeding cycle of a population*

The site contained no evidence of breeding and there were only two trees that contained potentially suitable hollows therefore clearing of the site would not result in this outcome.

- *Modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

Clearing of the site will not result in this outcome due to the large extent of Black Cockatoo habitat reserved in Bush Forever sites within 5km of the site.

- *Result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*

Clearing of the site will not result in the establishment of an invasive species harmful to Carnaby's Black Cockatoos.

- *Introduce disease that may cause the species to decline*

Clearing of the site will not cause disease to be introduced therefore will not result in this outcome.

- *Interfere with the recovery of the species*

The Carnaby's Black Cockatoos that would utilise the site have access to approximately 2651.6ha of Black Cockatoo habitat within 5km reserved in Bush Forever sites. Therefore any clearing of habitat on the site would not interfere substantially with the recovery of the species.

The conclusion of this assessment in accordance with the criteria set out in the Significant Impact Guidelines 1.1 is that residential development at Lots 5-8 Kerosene Lane in Baldvis would not have a significant impact on Carnaby's Black Cockatoos.

Forest Red-tailed Black Cockatoo (Vulnerable)

The impact on Forest Red-tailed Black Cockatoos from clearing the Black Cockatoo habitat on the site has been assessed against the criteria set out in the Significant Impact Guidelines 1.1 for the impact on a Vulnerable species and is shown below:

- *Lead to a long-term decrease in the size of an important population of a species*

In the Significant Impact Guidelines 1.1 an important population is defined as "a population that is necessary for a species' long-term survival and recovery" and may be "key source populations either for breeding or dispersal, populations that are necessary for maintaining genetic diversity, and/or populations that are near the limit of the species' range".

There were only nine Jarrahs and eight SDTs located on the site with a DBH of 500mm or greater, providing potential breeding habitat for Forest Red-tailed Black Cockatoos, and there was no evidence of breeding occurring on the site. Additionally the surrounding area contains a number of Bush Forever sites providing large areas of foraging and breeding habitat for Cockatoos that utilise the site. Development of the site would therefore not result in this outcome.

- *Reduce the area of occupancy of an important population*

There was no evidence found of Forest Red-tailed Black Cockatoos breeding or roosting on the site. Clearing of the site will not significantly reduce the area of foraging available to Forest Red-tailed Black Cockatoos due to the small number of Jarrahs on the site and there is approximately 2651.6ha of foraging habitat within 5km of the site in Bush Forever sites. Therefore clearing of the site would not result in this outcome.

- *Fragment an existing important population into two or more populations*

There are large areas of Bush Forever sites within 5km of the site that provide foraging and potential breeding habitat. Forest Red-tailed Black Cockatoos can fly large distances between foraging areas. Additionally the site does not provide significant habitat for Forest Red-tailed Black Cockatoos. Therefore clearing of the site would not result in this outcome.

- *Adversely affect habitat critical to the survival of a species*

There was no evidence that Forest Red-tailed Black Cockatoos breed on the site and the site contains limited foraging habitat for this species while there are large areas of foraging habitat within 5km of

the site, as Bush Forever sites. Therefore the site is not considered critical to the survival of the species.

- *Disrupt the breeding cycle of an important population*

There was no evidence that Forest Red-tailed Black Cockatoos breed on the site. There were only two trees on the site that contained potentially suitable hollows both of which were Tuarts and they are not preferred breeding trees for this species. Therefore clearing of the site would not result in this outcome.

- *Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline*

The site provides limited habitat for Forest Red-tailed Black Cockatoos and the large areas of foraging and breeding habitat located in the Bush Forever sites within 5km of the site would prevent the population from declining as a result of clearing of the site.

- *Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat*

Clearing the site will not result in invasive species being introduced, therefore would not result in this outcome.

- *Introduce disease that may cause the species to decline*

Clearing the site will not result in disease being introduced, therefore would not result in this outcome.

- *Interfere substantially with the recovery of the species*

The site provides limited habitat for Forest Red-tailed Black Cockatoos and those that may utilise the site have access to approximately 2651.6ha of Black Cockatoo habitat within 5km reserved in Bush Forever sites. Therefore clearing the site would not interfere substantially with the recovery of the species.

In accordance with the criteria set out in the Significant Impact Guidelines 1.1 the conclusion of this assessment is that residential development at Lots 5-8 Kerosene Lane in Baldivis would not have a significant impact on Forest Red-tailed Black Cockatoos.

4.6 Black Cockatoo Referral Guidelines

The EPBC Act referral guidelines for three threatened Black Cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris* Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii* Forest red-tailed Black Cockatoo (vulnerable) *Calyptorhynchus banksii naso* (SEWPaC, 2012) (Black Cockatoo Referral Guidelines) contain several steps to determine whether or not a referral is required.

These steps are:

1. The definition of habitat (breeding, roosting and foraging – Table 1 in the Black Cockatoo Referral Guidelines);

2. A description of the type of action that may have a high or low risk of being a significant impact and therefore require referral (Table 3 in the Black Cockatoo Referral Guidelines);
3. Formulation of a mitigation strategy to reduce the scale of impact; and
4. A flowchart to assist in decision making on whether or not an action should be referred.

Step 1 Black Cockatoo Habitat

As outlined previously there is approximately 5.43ha of Poor Value Foraging Habitat on the site with no evidence of foraging and also 98 trees that are considered to be potential breeding trees under the definition provided by the Department of the Environment. There is however no recorded breeding or roosting on the site or evidence of such.

Step 2 Level of Impact

Foraging

According to Table 3 in the Black Cockatoo Referral Guidelines the clearing of more than 1ha of quality foraging habitat has a high risk of causing a significant impact, quality referring specifically to Black Cockatoo use of the habitat. Degradation of more than 1ha of quality habitat by things such as altered hydrology or fire regimes has an uncertain risk. The significance of degradation depends on the type of degradation and the quality of the habitat.

The site contained approximately 5.43ha of only Poor Value Foraging Habitat for Black Cockatoos. Therefore clearing of the site will not lead to the loss of more than 1ha of quality foraging habitat and the risk of a significant impact on quality foraging habitat is considered to be low.

Roosting

The Black Cockatoo Referral Guidelines consider the clearing or degradation of a known roosting site as a high risk of being a significant impact. The site is not mapped as having a known Carnaby's Black Cockatoo roosting site by the Department of Planning mapping of January 2011, with the only close known roosting site occurring approximately 6km to the west. There were no roosting sites recorded during the Significant Tree Survey and the risk of a significant impact on a known roosting site is considered to be low.

Breeding

According to Table 3 in the Black Cockatoo Referral Guidelines the clearing of any known nesting tree has a high risk of being a significant impact. A known nesting tree is defined in the Black Cockatoo Referral Guidelines as any existing tree in which breeding has been recorded or suspected. There are no known nesting trees that occur on the site and therefore there is no risk of a significant impact on known breeding habitat of Black Cockatoos.

The Black Cockatoo Referral Guidelines also consider that the clearing of any part or degradation of breeding habitat is likely to have a high risk of a significant impact. In Table 1 of the Black Cockatoo Referral Guidelines breeding habitat is defined as woodlands, forests or isolated trees that contain or consist of live or dead trees of certain species with either a DBH of or greater than 500mm or the presence of suitable nest hollows.

The Black Cockatoo Referral Guidelines state that breeding habitat predominantly applies to those areas within the breeding range of the Black Cockatoo species as shown in the maps attached to the Black Cockatoo Referral Guidelines. The site is outside the breeding range of Carnaby's Black Cockatoos. The breeding range of Forest Red-tailed Black Cockatoos is not specified within the map attached to the Black Cockatoo Referral Guidelines, however the site is within the distribution range.

According to the Black Cockatoo Referral Guidelines, the definition of breeding habitat outside of the known breeding range still applies unless proven otherwise. A tree consists of breeding habitat if it is a suitable species, identified in Table 1 of the Black Cockatoo Referral Guidelines, and contains a hollow large enough for a Black Cockatoo to enter and form a nest or has a DBH of or greater than 500mm. The site contained nine Jarrah trees with a DBH of or greater than 500mm, none of which contained hollows suitable for Black Cockatoos; eight SDTs with a DBH of or greater than 500mm, one of which contained small hollows unsuitable for Black Cockatoos; and 81 Tuart trees with a DBH of or greater than 500mm of which three contained hollows and one contained a potential spout. Only two of these Tuart trees contained a potentially suitable hollow or spout.

According to Table 1 of the Black Cockatoo Referral Guidelines Jarrah is a species suitable for breeding by Carnaby's Black Cockatoos and Forest Red-tailed Black Cockatoos, while Tuarts are suitable for breeding by Carnaby's Black Cockatoos but not Forest Red-tailed Black Cockatoos. In accordance with the Black Cockatoo Referral Guidelines the risk of a significant impact on breeding habitat of Forest Red-tailed Black Cockatoos is considered to be high due to the nine Jarrah and eight SDTs on the site. The risk of a significant impact on breeding habitat of Carnaby's and Forest Red-tailed Black Cockatoos is considered to be low for the 96 trees that do not contain a hollow suitable for breeding. For the two trees with potentially suitable hollows for breeding, PGV Environmental undertook a follow-up survey in the breeding season (July-October) to look for evidence of the presence or absence of breeding activity in these trees. No evidence of breeding was observed. Therefore the risk of a significant impact on breeding habitat of Carnaby's and Forest Red-tailed Black Cockatoos is considered to be low.

Surrounding Habitat

According to the Black Cockatoo Referral Guidelines clearing of vegetation that results in a gap of greater than 4km between patches of Black Cockatoo habitat (foraging, roosting or breeding) has a high risk of having a significant impact. As listed in Table 5 there are three Bush Forever sites within 4km of the site that provide Black Cockatoo habitat. Therefore the risk of creating a gap of greater than 4km between areas of Black Cockatoo habitat is considered to be low.

Step 3 Mitigation

The consideration of a mitigation strategy during the determination of the level of impact and requirement to refer is allowed by the Black Cockatoo Referral Guidelines and setting in place the best practice mitigation strategy may reduce the level of impact and in turn the risk of a significant impact. Mitigation strategies include avoiding impact, managing impact so that there is no net decline in habitat and monitoring the effectiveness of mitigation.

This assessment is based on all 98 potential breeding trees being cleared. However, putting a mitigation strategy in place during the planning stage may reduce the level of impact on Black Cockatoos from clearing of the site.

Step 4 Referral Advice

The Decision Making flowchart in Figure 1 of the Black Cockatoo Referral Guidelines was applied to the site without consideration of mitigation strategies and is shown in sequence below:

- 1 Could the impacts of your action occur within the modelled distribution of the black cockatoos? – YES (Forest Red-tailed Black Cockatoos and Carnaby’s Black Cockatoos)
- 2 Could the impacts of your action affect any black cockatoo habitat or individuals? - YES
- 3 Have you surveyed for black cockatoo habitat using the recommended methods? – YES
- 4 Could your action have an impact on black cockatoos or their habitat? – YES
- 5 Is your impact mitigation best practice so that it may reduce the significance of your impacts on black cockatoos? Prioritise impact avoidance over impact minimisation - NO

RESULT – Referral Recommended: High risk of resulting in significant impact.

A mitigation strategy that retains some of the nine Jarrah and two trees with potentially suitable hollows will reduce the level of impact and although a referral is still recommended the offsets required may be reduced.

The proposed Subdivision Concept Plan (Appendix 6) indicates that three areas of POS will be located on the site, however it is not known whether the habitat trees located within these areas are proposed to be retained. Additionally not all of the Jarrahs and SDTs and neither of the two Tuarts with potential hollows (Tree Number 54 and 92) are located within these areas (Figure 3).

5 SUMMARY AND CONCLUSIONS

This Level 1 Fauna Survey and Targeted Search concludes that Lots 5-8 Kerosene Lane, Baldivis have the following fauna values:

- Lots 5 and 7 contain dwellings with remnant vegetation, while Lots 6 and 8 are vacant and consist of bushland;
- Tuarts (*Eucalyptus gomphocephala*) are the dominant trees on the site with some scattered Jarrahs (*Eucalyptus marginata*) and non-native trees and a small area of Parrot Bush (*Banksia sessilis*);
- The vegetation in the northern half of Lot 5 as well as the entire Lot 7 is in Completely Degraded Condition containing native and non-native trees over a cleared understorey as well as completely cleared areas. The southern half of Lot 5 and the majority of Lots 6 and 8 contain vegetation in Good Condition with these areas containing some understorey species, although there are still weed species present;
- The entire site consists of Disturbed Fauna Habitat due to the absence of an understorey over large sections, altered understorey over the remaining sections, limited connectivity and the presence of dogs which would deter native fauna;
- The biodiversity value of the site, from a fauna perspective, is considered to be low. Feral species such as cats, foxes and rabbits are also likely to be present particularly within Lots 6 and 8 where the pet dogs are not present;
- Six fauna species of conservation significance could possibly use the site as habitat:
 - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*)
 - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)
 - Forked-tailed Swift (*Apus pacificus*)
 - Rainbow Bee-eater (*Merops ornatus*)
 - Peregrine Falcon (*Falco peregrinus*)
 - Southern Brown Bandicoot (*Isodon obesulus fusciventer*)

Development of the site will not have a significant impact on the Forked-tailed Swift, Rainbow Bee-eater or Peregrine Falcon as they are either aerial or intermittent visitors that do not rely on the site for survival;

- Southern Brown Bandicoots are present on the site and a trapping and relocation program will be required prior to clearing;
- The results of the Targeted Search for Black Cockatoo habitat are summarised below:
 - The site contains approximately 5.43ha of foraging habitat which was classified as Poor Quality Foraging Habitat. No evidence of foraging was observed on the site. The risk of a significant impact on quality foraging habitat is considered to be low;
 - The site does not contain a known roosting site and no evidence of roosting was observed;
 - The site does not contain known breeding sites and no evidence of breeding was recorded on the site;
 - There were 98 potential breeding habitat trees (81 Tuarts, nine Jarrahs and eight Standing Dead Trees with a diameter of 500mm or greater) recorded on the site. Four of the trees contained hollows or spouts, however only two of the trees contained a

hollow or spout that were potentially large enough for breeding by Black Cockatoos (Tree Number 54 and 92) (Figure 3). No evidence of breeding was recorded in these trees during the breeding season;

- According to the Significant Impact Guidelines 1.1 development of the site would not lead to a significant impact on Black Cockatoos;
- According to the Black Cockatoo Referral Guidelines there is a low risk of development of the site resulting in a significant impact on Forest Red-tailed Black Cockatoos and Carnaby's Black Cockatoos;
- The surrounding Bush Forever sites provide a large amount of foraging and potential breeding habitat in close vicinity of the site and are likely to lower the impact that clearing of the site would have on Black Cockatoos;
- Referral to the Department of the Environment under the EPBC Act is recommended due to the impact on future potential breeding trees;
- Implementing avoidance and mitigation strategies such as retaining trees with large hollows and large Jarrah trees in POS and planting Tuart trees in the POS areas, would reduce the level of impact of clearing on Black Cockatoos and may mean the development would not need to be referred under the EPBC Act; and
- If the current concept plan for subdivision were to be referred under the EPBC Act PGV Environmental considers there would be a strong likelihood that the plan would not need to be fully assessed based on the results of EPBC Act Referrals involving impacts on Black Cockatoos in the last 2 years.

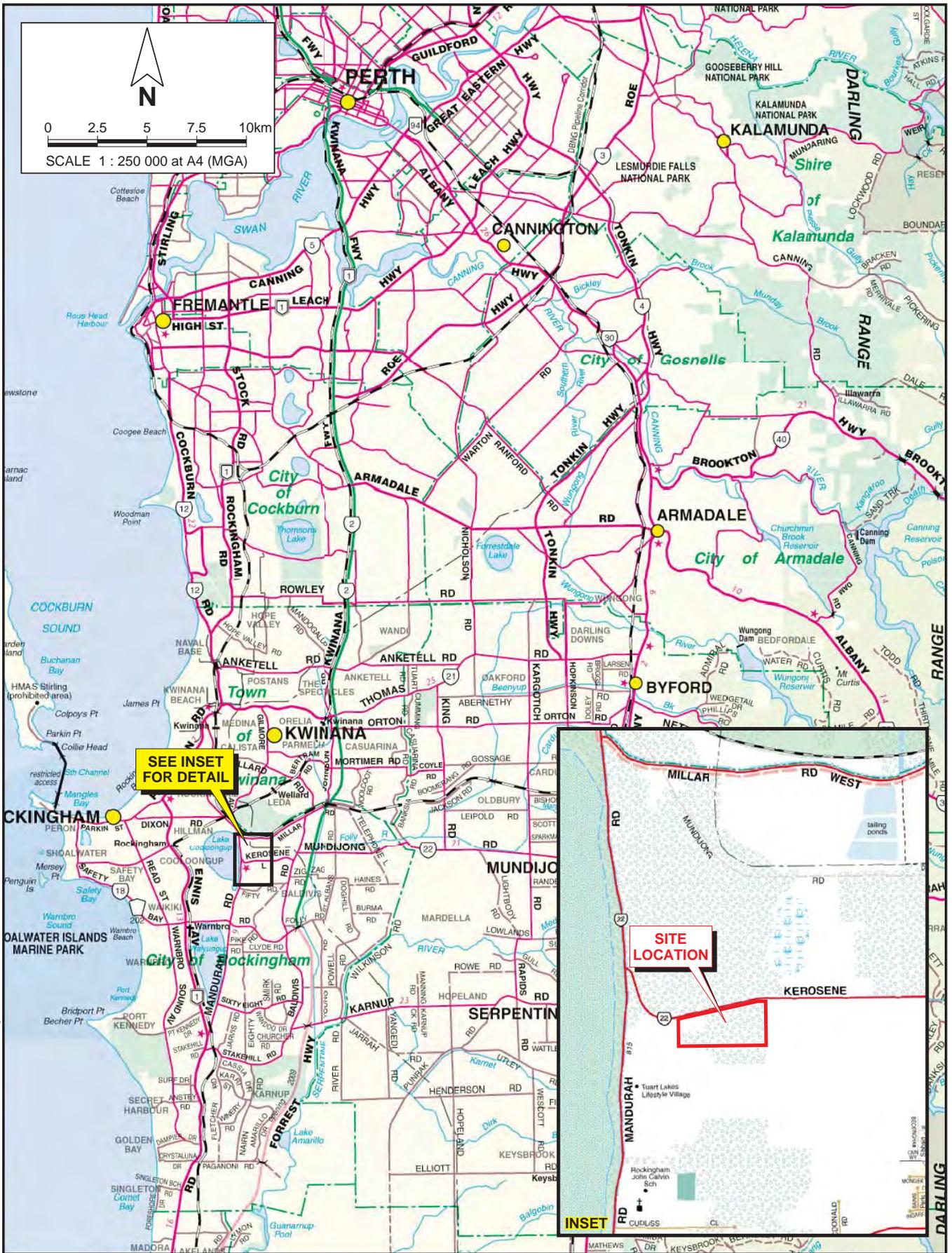
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FIGURES



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PINPOINT CARTOGRAPHICS (08) 9562 7136



Terranovis Pty Ltd
 LEVEL 1 FAUNA SURVEY AND TARGETED SEARCH
 LOTS 5-8 KEROSENE LANE, BALDIVIS

Drawn: J-M. Ward	Date: 17 Jul 2015
Job: 10224 Rpt: 2015-215	Revision: A

SITE LOCATION

Figure 1

- Legend**
- - - Site Boundary
 - - - Cadastral Boundary
 - - - Easement Boundary
 - - - Topographic Contour

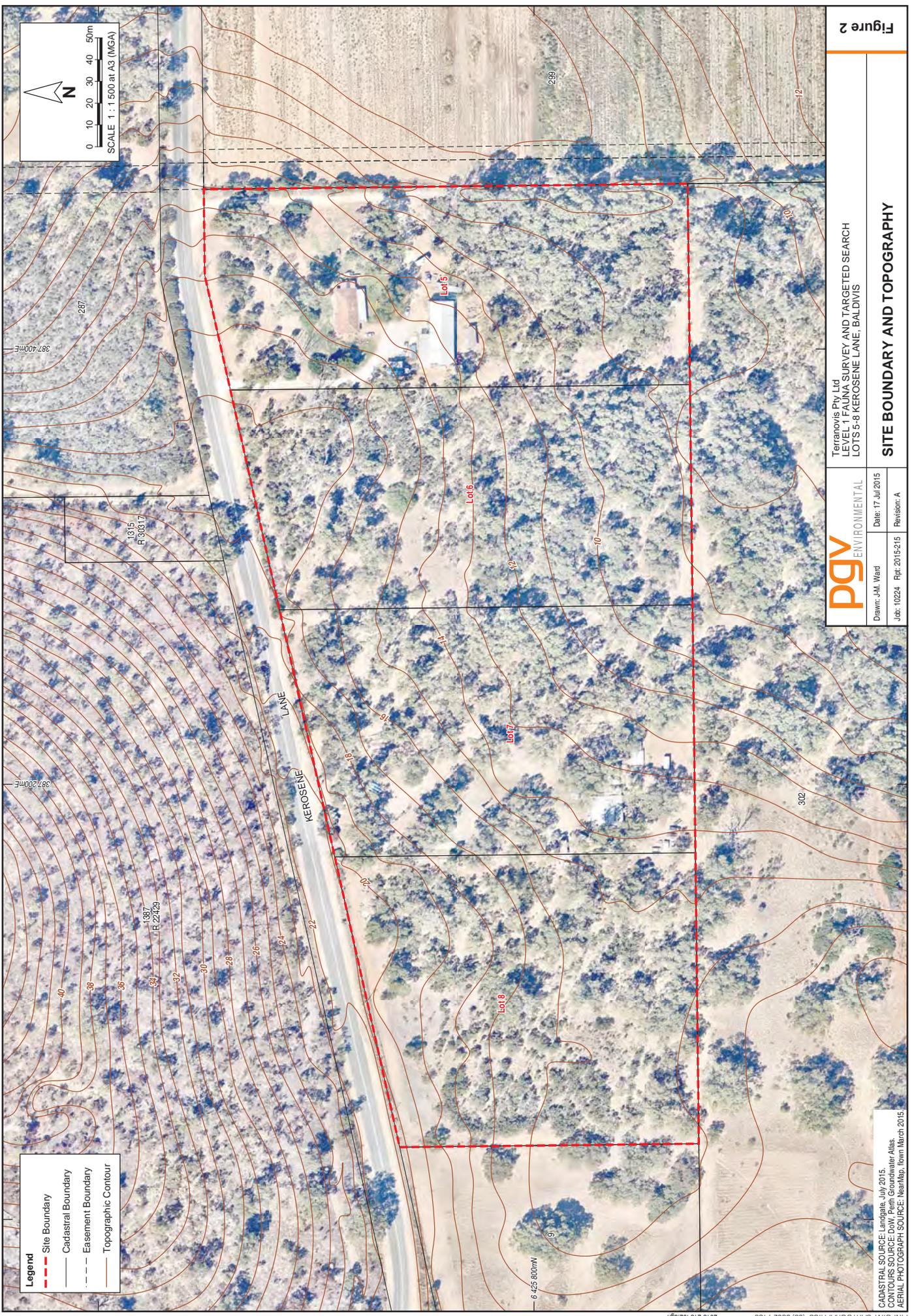
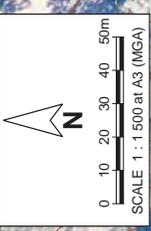


Figure 2

Terraviva Pty Ltd
LEVEL FAUNA SURVEY AND TARGETED SEARCH
LOTS 5-8 KEROSENE LANE, BALDIVIS

PGV ENVIRONMENTAL

Drawn: JM, Ward	Date: 17 Jul 2015
Job: 10224 Rpt: 2015-215	Revision: A

SITE BOUNDARY AND TOPOGRAPHY

CADASTRAL SOURCE: Landgate, July 2015.
 CONTOURS SOURCE: Dow, Perth Groundwater Atlas.
 AERIAL PHOTOGRAPH SOURCE: NearMap, flown March 2015.

Legend

- - - Site Boundary
- - - Cadastral Boundary
- - - Easement Boundary
- Black Cockatoo Foraging Habitat

Significant Trees

- Jarrah (*Eucalyptus marginata*)
- Tuart (*Eucalyptus gomphocephala*)
- Standing Dead Tree
- ✕ Tree Contains Hollow



PGV ENVIRONMENTAL

Terraviva Pty Ltd
 LEVEL 1 FAUNA SURVEY AND TARGETED SEARCH
 LOTS 5-8 KEROSENE LANE, BALDVIS

Drawn: J.M. Ward | Date: 20 Jul 2015
 Job: 10224 Rpt: 2015-215 | Revision: A

**BLACK COCKATOO FORAGING HABITAT
 AND SIGNIFICANT TREES**

CADASTRAL SOURCE: Landgate, July 2015.
 AERIAL PHOTOGRAPH SOURCE: NearMap, Down March 2015.

2015-215-103.dgn | 081 9562 7136 | P:\P\POINT CARTOGRAPHICS

Figure 3

APPENDIX 1

DPaW Threatened Fauna Database Search Results

Lots 5-8 Kerosene Lane, Baldivis
DPaW Fauna Search Results

NAME	FAMILY	GENUS	SPECIES	INFRANAM E	VERNACULAR	KINGDOM	CONSV _CODE	CLASS	LOCALITY
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	COOLOONGUP
Merops ornatus	Meropidae	Merops	ornatus		Rainbow Bee-eater	Animalia	IA	BIRD	COOLOONGUP
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis		Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta		Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis		Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta		Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis		Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta		Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis		Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Calidris ruficollis	Scolopacidae	Calidris	ruficollis		Red-necked Stint	Animalia	IA	BIRD	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis		Red-necked Stint	Animalia	IA	BIRD	COOLOONGUP
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	WARNBRO
Calidris ruficollis	Scolopacidae	Calidris	ruficollis		Red-necked Stint	Animalia	IA	BIRD	WARNBRO
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	WAIKIKI
Calidris ruficollis	Scolopacidae	Calidris	ruficollis		Red-necked Stint	Animalia	IA	BIRD	WAIKIKI
Ardea modesta	Ardeidae	Ardea	modesta		Eastern Great Egret	Animalia	IA	BIRD	WAIKIKI
Oxyura australis	Anatidae	Oxyura	australis		Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta		Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis		Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris		Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo	Animalia	T	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis		Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta		Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia		Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta		Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS

Lots 5-8 Kerosene Lane, Baldivis
DPaW Fauna Search Results

Merops ornatus	Meropidae	Merops	ornatus	Rainbow Bee-eater	Animalia	IA	BIRD	WELLARD
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	COOLOONGUP
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	Curlew Sandpiper	Animalia	T	BIRD	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	COOLOONGUP
Calidris acuminata	Scolopacidae	Calidris	acuminata	Sharp-tailed Sandpiper	Animalia	IA	BIRD	COOLOONGUP
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	COOLOONGUP
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	Curlew Sandpiper	Animalia	T	BIRD	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	COOLOONGUP
Calidris acuminata	Scolopacidae	Calidris	acuminata	Sharp-tailed Sandpiper	Animalia	IA	BIRD	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	WAIKIKI
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Haliaeetus leucogaster	Accipitridae	Haliaeetus	leucogaster	White-bellied Sea-Eagle	Animalia	IA	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Merops ornatus	Meropidae	Merops	ornatus	Rainbow Bee-eater	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	BALDIVIS
Calidris acuminata	Scolopacidae	Calidris	acuminata	Sharp-tailed Sandpiper	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	WARNBRO
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	WARNBRO
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS

Lots 5-8 Kerosene Lane, Baldvis
DPaW Fauna Search Results

Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea ibis	Ardeidae	Ardea	ibis	Cattle Egret	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Actitis hypoleucos	Scolopacidae	Actitis	hypoleucos	Common Sandpiper	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Actitis hypoleucos	Scolopacidae	Actitis	hypoleucos	Common Sandpiper	Animalia	IA	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Tringa glareola	Scolopacidae	Tringa	glareola	Wood Sandpiper	Animalia	IA	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea ibis	Ardeidae	Ardea	ibis	Cattle Egret	Animalia	IA	BIRD	BALDIVIS
Tringa glareola	Scolopacidae	Tringa	glareola	Wood Sandpiper	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo	Animalia	T	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo	Animalia	T	BIRD	BALDIVIS

Lots 5-8 Kerosene Lane, Baldivis
DPaW Fauna Search Results

Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	BALDIVIS
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	BALDIVIS
Calidris acuminata	Scolopacidae	Calidris	acuminata	Sharp-tailed Sandpiper	Animalia	IA	BIRD	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo	Animalia	T	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo	Animalia	T	BIRD	BALDIVIS
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	COOLOONGUP
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	Curlew Sandpiper	Animalia	T	BIRD	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	COOLOONGUP
Calidris acuminata	Scolopacidae	Calidris	acuminata	Sharp-tailed Sandpiper	Animalia	IA	BIRD	COOLOONGUP
Merops ornatus	Meropidae	Merops	ornatus	Rainbow Bee-eater	Animalia	IA	BIRD	COOLOONGUP
Tringa nebularia	Scolopacidae	Tringa	nebularia	Common Greenshank	Animalia	IA	BIRD	COOLOONGUP
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	Curlew Sandpiper	Animalia	T	BIRD	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	BIRD	COOLOONGUP
Calidris acuminata	Scolopacidae	Calidris	acuminata	Sharp-tailed Sandpiper	Animalia	IA	BIRD	COOLOONGUP
Falco peregrinus	Falconidae	Falco	peregrinus	Peregrine Falcon	Animalia	S	BIRD	BALDIVIS
Merops ornatus	Meropidae	Merops	ornatus	Rainbow Bee-eater	Animalia	IA	BIRD	BALDIVIS
Apus pacificus	Apodidae	Apus	pacificus	Fork-tailed Swift	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Haliaeetus leucogaster	Accipitridae	Haliaeetus	leucogaster	White-bellied Sea-Eagle	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Actitis hypoleucos	Scolopacidae	Actitis	hypoleucos	Common Sandpiper	Animalia	IA	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS
Ardea modesta	Ardeidae	Ardea	modesta	Eastern Great Egret	Animalia	IA	BIRD	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo	Animalia	T	BIRD	BALDIVIS
Oxyura australis	Anatidae	Oxyura	australis	Blue-billed Duck	Animalia	4	BIRD	BALDIVIS

Lots 5-8 Kerosene Lane, Baldivis
DPaW Fauna Search Results

Numenius madagascariensis	Scolopacidae	Numenius	madagasca riensis	Eastern Curlew	Animalia	IA	Birds	COOLOONGUP
Ixobrychus minutus	Ardeidae	Ixobrychus	minutus	Little Bittern	Animalia	P4	Birds	COOLOONGUP
Isoodon obesulus fusciventer	Peramelidae	Isoodon	obesulus	Quenda	Animalia	P5	Mammals	COOLOONGUP
Isoodon obesulus fusciventer	Peramelidae	Isoodon	obesulus	Quenda	Animalia	P5	Mammals	LEDA
Numenius madagascariensis	Scolopacidae	Numenius	madagasca riensis	Eastern Curlew	Animalia	T	Birds	BALDIVIS
Numenius madagascariensis	Scolopacidae	Numenius	madagasca riensis	Eastern Curlew	Animalia	IA	Birds	BALDIVIS
Neelaps calonotos	Elapidae	Neelaps	calonotos	Black-striped Snake	Animalia	P3	Reptiles	COOLOONGUP
Calyptorhynchus banksii naso	Psittacidae	Calyptorhynchus	banksii	Forest Red-tailed Black Cockatoo	Animalia	T	Birds	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	BALDIVIS
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	Curlew Sandpiper	Animalia	T	Birds	COOLOONGUP
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	Curlew Sandpiper	Animalia	IA	Birds	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	Red-necked Stint	Animalia	IA	Birds	COOLOONGUP
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	LEDA
Calyptorhynchus banksii naso	Psittacidae	Calyptorhynchus	banksii	Forest Red-tailed Black Cockatoo	Animalia	T	Birds	BALDIVIS
Calyptorhynchus banksii naso	Psittacidae	Calyptorhynchus	banksii	Forest Red-tailed Black Cockatoo	Animalia	T	Birds	BALDIVIS
Isoodon obesulus fusciventer	Peramelidae	Isoodon	obesulus	Quenda	Animalia	P5	Mammals	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	WELLARD
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	WELLARD
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	WELLARD
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	HILLMAN
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	HILLMAN
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	HILLMAN
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	HILLMAN
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	WELLARD
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	Carnaby's Cockatoo	Animalia	T	Birds	WELLARD

Lots 5-8 Kerosene Lane, Baldivis
DPaW Fauna Search Results

Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	BALDIVIS
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	fusciventer	Curlew Sandpiper	Animalia	T	BIRD	COOLOONGUP
Calidris ferruginea	Scolopacidae	Calidris	ferruginea	fusciventer	Curlew Sandpiper	Animalia	T	BIRD	COOLOONGUP
Calidris ruficollis	Scolopacidae	Calidris	ruficollis	fusciventer	Red-necked Stint	Animalia	IA	BIRD	COOLOONGUP
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	BALDIVIS
Calyptorhynchus latirostris	Psittacidae	Calyptorhynchus	latirostris	fusciventer	Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo	Animalia	T	BIRD	BALDIVIS
Isodon obesulus fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda	Animalia	P5	Mammals	WELLARD
Isodon obesulus subsp. fusciventer	Peramelidae	Isodon	obesulus	fusciventer	Quenda, Southern Brown Bandicoot	Animalia	5	MAMMAL	LEDA
Neelaps calonotos	Elapidae	Neelaps	calonotos		Black-striped Snake	Animalia	3	REPTILE	COOLOONGUP

APPENDIX 2

Protected Matters Search Tool Results



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: 16/07/15 13:24:09

[Summary](#)

[Details](#)

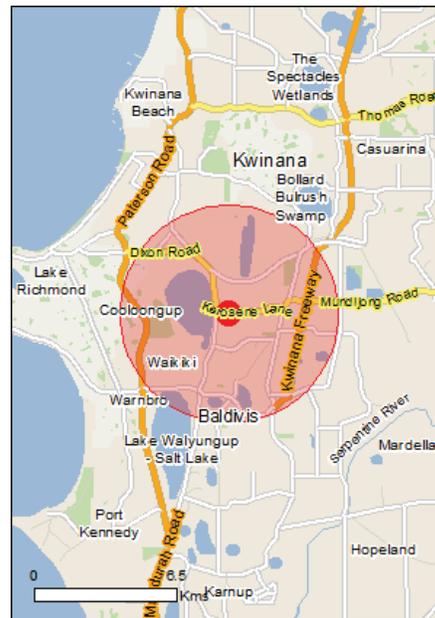
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

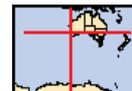
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Buffer: 5.0Km



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:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	21
Listed Migratory Species:	19

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/index.html>

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:	25
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:	2
Regional Forest Agreements:	None
Invasive Species:	36
Nationally Important Wetlands:	None
Key Ecological Features (Marine):	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Becher point wetlands	Within 10km of Ramsar
Peel-yalgorup system	Upstream from Ramsar

Listed Threatened Ecological Communities	[Resource Information]
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.	

Name	Status	Type of Presence
Sedgeland in Holocene dune swales of the southern Swan Coastal Plain	Endangered	Community known to occur within area

Listed Threatened Species	[Resource Information]
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Name	Status	Type of Presence
------	--------	------------------

Birds

Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
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Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
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Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat may occur within area
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Calyptorhynchus baudinii Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Species or species habitat likely to occur within area
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Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
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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
--	------------	--

Mammals

Bettongia penicillata ogilbyi Woylie [66844]	Endangered	Species or species habitat may occur within area
---	------------	--

Dasyurus geoffroi Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
--	------------	--

Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir [25911]	Vulnerable	Species or species habitat likely to occur
--	------------	--

Name	Status	Type of Presence within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa [6393]	Endangered	Species or species habitat likely to occur within area
Darwinia foetida Mucheia 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 may occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat likely to occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to 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
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat known to occur

Name	Threatened	Type of Presence
Ardea ibis Cattle Egret [59542]		within area 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 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 lapponica Bar-tailed Godwit [844]		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 cristatus Eastern Osprey [82411]		Species or species habitat likely 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 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]		Species or species habitat 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 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 lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
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
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely 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
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		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
Leda	WA
Unnamed WA51658	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 Resources Audit, 2001.

Name	Status	Type of Presence
Birds		

Name	Status	Type of Presence
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
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

Name	Status	Type of Presence
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		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 within area
Genista linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		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
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		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

Name

Status

Type of Presence

habitat likely to occur within
area

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

-32.29865 115.8027

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:

- [Department of Environment, Climate Change and Water, New South Wales](#)
- [Department of Sustainability and Environment, Victoria](#)
- [Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [Department of Environment and Natural Resources, South Australia](#)
- [Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts](#)
- [Environmental and Resource Management, Queensland](#)
- [Department of Environment and Conservation, Western Australia](#)
- [Department of the Environment, Climate Change, Energy and Water](#)
- [Birds Australia](#)
- [Australian Bird and Bat Banding Scheme](#)
- [Australian National Wildlife Collection](#)
- Natural history museums of Australia
- [Museum Victoria](#)
- [Australian Museum](#)
- [SA 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](#)
- [State Forests of 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.

APPENDIX 3

Naturemap Database Search Results

NatureMap Species Report

Created By Jeanne-Marie Ward on 16/07/2015

Current Names Only Yes
 Core Datasets Only Yes
 Method 'By Circle'
 Centre 115°48' 08" E,32°17' 56" S
 Buffer 5km
 Group By Kingdom

Kingdom	Species	Records
Animalia	204	3915
Chromista	1	2
Plantae	256	482
Protozoa	1	1
TOTAL	462	4400

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill, Inland Thornbill)			
2.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
3.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
4.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
5.	25535 <i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)			
6.	24281 <i>Accipiter cirrocephalus</i> subsp. <i>cirrocephalus</i> (Collared Sparrowhawk)			
7.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
8.	24282 <i>Accipiter fasciatus</i> subsp. <i>fasciatus</i> (Brown Goshawk)			
9.	25755 <i>Acrocephalus australis</i> (Australian Reed Warbler)			
10.	41323 <i>Actitis hypoleucos</i> (Common Sandpiper)		IA	
11.	<i>Allotrochosina karri</i>			
12.	<i>Aname mainae</i>			
13.	<i>Aname tepperi</i>			
14.	24312 <i>Anas gracilis</i> (Grey Teal)			
15.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
16.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
17.	25553 <i>Anhinga melanogaster</i> (Darter)			
18.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
19.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
20.	25554 <i>Apus pacificus</i> (Fork-tailed Swift)		IA	
21.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
22.	25558 <i>Ardea ibis</i> (Cattle Egret)		IA	
23.	41324 <i>Ardea modesta</i> (Eastern Great Egret)		IA	
24.	24340 <i>Ardea novaehollandiae</i> (White-faced Heron)			
25.	24341 <i>Ardea pacifica</i> (White-necked Heron)			
26.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
27.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
28.	24318 <i>Aythya australis</i> (Hardhead)			
29.	<i>Backobourkia brounii</i>			
30.	24319 <i>Biziura lobata</i> (Musk Duck)			
31.	42381 <i>Brachyurophis semifasciatus</i> (Southern Shovel-nosed Snake)			
32.	24359 <i>Burhinus grallarius</i> (Bush Stone-curlew)			
33.	25715 <i>Cacatua roseicapilla</i> (Galah)			
34.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
35.	24729 <i>Cacatua tenuirostris</i> (Eastern Long-billed Corella)	Y		
36.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
37.	42307 <i>Cacomantis pallidus</i> (Pallid Cuckoo)			
38.	24779 <i>Calidris acuminata</i> (Sharp-tailed Sandpiper)		IA	
39.	24784 <i>Calidris ferruginea</i> (Curlew Sandpiper)		T	
40.	24788 <i>Calidris ruficollis</i> (Red-necked Stint)		IA	
41.	24789 <i>Calidris subminuta</i> (Long-toed Stint)		IA	
42.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
43.	24731 <i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black-Cockatoo)		T	

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
44.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo), Carnaby's Cockatoo)		T	
45.	24186 <i>Chalinolobus gouldii</i> (Gould's Wattled Bat)			
46.	24373 <i>Charadrius melanops</i> (Black-fronted Dotterel)			
47.	24376 <i>Charadrius rubricollis</i> (Hooded Plover)		P4	
48.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
49.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
50.	24980 <i>Christinus marmoratus</i> (Marbled Gecko)			
51.	24431 <i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)			
52.	24833 <i>Cincloramphus cruralis</i> (Brown Songlark)			
53.	24288 <i>Circus approximans</i> (Swamp Harrier)			
54.	24774 <i>Cladorhynchus leucocephalus</i> (Banded Stilt)			
55.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
56.	24399 <i>Columba livia</i> (Domestic Pigeon)	Y		
57.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
58.	25592 <i>Corvus coronoides</i> (Australian Raven)			
59.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
60.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
61.	24422 <i>Cracticus tibicen subsp. dorsalis</i> (White-backed Magpie)			
62.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
63.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
64.	25400 <i>Crinia insignifera</i> (Squelching Froglet)			
65.	30893 <i>Cryptoblepharus buchananii</i>			
66.	25020 <i>Cryptoblepharus plagiocephalus</i>			
67.	25027 <i>Ctenotus australis</i>			
68.	25039 <i>Ctenotus fallens</i>			
69.	24322 <i>Cygnus atratus</i> (Black Swan)			
70.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)	Y		
71.	30902 <i>Dacelo novaeguineae subsp. novaeguineae</i> (Laughing Kookaburra)	Y		
72.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
73.	<i>Dingosa serrata</i>			
74.	24567 <i>Ephianura albifrons</i> (White-fronted Chat)			
75.	24379 <i>Erythronyctes cinctus</i> (Red-kneed Dotterel)			
76.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
77.	24472 <i>Falco cenchroides subsp. cenchroides</i> (Australian Kestrel)			
78.	25623 <i>Falco longipennis</i> (Australian Hobby)			
79.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)		S	
80.	24041 <i>Felis catus</i> (Cat)	Y		
81.	25727 <i>Fulica atra</i> (Eurasian Coot)			
82.	24761 <i>Fulica atra subsp. australis</i> (Eurasian Coot)			
83.	25729 <i>Gallinula tenebrosa</i> (Dusky Moorhen)			
84.	24763 <i>Gallinula tenebrosa subsp. tenebrosa</i> (Dusky Moorhen)			
85.	24764 <i>Gallinula ventralis</i> (Black-tailed Native-hen)			
86.	25730 <i>Gallirallus philippensis</i> (Buff-banded Rail)			
87.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
88.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
89.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)		IA	
90.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
91.	25410 <i>Heleioporus eyrei</i> (Moaning Frog)			
92.	25119 <i>Hemiergis quadrilineata</i>			
93.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
94.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
95.	<i>Holconia westralia</i>			
96.	43384 <i>Hydrophis platurus</i> (Yellow-bellied Seasnake)			
97.	<i>Idiommata blackwalli</i>			
98.	25478 <i>Isodon obesulus</i> (Southern Brown Bandicoot)		P5	
99.	24153 <i>Isodon obesulus subsp. fusciventer</i> (Quenda, Southern Brown Bandicoot)		P5	
100.	25563 <i>Ixobrychus minutus</i> (Little Bittern)		P4	
101.	<i>Lampona cylindrata</i>			
102.	24511 <i>Larus novaehollandiae subsp. novaehollandiae</i> (Silver Gull)			
103.	25133 <i>Lerista elegans</i>			
104.	25005 <i>Lialis burtonis</i>			
105.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
106.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
107.	25741 <i>Limosa limosa</i> (Black-tailed Godwit)		IA	
108.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
109.	25388 <i>Litoria moorei</i> (Motorbike Frog)			
110.	24690 <i>Macronectes giganteus</i> (Southern Giant Petrel)			
111.	24132 <i>Macropus fuliginosus</i> (Western Grey Kangaroo)			
112.	24133 <i>Macropus irma</i> (Western Brush Wallaby)		P4	

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
113.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
114.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
115.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
116.	25758 <i>Megalurus gramineus</i> (Little Grassbird)			
117.	25184 <i>Menetia greyii</i>			
118.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	
119.	25191 <i>Morethia lineocellata</i>			
120.	25192 <i>Morethia obscura</i>			
121.	25193 <i>Morethia ruficauda</i> subsp. <i>exquisita</i>			
122.	25194 <i>Morethia ruficauda</i> subsp. <i>ruficauda</i>			
123.	24184 <i>Mormopterus planiceps</i> (Southern Freetail-bat)			
124.	24223 <i>Mus musculus</i> (House Mouse)	Y		
125.	25249 <i>Neelaps calonotos</i> (Black-striped Snake)		P3	
126.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
127.	25748 <i>Ninox novaeseelandiae</i> (Boobook Owl)			
128.	25252 <i>Notechis scutatus</i> (Tiger Snake)			
129.	25198 <i>Notoscincus ornatus</i> subsp. <i>wotjulum</i>			
130.	24798 <i>Numenius madagascariensis</i> (Eastern Curlew)		T	
131.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
132.	24194 <i>Nyctophilus geoffroyi</i> (Lesser Long-eared Bat)			
133.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
134.	24085 <i>Oryctolagus cuniculus</i> (Rabbit)	Y		
135.	24328 <i>Oxyura australis</i> (Blue-billed Duck)		P4	
136.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
137.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
138.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
139.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
140.	24630 <i>Pardalotus striatus</i> subsp. <i>westraliensis</i> (Striated Pardalote)			
141.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
142.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
143.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
144.	25698 <i>Phalacrocorax melanoleucos</i> (Little Pied Cormorant)			
145.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
146.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
147.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
148.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
149.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
150.	24842 <i>Platalea regia</i> (Royal Spoonbill)			
151.	25721 <i>Platycercus zonarius</i> (Australian Ringneck, Ring-necked Parrot)			
152.	24750 <i>Platycercus zonarius</i> subsp. <i>semitorquatus</i> (Twenty-eight Parrot)			
153.	24843 <i>Plegadis falcinellus</i> (Glossy Ibis)		IA	
154.	24679 <i>Podargus strigoides</i> subsp. <i>brachypterus</i> (Tawny Frogmouth)			
155.	25704 <i>Podiceps cristatus</i> (Great Crested Grebe)			
156.	24681 <i>Poliocephalus poliocephalus</i> (Hoary-headed Grebe)			
157.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
158.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
159.	24767 <i>Porphyrio porphyrio</i> subsp. <i>bellus</i> (Purple Swamphen)			
160.	25732 <i>Porzana pusilla</i> (Baillon's Crake)			
161.	24771 <i>Porzana tabuensis</i> (Spotless Crake)			
162.	25199 <i>Proablepharus reginae</i>			
163.	25200 <i>Proablepharus tenuis</i>			
164.	25511 <i>Pseudonaja affinis</i> (Dugite)			
165.	25259 <i>Pseudonaja affinis</i> subsp. <i>affinis</i> (Dugite)			
166.	42340 <i>Ptilotula ornatus</i> (Yellow-plumed Honeyeater)			
167.	24245 <i>Rattus rattus</i> (Black Rat)	Y		
168.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
169.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
170.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
171.	<i>Servaea spinibarbis</i>			
172.	25266 <i>Simoselaps bertholdi</i> (Jan's Banded Snake)			
173.	30948 <i>Smicromis brevirostris</i> (Weebill)			
174.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
175.	25589 <i>Streptopelia chinensis</i> (Spotted Turtle-Dove)	Y		
176.	30951 <i>Streptopelia chinensis</i> subsp. <i>tigrina</i> (Spotted Turtle-Dove)	Y		
177.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)	Y		
178.	24942 <i>Strophurus spinigerus</i> subsp. <i>spinigerus</i>			
179.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
180.	24682 <i>Tachybaptus novaehollandiae</i> subsp. <i>novaehollandiae</i> (Australasian Grebe, Black-throated Grebe)			
181.	24185 <i>Tadarida australis</i> (White-striped Freetail-bat)			

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182.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck, Mountain Duck)			
183.	<i>Tetragnatha demissa</i>			
184.	24844 <i>Threskiornis molucca</i> (Australian White Ibis)			
185.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
186.	25202 <i>Tiliqua multifasciata</i> (Central Blue-tongue)			
187.	25203 <i>Tiliqua occipitalis</i> (Western Bluetongue)			
188.	25519 <i>Tiliqua rugosa</i>			
189.	25204 <i>Tiliqua rugosa</i> subsp. <i>aspera</i>			
190.	25205 <i>Tiliqua rugosa</i> subsp. <i>konowi</i> (Bobtail Lizard (Rottnest Is.), Shingleback)		T	
191.	25206 <i>Tiliqua rugosa</i> subsp. <i>palarra</i>			
192.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
193.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
194.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
195.	25521 <i>Trichosurus vulpecula</i> (Common Brushtail Possum)			
196.	24158 <i>Trichosurus vulpecula</i> subsp. <i>vulpecula</i> (Common Brushtail Possum)			
197.	24806 <i>Tringa glareola</i> (Wood Sandpiper)		IA	
198.	24808 <i>Tringa nebularia</i> (Common Greenshank)		IA	
199.	24849 <i>Turnix varia</i> subsp. <i>varia</i> (Painted Button-quail)			
200.	24852 <i>Tyto alba</i> subsp. <i>delicatula</i> (Barn Owl)			
201.	24386 <i>Vanellus tricolor</i> (Banded Lapwing)			
202.	25227 <i>Varanus tristis</i> subsp. <i>tristis</i> (Racehorse Monitor)			
203.	24206 <i>Vespadelus regulus</i> (Southern Forest Bat)			
204.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye, Silvereye)			

Chromista

205.	<i>Phytophthora cinnamomi</i>			
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Plantae

206.	3409 <i>Acacia lasiocarpa</i> (Panjang)			
207.	15482 <i>Acacia pulchella</i> var. <i>goadbyi</i>			
208.	3525 <i>Acacia rostellifera</i> (Summer-scented Wattle)			
209.	3527 <i>Acacia saligna</i> (Orange Wattle, Kudjong)			
210.	30032 <i>Acacia saligna</i> subsp. <i>saligna</i>			
211.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
212.	1208 <i>Acanthocarpus preissii</i>			
213.	4582 <i>Adriana quadripartita</i> (Bitter Bush)			
214.	184 <i>Aira caryophyllea</i> (Silvery Hairgrass)	Y		
215.	1728 <i>Allocasuarina fraseriana</i> (Sheoak, Kondli)			
216.	6565 <i>Alyxia buxifolia</i> (Dysentery Bush)			
217.	6211 <i>Apium prostratum</i> (Sea Celery)			
218.	12040 <i>Apium prostratum</i> var. <i>prostratum</i> (Sea Celery)			
219.	226 <i>Arundo donax</i> (Giant Reed)	Y		
220.	7851 <i>Asteridea pulverulenta</i> (Common Bristle Daisy)			
221.	17234 <i>Austrostipa compressa</i>			
222.	17240 <i>Austrostipa flavescens</i>			
223.	231 <i>Avellinia michelii</i>	Y		
224.	234 <i>Avena fatua</i> (Wild Oat)	Y		
225.	1800 <i>Banksia attenuata</i> (Slender Banksia, Piara)			
226.	1819 <i>Banksia grandis</i> (Bull Banksia, Pulgarla)			
227.	1830 <i>Banksia littoralis</i> (Swamp Banksia, Pungura)			
228.	1834 <i>Banksia menziesii</i> (Firewood Banksia)			
229.	32077 <i>Banksia sessilis</i> var. <i>cygnorum</i>			
230.	32080 <i>Banksia sessilis</i> var. <i>sessilis</i>			
231.	15037 <i>Bartsia trixago</i>	Y		
232.	740 <i>Baumea arthropophylla</i>			
233.	743 <i>Baumea juncea</i> (Bare Twigrush)			
234.	748 <i>Baumea vaginalis</i> (Sheath Twigrush)			
235.	749 <i>Bolboschoenus caldwellii</i> (Marsh Club-rush)			
236.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
237.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
238.	245 <i>Briza minor</i> (Shivery Grass)	Y		
239.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
240.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
241.	1276 <i>Caesia micrantha</i> (Pale Grass Lily)			
242.	1599 <i>Caladenia latifolia</i> (Pink Fairy Orchid)			
243.	2846 <i>Calandrinia calyptata</i> (Pink Purslane)			
244.	2854 <i>Calandrinia granulifera</i> (Pygmy Purslane)			
245.	2856 <i>Calandrinia liniflora</i> (Parakeelya)			
246.	96 <i>Callitris preissii</i> (Rottnest Island Pine, Maro)			
247.	5415 <i>Calothamnus lateralis</i>			
248.	35816 <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>			

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249.	2957 <i>Cassytha racemosa</i> (Dodder Laurel)			
250.	6539 <i>Centaurium erythraea</i> (Common Centaury)	Y		
251.	6542 <i>Centaurium tenuiflorum</i>	Y		
252.	6214 <i>Centella asiatica</i>			
253.	1125 <i>Centrolepis drummondiana</i>			
254.	2889 <i>Cerastium glomeratum</i> (Mouse Ear Chickweed)	Y		
255.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
256.	7937 <i>Cirsium vulgare</i> (Spear Thistle)	Y		
257.	10804 <i>Clematis linearifolia</i>			
258.	4552 <i>Comesperma confertum</i>			
259.	4555 <i>Comesperma integerrimum</i>			
260.	4564 <i>Comesperma virgatum</i> (Milkwort)			
261.	6217 <i>Conium maculatum</i> (Hemlock)	Y		
262.	1885 <i>Conospermum triplinervium</i> (Tree Smokebush)			
263.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
264.	1418 <i>Conostylis aculeata</i> (Prickly Conostylis)			
265.	11438 <i>Conostylis candicans</i> subsp. <i>candicans</i>			
266.	1436 <i>Conostylis juncea</i>			
267.	20074 <i>Conyza sumatrensis</i>	Y		
268.	3137 <i>Crassula colorata</i> (Dense Stonecrop)			
269.	3140 <i>Crassula glomerata</i>	Y		
270.	6663 <i>Cuscuta epithymum</i> (Lesser Dodder, Greater Dodder)	Y		
271.	283 <i>Cynodon dactylon</i> (Couch)	Y		
272.	285 <i>Cynosurus echinatus</i> (Rough Dogstail)	Y		
273.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
274.	1218 <i>Dasyopogon bromeliifolius</i> (Pineapple Bush)			
275.	3845 <i>Daviesia triflora</i>			
276.	1259 <i>Dianella revoluta</i> (Blueberry Lily)			
277.	11636 <i>Dianella revoluta</i> var. <i>divaricata</i>			
278.	1287 <i>Dichopogon capillipes</i>			
279.	7054 <i>Dischisma arenarium</i>	Y		
280.	12939 <i>Diuris magnifica</i>			
281.	4763 <i>Dodonaea hackettiana</i> (Hackett's Hopbush)		P4	
282.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
283.	3106 <i>Drosera macrantha</i> (Bridal Rainbow)			
284.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
285.	3131 <i>Drosera stolonifera</i> (Leafy Sundew)			
286.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
287.	349 <i>Ehrharta longiflora</i> (Annual Veldt Grass)	Y		
288.	6131 <i>Epilobium billardioreanum</i> (Glabrous Willow Herb)			
289.	17175 <i>Eremophila glabra</i> subsp. <i>albicans</i>			
290.	15446 <i>Eryngium pinnatifidum</i> subsp. <i>pinnatifidum</i>			
291.	5649 <i>Eucalyptus foecunda</i> (Narrow-leaved Red Mallee)			
292.	5659 <i>Eucalyptus gomphocephala</i> (Tuart, Duart)			
293.	5708 <i>Eucalyptus marginata</i> (Jarrah, Djara)			
294.	5763 <i>Eucalyptus rudis</i> (Flooded Gum, Kulurda)			
295.	4648 <i>Euphorbia terracina</i> (Geraldton Carnation Weed)	Y		
296.	10765 <i>Exocarpos sparteus</i> (Broom Ballart, Djuk)			
297.	907 <i>Gahnia trifida</i> (Coast Saw-sedge)			
298.	7323 <i>Galium murale</i> (Small Goosegrass)	Y		
299.	4339 <i>Geranium molle</i> (Dove's Foot Cranesbill)	Y		
300.	1520 <i>Gladiolus caryophyllaceus</i> (Wild Gladiolus)	Y		
301.	6587 <i>Gomphocarpus fruticosus</i> (Narrowleaf Cottonbush)	Y		
302.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
303.	2119 <i>Grevillea vestita</i>			
304.	12824 <i>Grevillea vestita</i> subsp. <i>vestita</i>			
305.	2175 <i>Hakea lissocarpa</i> (Honey Bush)			
306.	2197 <i>Hakea prostrata</i> (Harsh Hakea)			
307.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
308.	3016 <i>Heliophila pusilla</i>	Y		
309.	6839 <i>Hemiandra pungens</i> (Snakebush)			
310.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
311.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
312.	6222 <i>Homalosciadium homalocarpum</i>			
313.	12859 <i>Hovea trisperma</i> var. <i>trisperma</i>			
314.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
315.	5218 <i>Hybanthus debilissimus</i>			
316.	6224 <i>Hydrocotyle blepharocarpa</i>			
317.	6229 <i>Hydrocotyle diantha</i>			
318.	6232 <i>Hydrocotyle hispidula</i>			

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319.	5825 <i>Hypocalymma robustum</i> (Swan River Myrtle)			
320.	8086 <i>Hypochaeris glabra</i> (Smooth Catsear)	Y		
321.	910 <i>Isolepis cernua</i> (Nodding Club-rush)			
322.	20199 <i>Isolepis cernua</i> var. <i>cernua</i>			
323.	20200 <i>Isolepis cernua</i> var. <i>setiformis</i>			
324.	917 <i>Isolepis marginata</i> (Coarse Club-rush)			
325.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
326.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			
327.	8092 <i>Ixiolaena viscosa</i> (Sticky Ixiolaena)			
328.	4012 <i>Jacksonia furcellata</i> (Grey Stinkwood)			
329.	20454 <i>Juncus acutus</i> subsp. <i>acutus</i>	Y		
330.	1178 <i>Juncus bufonius</i> (Toad Rush)	Y		
331.	1185 <i>Juncus kraussii</i> (Sea Rush)			
332.	1189 <i>Juncus pauciflorus</i> (Loose Flower Rush)			
333.	4037 <i>Kennedia coccinea</i> (Coral Vine)			
334.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
335.	5832 <i>Kunzea ericifolia</i> (Spearwood, Pondii)			
336.	1370 <i>Lachenalia reflexa</i>	Y		
337.	467 <i>Lagurus ovatus</i> (Hare's Tail Grass)	Y		
338.	28342 <i>Landoltia punctata</i> (Thin Duckweed)			
339.	1309 <i>Laxmannia squarrosa</i>			
340.	925 <i>Lepidosperma angustatum</i>			
341.	933 <i>Lepidosperma gladiatum</i> (Coast Sword-sedge, Kerbin)			
342.	937 <i>Lepidosperma longitudinale</i> (Pithy Sword-sedge)			
343.	944 <i>Lepidosperma scabrum</i>			
344.	6374 <i>Leucopogon conostephioides</i>			
345.	6427 <i>Leucopogon parviflorus</i> (Coast Beard-heath)			
346.	6436 <i>Leucopogon propinquus</i>			
347.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
348.	4362 <i>Linum marginale</i> (Wild Flax)			
349.	9289 <i>Lobelia anceps</i> (Angled Lobelia)			
350.	7408 <i>Lobelia tenuior</i> (Slender Lobelia)			
351.	6515 <i>Logania vaginalis</i> (White Spray)			
352.	476 <i>Lolium perenne</i> (Perennial Ryegrass)	Y		
353.	478 <i>Lolium rigidum</i> (Wimmera Ryegrass)	Y		
354.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
355.	1231 <i>Lomandra maritima</i>			
356.	1232 <i>Lomandra micrantha</i> (Small-flower Mat-rush)			
357.	1234 <i>Lomandra nigricans</i>			
358.	1239 <i>Lomandra preissii</i>			
359.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
360.	1246 <i>Lomandra suaveolens</i>			
361.	1198 <i>Luzula meridionalis</i> (Field Woodrush)			
362.	1097 <i>Lyginia barbata</i>			
363.	85 <i>Macrozamia riedlei</i> (Zamia, Djiridji)			
364.	13271 <i>Melaleuca huegelii</i> subsp. <i>huegelii</i>			
365.	5959 <i>Melaleuca rhapsiophylla</i> (Swamp Paperbark)			
366.	5978 <i>Melaleuca teretifolia</i> (Banbar)			
367.	5980 <i>Melaleuca thymoides</i>			
368.	13280 <i>Melaleuca viminea</i> subsp. <i>viminea</i>			
369.	4084 <i>Melilotus albus</i>	Y		
370.	955 <i>Mesomelaena pseudostygia</i>			
371.	485 <i>Microlaena stipoides</i> (Weeping Grass)			
372.	7085 <i>Misopates orontium</i> (Lesser Snapdragon)	Y		
373.	4662 <i>Monotaxis grandiflora</i> (Diamond of the Desert)			
374.	4666 <i>Monotaxis occidentalis</i>			
375.	2412 <i>Muehlenbeckia adpressa</i> (Climbing Lignum)			
376.	7289 <i>Myoporum caprarioides</i> (Slender Myoporum)			
377.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		
378.	8127 <i>Olearia axillaris</i> (Coastal Daisybush)			
379.	7348 <i>Opercularia hispidula</i> (Hispid Stinkweed)			
380.	18255 <i>Opercularia vaginata</i> (Dog Weed)			
381.	1372 <i>Ornithogalum arabicum</i> (Lesser Cape Lily)	Y		
382.	516 <i>Parapholis incurva</i> (Coast Barbgrass)	Y		
383.	7090 <i>Parentucellia viscosa</i> (Sticky Bartsia)	Y		
384.	1762 <i>Parietaria debilis</i> (Pellitory)			
385.	528 <i>Paspalum distichum</i> (Water Couch)	Y		
386.	1550 <i>Patersonia occidentalis</i> (Purple Flag, Koma)			
387.	4343 <i>Pelargonium capitatum</i> (Rose Pelargonium)	Y		
388.	4346 <i>Pelargonium littorale</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
389.	2273 <i>Persoonia saccata</i> (Snottygobble)			
390.	2299 <i>Petrophile linearis</i> (Pixie Mops)			
391.	551 <i>Phalaris minor</i> (Lesser Canary Grass)	Y		
392.	552 <i>Phalaris paradoxa</i> (Paradoxa Grass)	Y		
393.	1478 <i>Phlebocarya ciliata</i>			
394.	6734 <i>Phyla nodiflora</i> var. <i>nodiflora</i>	Y		
395.	4675 <i>Phyllanthus calycinus</i> (False Boronia)			
396.	6983 <i>Physalis peruviana</i> (Cape Gooseberry)	Y		
397.	5254 <i>Pimelea leucantha</i>			
398.	5261 <i>Pimelea rosea</i> (Rose Banjine)			
399.	7303 <i>Plantago lanceolata</i> (Ribwort Plantain)	Y		
400.	577 <i>Poa poiformis</i> (Coastal Poa)			
401.	578 <i>Poa porphyroclados</i>			
402.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
403.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
404.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
405.	11341 <i>Rhagodia baccata</i> subsp. <i>baccata</i>			
406.	4822 <i>Rhamnus alaternus</i> (Buckthorn)	Y		
407.	1556 <i>Romulea rosea</i> (Guildford Grass)	Y		
408.	6483 <i>Samolus junceus</i>			
409.	6484 <i>Samolus repens</i> (Creeping Brookweed)			
410.	7595 <i>Scaevola anchusifolia</i>			
411.	7603 <i>Scaevola canescens</i> (Grey Scaevola)			
412.	13182 <i>Scaevola repens</i> var. <i>repens</i>			
413.	973 <i>Schoenus asperocarpus</i> (Poison Sedge)			
414.	978 <i>Schoenus brevisetis</i>			
415.	982 <i>Schoenus clandestinus</i>			
416.	1004 <i>Schoenus nitens</i> (Shiny Bog-rush)			
417.	25878 <i>Senecio condylus</i>			
418.	2909 <i>Silene gallica</i> (French Catchfly)	Y		
419.	8225 <i>Siloxerus humifusus</i> (Procumbent Siloxerus)			
420.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
421.	7037 <i>Solanum symonii</i>			
422.	9367 <i>Sonchus hydrophilus</i> (Native Sowthistle)			
423.	8231 <i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
424.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
425.	635 <i>Sporobolus virginicus</i> (Marine Couch)			
426.	4828 <i>Spyridium globulosum</i> (Basket Bush)			
427.	2918 <i>Stellaria media</i> (Chickweed)	Y		
428.	20397 <i>Stellaria pallida</i>	Y		
429.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
430.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
431.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			
432.	2326 <i>Synaphea polymorpha</i> (Albany Synaphea, Pinda)			
433.	2329 <i>Synaphea spinulosa</i>			
434.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
435.	15741 <i>Tamarix aphylla</i> (Athel Tree)	Y		
436.	4256 <i>Templetonia retusa</i> (Cockies Tongues)			
437.	2791 <i>Tersonia cyathiflora</i> (Button Creeper)			
438.	5077 <i>Thomasia cognata</i>			
439.	1319 <i>Thysanotus arenarius</i>			
440.	1338 <i>Thysanotus manglesianus</i> (Fringed Lily)			
441.	1339 <i>Thysanotus multiflorus</i> (Many-flowered Fringe Lily)			
442.	1351 <i>Thysanotus sparteus</i>			
443.	6266 <i>Trachymene coerulea</i> (Blue Lace Flower)			
444.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
445.	1481 <i>Tribonanthes australis</i>			
446.	4383 <i>Tribulus terrestris</i> (Caltrop)	Y		
447.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
448.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
449.	147 <i>Triglochin mucronata</i>			
450.	151 <i>Triglochin striata</i>			
451.	99 <i>Typha orientalis</i> (Bulrush, Cumbungi)	Y		
452.	8255 <i>Ursinia anthemoides</i> (Ursinia)	Y		
453.	38388 <i>Ursinia anthemoides</i> subsp. <i>anthemoides</i>	Y		
454.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
455.	724 <i>Vulpia myuros</i> (Rat's Tail Fescue)	Y		
456.	6658 <i>Wilsonia backhousei</i> (Narrow-leaf Wilsonia)			
457.	1394 <i>Wurmbea dioica</i> (Early Nancy)			
458.	1256 <i>Xanthorrhoea preissii</i> (Grass tree, Palga)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
459.	6289 <i>Xanthosia huegelii</i>			
460.	2331 <i>Xylomelum occidentale</i> (Woody Pear, Djandin)			
461.	1049 <i>Zantedeschia aethiopica</i> (Arum Lily)	Y		

Protozoa

462.	39097 <i>Trichia decipiens</i>			
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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
 2 - Priority 2
 3 - Priority 3
 4 - Priority 4
 5 - Priority 5

¹ For NatureMap's purposes, species flagged as endemic are those whose records are wholly 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.

APPENDIX 4
Conservation Codes

Conservation Codes for Western Australian Flora and Fauna

T Threatened species

Listed as Specially Protected under the Wildlife Conservation Act 1950, published under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

- Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection
- Flora that are extant and considered likely to become extinct, or rare and therefore in need of special protection, are declared to be rare flora

Species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such. The assessment of the conservation status of these species is based on their national extent.

X Presumed extinct species

Listed as Specially Protected under the Wildlife Conservation Act 1950, published under Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora (which may also be referred to as Declared Rare Flora).

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

IA Migratory birds protected under an international agreement

Listed as Specially Protected under the Wildlife Conservation Act 1950, listed under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), relating to the protection of migratory birds.

S Other specially protected fauna

Listed as Specially Protected under the Wildlife Conservation Act 1950. Fauna declared to be in need of special protection, otherwise than for the reasons mentioned for Schedules 1, 2 or 3, are published under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Threatened Fauna and Flora are ranked according to their level of threat using IUCN Red List categories and criteria. For example: Carnaby's Cockatoo (*Calyptorhynchus latirostris*) is listed as 'Specially Protected' under the Wildlife Conservation Act 1950, published under Schedule 1, and referred to as a 'Threatened' species with a ranking of 'Endangered'.

CR Critically Endangered - considered to be facing an extremely high risk of extinction in the wild.

EN Endangered - considered to be facing a very high risk of extinction in the wild.

VU Vulnerable - considered to be facing a high risk of extinction in the wild.

A list of the current rankings can be downloaded from the Parks and Wildlife Threatened Species and Communities webpage at <http://dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/>

P Priority species

Species that maybe threatened or near threatened but are data deficient, have not yet been adequately surveyed to be listed under the Schedules of the Wildlife Conservation (Specially Protected Fauna) Notice or the Wildlife Conservation (Rare Flora) Notice, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation dependent species that are subject to a specific conservation program are placed in Priority 5.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1: Priority One: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2: Priority Two: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not

meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3: Priority Three: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies, variety or forma).

Commonwealth of Australia Conservation Codes

The Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* has the following nine conservation codes for Flora and Fauna.

Extinct

Taxa not definitely located in the wild during the past 50 years

Extinct in the Wild

Taxa known to survive only in captivity

Critically Endangered

Taxa facing an extremely high risk of extinction in the wild in the immediate future

Endangered

Taxa facing a very high risk of extinction in the wild in the near future

Vulnerable

Taxa facing a high risk of extinction in the wild in the medium-term

Near Threatened

Taxa that risk becoming Vulnerable in the wild

Conservation Dependent

Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.

Data Deficient (Insufficiently Known)

Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

Least Concern

Taxa that are not considered Threatened

APPENDIX 5

Significant Tree Survey Results

Lots 5-8 Kerosene Lane, Baldivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
7	1	Tuart (<i>Eucalyptus gomphocephala</i>)	387181	6425881	1432	11	520		Sprouting
7	2	Tuart (<i>Eucalyptus gomphocephala</i>)	387198	6425878	1433	12	1000		Good condition
7	3	Tuart (<i>Eucalyptus gomphocephala</i>)	387235	6425883	1434	7	570		Damaged - Fair Condition
7	4	Tuart (<i>Eucalyptus gomphocephala</i>)	387256	6425904	1435	11	720	370	Good condition
7	5	Tuart (<i>Eucalyptus gomphocephala</i>)	387240	6425901	1436	11	530	80	Good condition
7	6	Tuart (<i>Eucalyptus gomphocephala</i>)	387265	6425898	1437	11	500		Good condition
7	7	Tuart (<i>Eucalyptus gomphocephala</i>)	387274	6425897	1438	12	570		Good condition
7	8	Tuart (<i>Eucalyptus gomphocephala</i>)	387275	6425872	1439	11	670	500	Good condition
7	9	Tuart (<i>Eucalyptus gomphocephala</i>)	387246	6425857	1440	11	1100		Good condition
7	10	Tuart (<i>Eucalyptus gomphocephala</i>)	387260	6425862	1441	11	500		Good condition
7	11	Tuart (<i>Eucalyptus gomphocephala</i>)	387215	6425849	1442	12	570	500/300	Good condition, two main trunks
7	12	Tuart (<i>Eucalyptus gomphocephala</i>)	387179	6425852	1444	10	660	440	Good condition
7	13	Tuart (<i>Eucalyptus gomphocephala</i>)	387172	6425826	1445	11	1200		Two hollows, not suitable for Black Cockatoos
7	14	Tuart (<i>Eucalyptus gomphocephala</i>)	387176	6425821	1446	10	800		Good condition
7	15	Standing Dead Tree	387190	6425823	1447	6	1100		Good condition
7	16	Tuart (<i>Eucalyptus gomphocephala</i>)	387212	6425823	1448	10	540		Good condition
7	17	Tuart (<i>Eucalyptus gomphocephala</i>)	387222	6425822	1449	10	530		Good condition
7	18	Tuart (<i>Eucalyptus gomphocephala</i>)	387246	6425835	1450	11	750		Good condition
7	19	Tuart (<i>Eucalyptus gomphocephala</i>)	387264	6425821	1451	12	500		Good condition
7	20	Tuart (<i>Eucalyptus gomphocephala</i>)	387273	6425830	1452	12	550		Good condition
7	21	Tuart (<i>Eucalyptus gomphocephala</i>)	387272	6425812	1453R	11	600	280	Close together
7	22	Tuart (<i>Eucalyptus gomphocephala</i>)	387272	6425811	1453L	11	530		
7	23	Tuart (<i>Eucalyptus gomphocephala</i>)	387272	6425810	1453M	11	500		Good condition
7	24	Tuart (<i>Eucalyptus gomphocephala</i>)	387271	6425803	1454	12	550		Good condition
7	25	Tuart (<i>Eucalyptus gomphocephala</i>)	387262	6425792	1455	11	550		Good condition
7	26	Tuart (<i>Eucalyptus gomphocephala</i>)	387252	6425788	1456	11	500	340	Good condition
7	27	Tuart (<i>Eucalyptus gomphocephala</i>)	387248	6425795	1457	10	520	420	Wire
7	28	Jarrah (<i>Eucalyptus marginata</i>)	387271	6425767	1458	9	520	470/350/280	Good condition
7	29	Jarrah (<i>Eucalyptus marginata</i>)	387279	6425752	1459	9	500		Good condition

Lots 5-8 Kerosene Lane, Baldivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
7	30	Jarrah (<i>Eucalyptus marginata</i>)	387277	6425734	1460	8	550	490/360	Good condition
7	31	Tuart (<i>Eucalyptus gomphocephala</i>)	387236	6425739	1461	11	630	530/280/ 170	Good condition
7	32	Tuart (<i>Eucalyptus gomphocephala</i>)	387236	6425748	1462	8	580	220/200	White trunk
7	33	Tuart (<i>Eucalyptus gomphocephala</i>)	387236	6425748	1463	7	600		Leaning
7	34	Tuart (<i>Eucalyptus gomphocephala</i>)	387239	6425774	1464	11	610	550	Leaning
7	35	Standing Dead Tree	387215	6425768	1465	10	750		Near house
7	36	Tuart (<i>Eucalyptus gomphocephala</i>)	387221	6425794	1466	11	630	450	Good condition
7	37	Tuart (<i>Eucalyptus gomphocephala</i>)	387202	6425772	1467R	11	1750		Good condition
7	38	Tuart (<i>Eucalyptus gomphocephala</i>)	387202	6425771	1467L	10	550		Good condition
7	39	Tuart (<i>Eucalyptus gomphocephala</i>)	387179	6425773	1468	10	500	450	Chopped
7	40	Tuart (<i>Eucalyptus gomphocephala</i>)	387171	6425769	1470	10	800	400	Good condition
7	41	Tuart (<i>Eucalyptus gomphocephala</i>)	387180	6425755	1469	9	550	200	Good condition
7	42	Tuart (<i>Eucalyptus gomphocephala</i>)	387196	6425755	1523	7	530	110/70	Good condition
7	43	Tuart (<i>Eucalyptus gomphocephala</i>)	387191	6425737	1471	11	600	600	Good condition
5	44	Tuart (<i>Eucalyptus gomphocephala</i>)	387389	6425923	1472	8	960		Good condition
5	45	Tuart (<i>Eucalyptus gomphocephala</i>)	387455	6425913	1473	8	940	110	Good condition
5	46	Tuart (<i>Eucalyptus gomphocephala</i>)	387458	6425870	1474	10	580	270/80	secondary branch dead
5	47	Tuart (<i>Eucalyptus gomphocephala</i>)	387465	6425826	1475	12	700		Good condition
5	48	Tuart (<i>Eucalyptus gomphocephala</i>)	387462	6425833	1476	11	520	300	Good condition
5	49	Standing Dead Tree	387456	6425813	1477	11	650		Good condition
5	50	Tuart (<i>Eucalyptus gomphocephala</i>)	387451	6425813	1478	12	560	280	Good condition
5	51	Tuart (<i>Eucalyptus gomphocephala</i>)	387439	6425826	1480	11	530	320	Leaning
5	52	Tuart (<i>Eucalyptus gomphocephala</i>)	387434	6425828	1479L	11	530		Good condition
5	53	Tuart (<i>Eucalyptus gomphocephala</i>)	387430	6425830	1479R	10	650		Good condition
5	54	Tuart (<i>Eucalyptus gomphocephala</i>)	387434	6425792	1481	11	1770		Large tree, contains potential spout
5	55	Tuart (<i>Eucalyptus gomphocephala</i>)	387435	6425787	1482	11	710	190/180/ 110	Good condition
5	56	Tuart (<i>Eucalyptus gomphocephala</i>)	387426	6425769	1483	11	850	720/430	Good condition
5	57	Tuart (<i>Eucalyptus gomphocephala</i>)	387413	6425780	1485	8	640	50	Good condition
5	58	Tuart (<i>Eucalyptus gomphocephala</i>)	387417	6425747	1486	10	750		Good condition

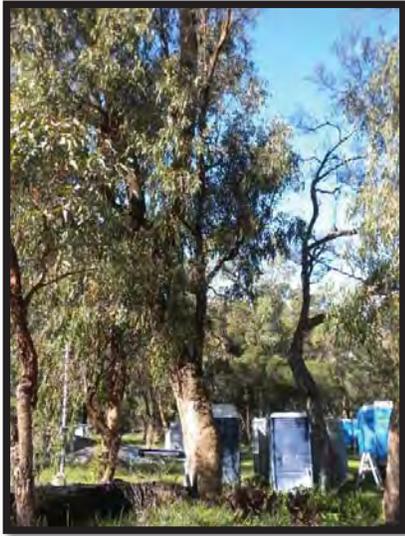
Lots 5-8 Kerosene Lane, Baldivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
5	59	Tuart (<i>Eucalyptus gomphocephala</i>)	387436	6425753	1487	12	1170		Good condition
5	60	Tuart (<i>Eucalyptus gomphocephala</i>)	387444	6425746	1488	12	660	70	Good condition
5	61	Tuart (<i>Eucalyptus gomphocephala</i>)	387472	6425749	1489	12	2860		Massive
5	62	Standing Dead Tree	387458	6425764	1490R	10	570		Good condition
5	63	Jarrah (<i>Eucalyptus marginata</i>)	387459	6425776	1490L	11	940		Good condition
5	64	Standing Dead Tree	387450	6425770	1491	7	670		Good condition
5	65	Tuart (<i>Eucalyptus gomphocephala</i>)	387472	6425783	1492	11	1570		Good condition
6	66	Tuart (<i>Eucalyptus gomphocephala</i>)	387285	6425899	1493	11	880		Good condition
6	67	Tuart (<i>Eucalyptus gomphocephala</i>)	387314	6425892	1494	12	580	500/430/ 240	Good condition
6	68	Tuart (<i>Eucalyptus gomphocephala</i>)	387310	6425882	1495	9	730	240	Good condition
6	69	Tuart (<i>Eucalyptus gomphocephala</i>)	387312	6425880	1496	10	600	420/400	Bull ants
6	70	Tuart (<i>Eucalyptus gomphocephala</i>)	387305	6425876	1497	9	900		Burnt
6	71	Jarrah (<i>Eucalyptus marginata</i>)	387331	6425841	NA	5	520		Good condition
6	72	Jarrah (<i>Eucalyptus marginata</i>)	387276	6425798	1498	10	990	550/550/ 540/350/ 290	Good condition
6	73	Jarrah (<i>Eucalyptus marginata</i>)	387285	6425783	1499	11	650		Good condition
6	74	Jarrah (<i>Eucalyptus marginata</i>)	387299	6425767	1500	9	580	230/170	Good condition
6	75	Jarrah (<i>Eucalyptus marginata</i>)	387318	6425736	1501	10	670	9 x 50-100	Good condition
6	76	Tuart (<i>Eucalyptus gomphocephala</i>)	387344	6425728.5	1502	12	760	670	Good condition
6	77	Tuart (<i>Eucalyptus gomphocephala</i>)	387343	6425802	1503	12	1520		Good condition
6	78	Standing Dead Tree	387352	6425814	1504	6	660	360	Good condition
6	79	Tuart (<i>Eucalyptus gomphocephala</i>)	387376	6425811	1505	9	750	50	Good condition
6	80	Tuart (<i>Eucalyptus gomphocephala</i>)	387380	6425840	1506	10	820	300/ 4x<200	Good condition
6	81	Tuart (<i>Eucalyptus gomphocephala</i>)	387382	6425866	1507	11	590	560	Good condition
6	82	Standing Dead Tree	387363	6425891	1508	7	530		Good condition
6	83	Tuart (<i>Eucalyptus gomphocephala</i>)	387346	6425902	1509	8	530	500/4x100	Good condition
6	84	Tuart (<i>Eucalyptus gomphocephala</i>)	387350	6425905	1510	8	1050	100/80	Good condition
6	85	Standing Dead Tree	387377	6425904	1511	8	660	560/560/ 4x<50	Small hollows

Lots 5-8 Kerosene Lane, Baldivis

Lot Number	Tree Number	Species	Easting MGA zn50	Northing MGA zn50	Photo Number	Height (m)	Diameter (mm)	Secondary Branches (mm)	Notes (hollows, bees etc.)
8	86	Tuart (<i>Eucalyptus gomphocephala</i>)	387056	6425744	1512	9	660	640	Good condition
8	87	Tuart (<i>Eucalyptus gomphocephala</i>)	387079	6425733	1513	10	1150		Good condition
8	88	Tuart (<i>Eucalyptus gomphocephala</i>)	387090	6425739	1514	11	800	440	Good condition
8	89	Tuart (<i>Eucalyptus gomphocephala</i>)	387102	6425732	1515	11	640	2x<50	Good condition
8	90	Tuart (<i>Eucalyptus gomphocephala</i>)	387098	6425755	1516	10	530	390	Leaning
8	91	Tuart (<i>Eucalyptus gomphocephala</i>)	387102	6425780	1517	11	1100	200	Good condition
8	92	Tuart (<i>Eucalyptus gomphocephala</i>)	387100	6425803	1521	11	1280	220/50/50	Very large tree with hollows
8	93	Tuart (<i>Eucalyptus gomphocephala</i>)	387127	6425785	1518	10	560	370/230	Good condition
8	94	Tuart (<i>Eucalyptus gomphocephala</i>)	387136	6425777	1519	10	570	350/270/160	Good condition
8	95	Tuart (<i>Eucalyptus gomphocephala</i>)	387143	6425779	1520	11	800		Good condition
8	96	Tuart (<i>Eucalyptus gomphocephala</i>)	387143	6425755	1522	11	850		Good condition
8	97	Tuart (<i>Eucalyptus gomphocephala</i>)	387137	6425846	1524	12	640		Good condition
8	98	Tuart (<i>Eucalyptus gomphocephala</i>)	387116	6425845	1531	10	500		Good condition

Lots 5-8 Kerosene Lane, Baldivis



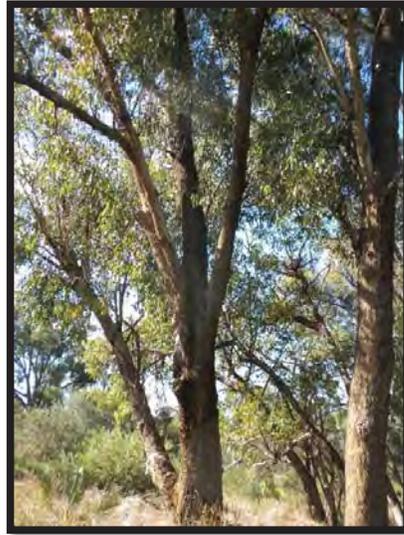
Tree 1



Tree 2



Tree 3



Tree 4



Tree 5



Tree 6

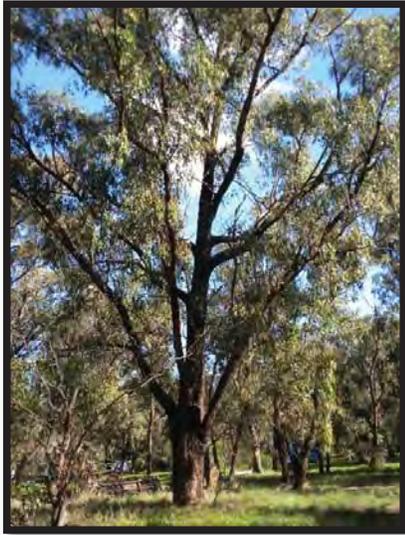
Lots 5-8 Kerosene Lane, Baldivis



Tree 7



Tree 8



Tree 9



Tree 10



Tree 11



Tree 12

Lots 5-8 Kerosene Lane, Baldivis



Tree 13



Tree 14



Tree 15



Tree 16



Tree 17

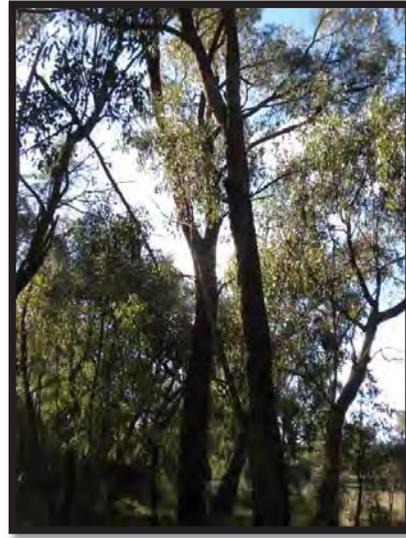


Tree 18

Lots 5-8 Kerosene Lane, Baldivis



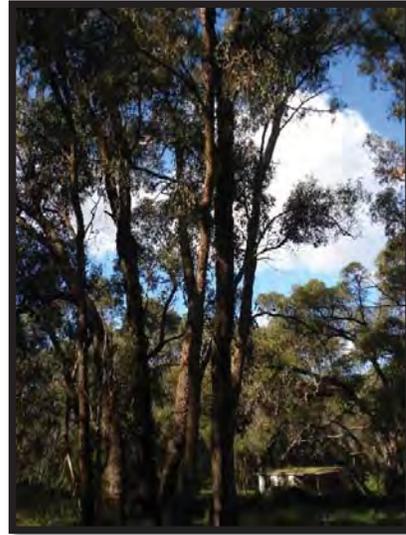
Tree 19



Tree 20



Tree 21 (right) Tree 22 (left) Tree 23 (middle)



Tree 24

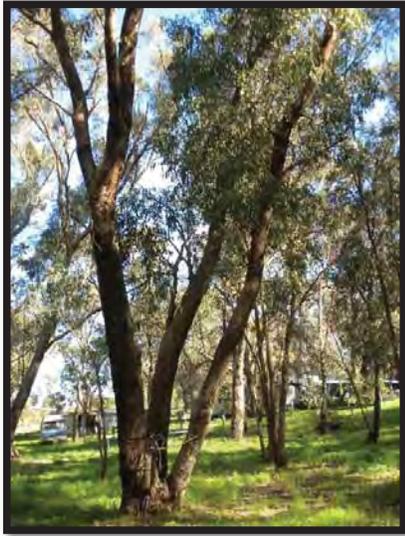


Tree 25



Tree 26

Lots 5-8 Kerosene Lane, Baldivis



Tree 27



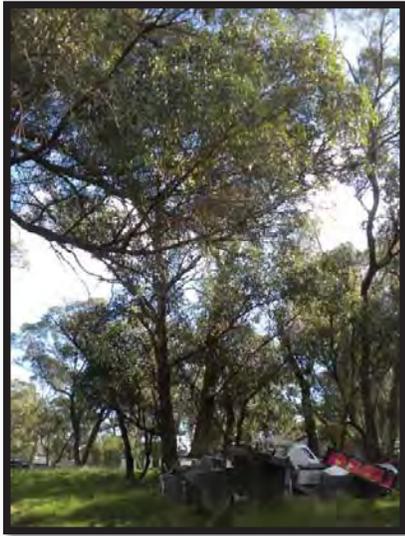
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Tree 29



Tree 30



Tree 31

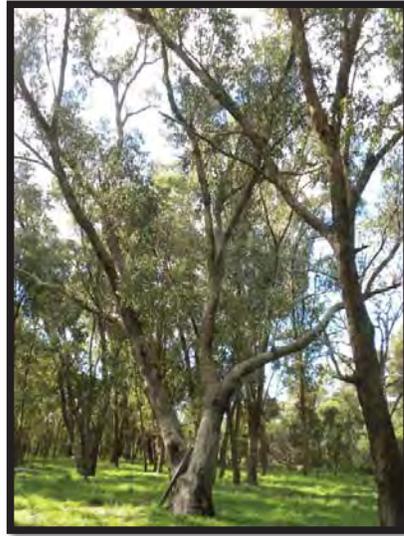


Tree 32

Lots 5-8 Kerosene Lane, Baldivis



Tree 33



Tree 34



Tree 35



Tree 36



Tree 37 (right) Tree 38 (left)



Tree 39

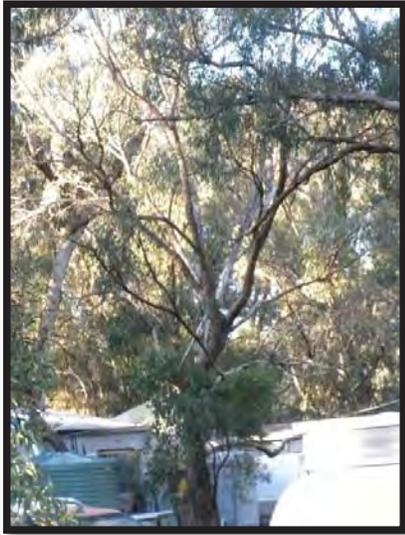
Lots 5-8 Kerosene Lane, Baldivis



Tree 40



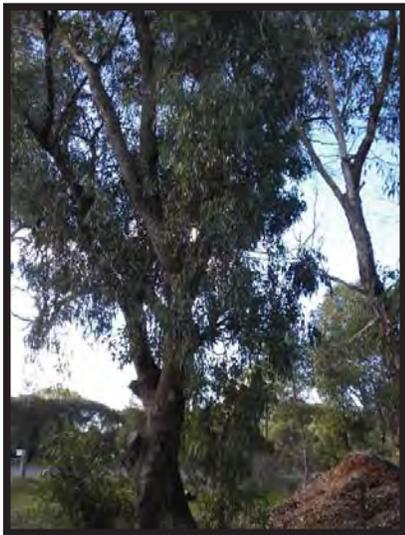
Tree 41



Tree 42



Tree 43

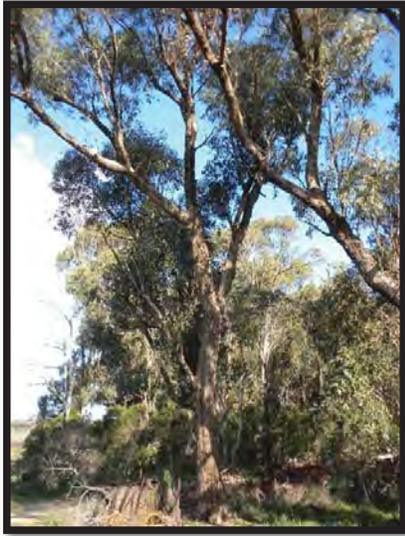


Tree 44



Tree 45

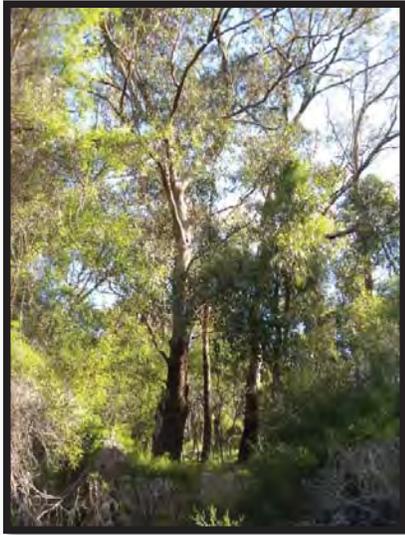
Lots 5-8 Kerosene Lane, Baldivis



Tree 46



Tree 47



Tree 48



Tree 49



Tree 50

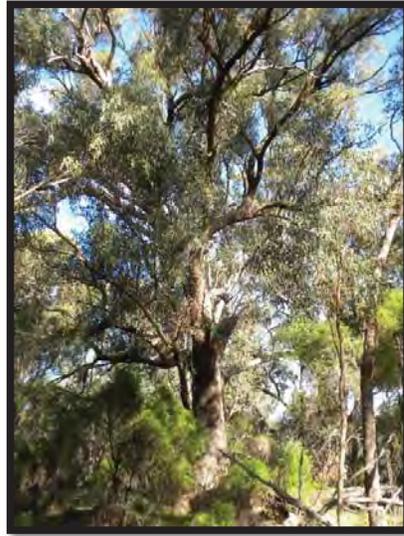


Tree 51

Lots 5-8 Kerosene Lane, Baldivis



Tree 52 (left) Tree 53 (right)



Tree 54



Tree 55



Tree 56

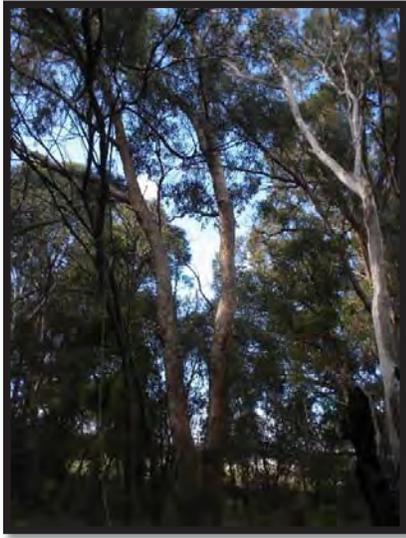


Tree 57



Tree 58

Lots 5-8 Kerosene Lane, Baldivis



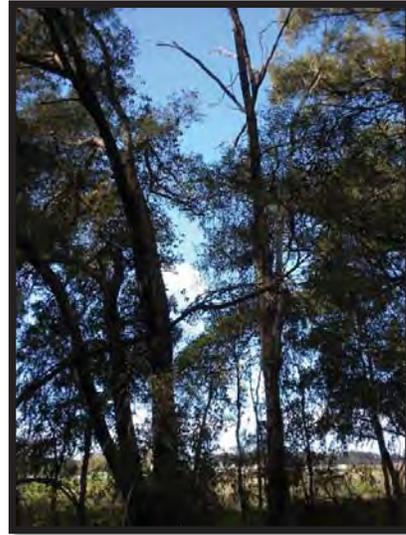
Tree 59



Tree 60



Tree 61



Tree 62 (right) Tree 63 (left)



Tree 64



Tree 65

Lots 5-8 Kerosene Lane, Baldivis



Tree 66



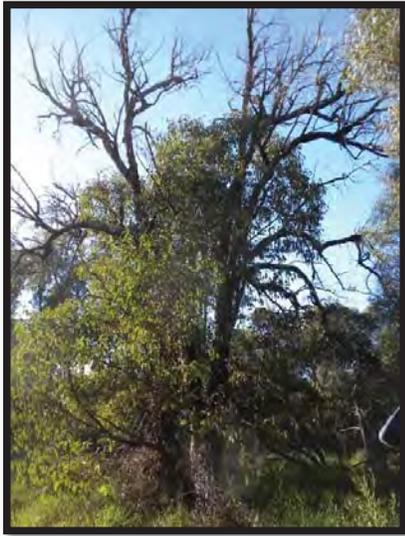
Tree 67



Tree 68



Tree 69

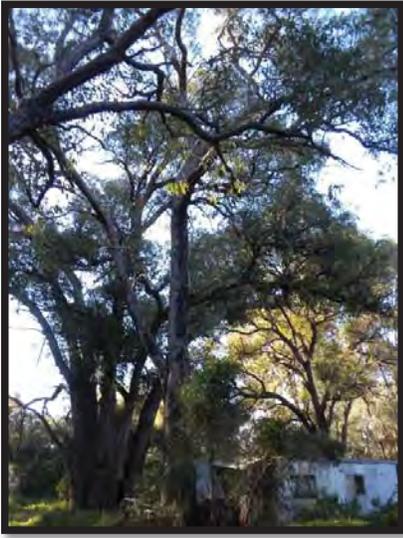


Tree 70

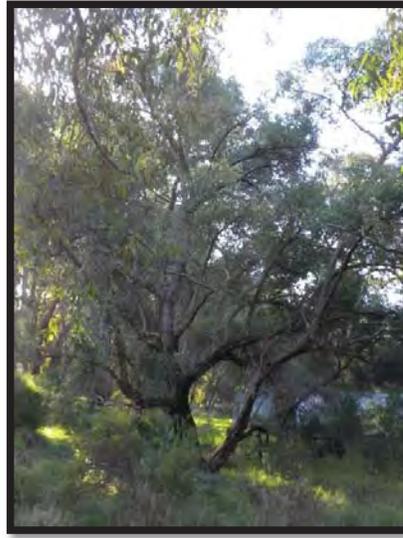


Tree 72

Lots 5-8 Kerosene Lane, Baldivis



Tree 73



Tree 74



Tree 75



Tree 76



Tree 77



Tree 78

Lots 5-8 Kerosene Lane, Baldivis



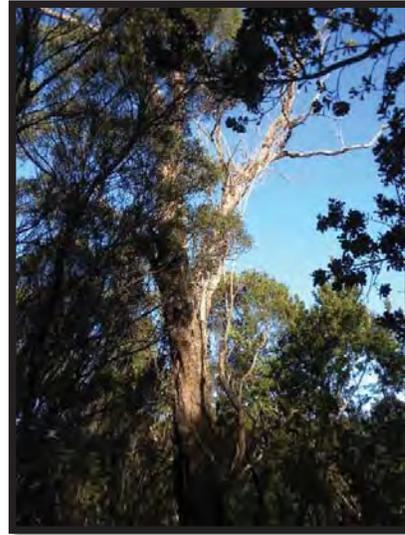
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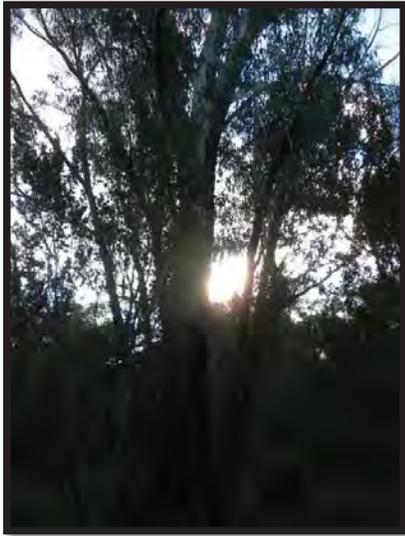
Tree 80



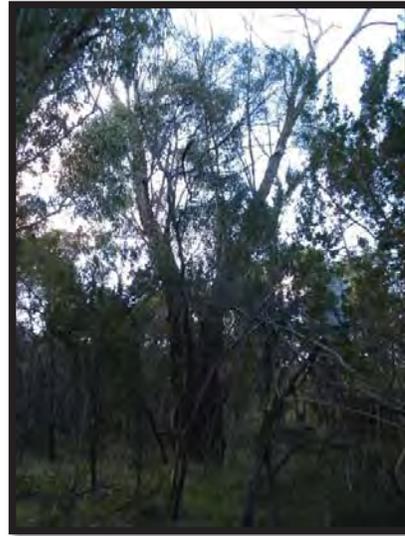
Tree 81



Tree 82

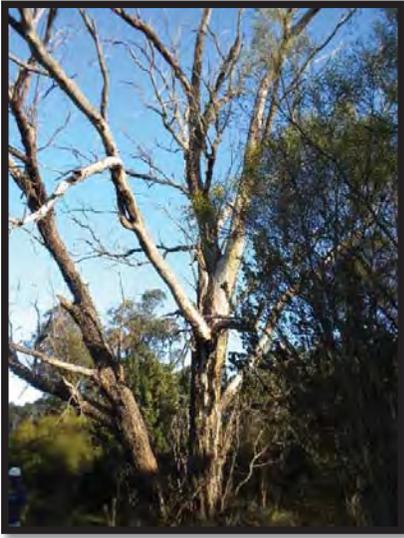


Tree 83



Tree 84

Lots 5-8 Kerosene Lane, Baldivis



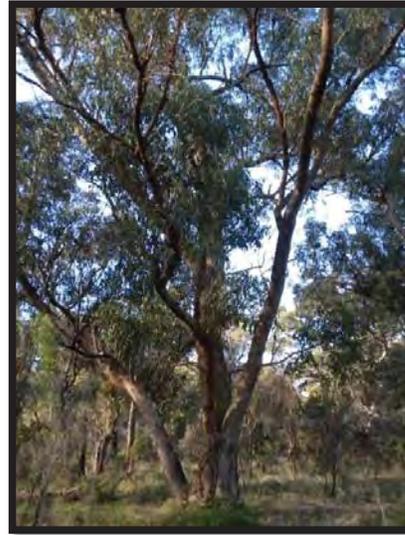
Tree 85



Tree 86



Tree 87



Tree 88



Tree 89



Tree 90

Lots 5-8 Kerosene Lane, Baldivis



Tree 91



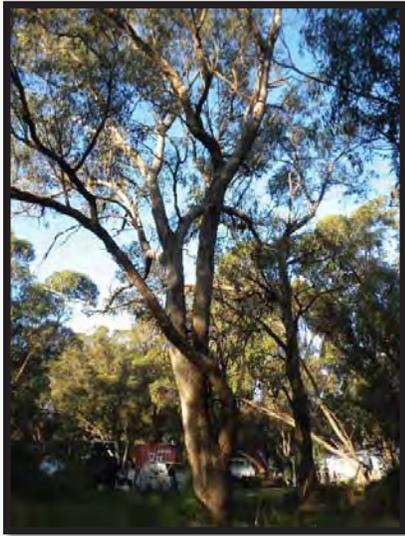
Tree 92



Tree 93



Tree 94

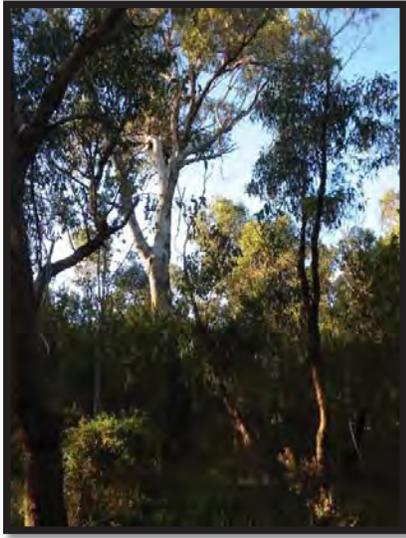


Tree 95

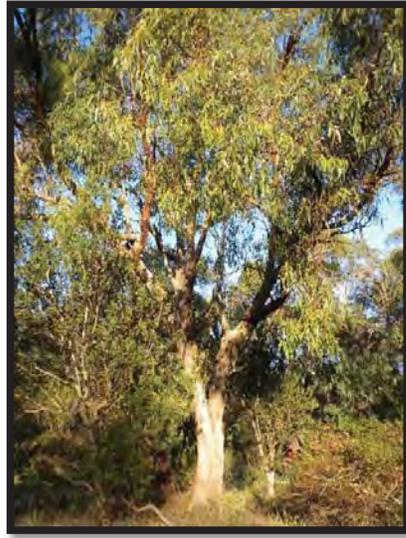


Tree 96

Lots 5-8 Kerosene Lane, Baldivis



Tree 97



Tree 98

APPENDIX 6

Subdivision Concept Plan (Whelans Town Planning)

**SUBDIVISION CONCEPT PLAN
LOTS 5 - 8 KEROSENE LANE
BALDIVIS**

DATE DRAWN: 2/28/2015
DRAWN BY: CML
CHECKED BY: JPL
FILE: 15054-MD-concept-0813.dwg
V-DRAWING-02
H-DRAWING-02



- LEGEND**
- - - Solid Wall
 - ← Dwelling Orientation
 - - - Structure Plan Boundary
 - - - Pipeline
 - - - Existing parent lot boundary
 - - - Pipeline 32m setback

APPENDIX 4 BUSHFIRE MANAGEMENT PLAN

**Lot 5, 6, 7 and 8
Kerosene Lane
Baldivis**

Bushfire Management Plan



2/9/2016

Kathryn Kinnear

Bio Diverse Solutions

DOCUMENT CONTROL

TITLE

Lots 5, 6, 7 and 8 Kerosene Lane Baldvis Bushfire Management Plan
Author (s) : Kathryn Kinnear
Reviewer (s): Lorraine Spencer
Job No. : TER006
Client : Terranovis Pty Ltd

REVISION RECORD

Revision	Summary	Revised By	Date
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Draft id 25/09/2015	Issued to client for review	L.Spencer	25/9/2015
Final Id 02/10/2015	Issued to client after client review	Kathryn Kinnear	2/10/2015
Final Id 19/10/2015	Issued to client with updated adjacent SGP's	Kathryn Kinnear	19/10/2015
Final ID 8/8/2016	Updated with CoR changes	Kathryn Kinnear	8/8/2016
Final ID 28/8/2016	Updated with Staging Plan	Kathryn Kinnear	28/8/2016
FINAL ID 2/9/2016	Updated with Staging Plan	Kathryn Kinnear	2/9/2016

The recommendations and measures contained in this assessment report are based on the requirements of the Australian Standards 3959 – Building in Bushfire prone Areas, WAPC SPP3.7, Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) and CSIRO's research into Bushfire behaviour. These are considered the minimum standards required to balance the protection of the proposed dwelling and occupants with the aesthetic and environmental conditions required by local, state and federal government authorities. They DO NOT guarantee that a building will not be destroyed or damaged by a bushfire. All surveys and forecasts, projections and recommendations made in this assessment report and associated with this proposed dwelling are made in good faith on the basis of the information available to the fire protection consultant at the time of assessment. The achievement of the level of implementation of fire precautions will depend amongst other things on actions of the landowner or occupiers of the land, over which the fire protection consultant has no control. Notwithstanding anything contained within, the fire consultant/s or local government authority will not, except as the law may require, be liable for any loss or other consequences (whether or not due to negligence of the fire consultant/s and the local government authority, their servants or agents) arising out of the services rendered by the fire consultant/s or local government authority.



Bio Diverse Solutions
55 Peppermint Drive
Albany WA 6330



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CONTENTS

1.	EXECUTIVE SUMMARY	4
2.	INTRODUCTION	5
	2.1.STATUTORY CONDITIONS	5
	2.2.SUITABLY QUALIFIED BUSHFIRE CONSULTANT	6
3.	AIMS OF THIS PLAN	7
	3.1.PLANNING CONTEXT	7
	3.2.SITE INSPECTION	7
	3.3.OBJECTIVES	7
4.	DESCRIPTION OF THE AREA	8
	4.1.LOCATION	8
	4.2.DEVELOPMENT PROPOSAL	8
5.	DESKTOP ASSESSMENT – REGIONAL SETTING	9
	5.1.CURRENT SITE LAND USE	9
	5.2.SURROUNDING LAND USES	9
	5.3.CLIMATE	11
	5.3.1.RAINFALL	11
	5.3.2.TEMPERATURE	11
	5.3.3.WIND	12
	5.3.4.PREVALENT FIRE WEATHER	13
	5.3.5.CLIMATE CHANGE	13
	5.4.TOPOGRAPHY	14
	5.5.BUSHFIRE FUELS – VEGETATION	14
	5.6.ASSETS	19
	5.7.ACCESS	19
	5.8.WATER SUPPLY	19
	5.9.FIRE BREAKS	20
6.	POTENTIAL BUSHFIRE ISSUES AND BUSHFIRE HAZARDS	21
7.	ASSESSMENT TO THE BUSHFIRE PROTECTION CRITERIA	23
	7.1.ELEMENT 1: LOCATION	24
	7.1.1.RECOMMENDATIONS ARISING FROM ASSESSMENT TO THIS ELEMENT	25
	7.2.ELEMENT 2: SITING AND DESIGN OF DEVELOPMENT	26
	7.2.1.ASSET PROTECTION ZONE (ACCEPTABLE SOLUTION A2.1)	26
	7.2.2.RECOMMENDATIONS ARISING FROM ASSESSMENT TO A2	27
	7.3.ELEMENT 3: VEHICLE ACCESS - PERFORMANCE CRITERIA	29
	7.3.1.TWO ACCESS ROUTES (A3.1)	29
	7.3.2.PUBLIC ROADS (A3.2)	29
	7.3.3.CUL DE SACS (A3.3)	29
	7.3.4.BATTLE AXES (A3.4)	30
	7.3.5.PRIVATE DRIVEWAYS (A3.5)	30
	7.3.6.EMERGENCY ACCESS WAYS (A3.6)	30
	7.3.7.FIRE SERVICE ACCESS ROUTES (A3.7)	30
	7.3.8.FIREBREAKS (A3.8)	30
	7.3.9.RECOMMENDATIONS ARISING FROM ASSESSMENT TO THIS ELEMENT	30
	7.4.ELEMENT 4 WATER – PERFORMANCE CRITERIA	31
	7.4.1.RETICULATED AREAS (A4.1)	31
	7.4.2.NON-RETICULATED AREAS (A4.2)	31
	7.4.3.INDIVIDUAL LOTS WITHIN NON-RETICULATED AREAS	31
	7.4.4.RECOMMENDATIONS ARISING FROM ASSESSMENT TO THIS ELEMENT	31
	7.5.OTHER FIRE MITIGATION MEASURES	32
	7.5.1.REDUCTION IN CONSTRUCTION THROUGH SHIELDING	32
	7.5.2.LANDSCAPING/STREETSCAPING AREAS	32
	7.5.3.EVAPORATIVE AIR CONDITIONERS	32
	7.5.4.BARRIER FENCING	33
	7.5.5.STAGING	33
	7.5.6.INFORMATION ON BUILDING TO BAL/AS3959-2009	33
8.	CITY OF ROCKINGHAM BUSHFIRE PROTECTION PLAN	35
	8.1.FIRE FIGHTING FACILITIES	35
	8.2.FIRE SUPPRESSION ACTIONS COR	35
	8.3.HOMEOWNER PROTECTION	35
	8.4.BUSHFIRE PLAN	36
9.	SUMMARY	37
	9.1.OVERALL FIRE THREAT	37
	9.2.FUTURE LOT OWNERS RESPONSIBILITY	37
	9.3.DEVELOPERS RESPONSIBILITY	38
	9.4.CITY OF ROCKINGHAM RESPONSIBILITY	39
10.	CONCLUSIONS	40
11.	REFERENCES	42

APPENDICES

APPENDIX A – LOCATION MAPPING
APPENDIX B –STRUCTURE PLANS
APPENDIX C – VEGETATION MAPPING
APPENDIX D – BUSHFIRE HAZARD RATING
APPENDIX E –BAL CONTOUR PLANS
APPENDIX F – BUSHFIRE MANAGEMENT PLAN

1. Executive Summary

Terranovis Pty Ltd commissioned Bio Diverse Solutions (Bushfire Consultants) to undertake a bushfire hazard assessment and prepare a Bushfire Management Plan to guide all future bushfire management for the proposed development of Lots 5, 6, 7 and 8 Kerosene Lane Baldvis Structure Plan and associated Subdivision Guide Plan. The proposed structure plan contemplates the creation of future lots in the density range of R30 and a public open space area. The publicly released Bushfire Prone Mapping (SLIP 2015 & 2016) indicates this area as bushfire prone.

To the west, south and east there is proposed urban development which will reduce the bushfire hazards to this development. The development to the east proposes to construct a road reserve to give access to the east, which assists the subject site achieving two opposing access/egress points. Legal agreements are presently being formed with adjacent neighbours to ensure there is access, sewer and maintenance of any bushfire hazards upon their land. Copies shall be forward to the CoR upon completion.

The subject site is has internal areas of Forest Type A and Scrub Type D which is proposed to be cleared for the subdivision. The adjacent land within 100m of the site is Forest Type A, Woodland (Type B), Scrub type D and cleared paddock areas (Type G). Bushfire Prone Vegetation within 100m of the site is located within Reserve 22429 and private property north/north east of Kerosene Lane. Urban growth the west, south and east are classified as future “*Low Threat Vegetation and Non Vegetated Areas*” (AS3959-2009). The majority of the site will be cleared for the subdivision with internal POS areas proposed to be landscaped public reserves (classified as low fuel areas).

The structure plan area has been rated as having an **Extreme-Moderate** bushfire hazard level as defined by Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) and State Planning Policy 3.7 (WAPC, 2015b) due to adjacent Woodland, Forest and Scrub bushfire hazards. There are low effective slopes across the site and the majority of the long term bushfire risk (Woodland Type B vegetation (extreme)) is located upslope of the proposed dwellings. The external Scrub Type D vegetation (Moderate) is located downslope of the proposed subdivision.

The project is planned to be constructed and timed with the adjacent developers to the south and the east. Legal agreements are currently being drawn up to address access and low fuel areas (among other construction issues). If in the event that the adjacent developers do not construct at the time of this proposal then the BAL Contour Plan (Appendix E) had identified any areas of concern for BAL allocation. The developer has indicated some lots may be land banked until such time as the adjacent developer constructs (mainly affects south west and south east corner of the structure plan). The plan of subdivision, upon completed construction, will meet all the requirements of the Acceptable Solutions as outlined by WAPC Guidelines for Planning in Bushfire Prone areas.

This BMP report provides details of the fire management strategies proposed to be implemented across the site as it is subdivided and developed to ensure adequate protection of life, property and biodiversity assets. To ensure the mitigation measures are implemented responsibilities are outlined for the Future Lot Owner, Developer and CoR.

2. Introduction

Terranovis Pty Ltd commissioned Bio Diverse Solutions (Bushfire Consultants) to undertake a fire hazard assessment and prepare a Bushfire Management Plan to guide all future fire management as part OF the planning process for a proposed development (Structure Plan) and subsequent subdivision of Lots 5, 6, 7 and 8 Kerosene Lane, Baldivis.

The basic requirements of any Bushfire Management Plan (BMP) is to identify potential issues or problems relating to environmental fire threats and recommend specific actions by certain persons, agencies, authorities and developers to ensure, as much as practical, that the lives and assets of the location are not put at undue threat from any unplanned fire event. A BMP takes into account various physical attributes of the land, including topographical and vegetation properties, local climatic impacts, biodiversity, past and current land use, past fire history and management practices, local authority fire management obligations, road access, water supplies, adjacent property and tenure, and future obligations by various parties should the subdivision application be successful.

Such planning takes into consideration standards and requirements specified in various documents such as Australian Standard (AS) 3959-2009, Western Australian Planning Commission (WAPC) Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) and State Planning Policy 3.7 (WAPC, 2015b). These policies, plans and guidelines have developed by WAPC to ensure uniformity to planning in designated "Bushfire Prone Areas" and consideration of the relevant bushfire hazards when identifying or investigating land for future development.

The subject area is described as Lots 5, 6, 7 and 8 Kerosene Lane, Baldivis and is shown in Appendix A and the Structure Plan (SP) at Appendix B.

2.1. Statutory Conditions

On the 7th December 2015 the *Fire and Emergency Services (Bush Fire Prone Areas) Order 2015; Planning and Development (Local Planning Scheme) Amendment Regulations 2015; Planning and Development Act 2005 State Planning Policy 3.7 - Planning in Bushfire Prone Areas* and the *Building Amendment Regulations (No.3)* were published in the WA Government Gazette. The Western Australian State Bushfire Prone Mapping was also publicly released.

These reforms introduce new requirements for people intending to develop and/or build in bushfire prone areas, including the need to assess a property's bushfire risk and take additional construction measures to limit the impact of bushfires.

The reforms introduced in 2015 included:

- **Emergency Services (Bush Fire Prone Areas) Order 2015:** 4 (1) *The areas of the state described in the Bushfire Prone Areas dataset are designated as bush fire prone areas.*
 - **Planning and Development (Local Planning scheme) Amendment Regulations 2015:**
 - *States that a property is within a 'bush fire prone area' if designated as such by the Fire and Emergency Services Commissioner for the purposes of land-use planning requirements;*
 - *Clarify where exemptions to the requirements set out in the LPS Amendment Regulations 2015 apply;*
 - *Ensure that a Bushfire Attack Level (BAL) assessment is undertaken for new habitable buildings in a bush fire prone area (unless exemptions apply);*
 - *Require development approval for habitable buildings and land uses on sites that receive a BAL of BAL-40 or BAL-Flame Zone (FZ);*
 - *Include a four-month transitional period from the date a site is designated as being bushfire prone to ensure landowners and the development industry have time to adequately prepare; and*
 - *Ensure Special Control Areas continue to have effect in local government areas.*
- (DoP, 2016)

- **Planning and Development Act 2005 State Planning Policy 3.7 (SPP 3.7)- Planning in Bushfire Prone Areas:** *The intent of this policy is to implement effective, risk based land use planning and development to preserve life and reduce the impact of bushfire on property and infrastructure. The application of SPP 3.7 applies to all higher order strategic planning documents, strategic planning proposals, subdivision and development applications located in designated bushfire prone areas.*
- **Building Amendment Regulations (No.3):** Outlines the definition of the bushfire prone area as designated under the *Fire and Emergency Services Act 1998* Regulation 31BA applicable building standards for buildings and incidental structures in bushfire prone areas. (WA Australian Government Gazette, 2015)

The publicly released bushfire prone mapping (Bushfire Prone Area Mapping, SLIP 8/12/15 & 21/5/2016) outlines the site to be Bushfire Prone as per the above regulations, as it is situated within 100m of >1 ha of bushfire prone vegetation. Refer to extract from the Office of Bushfire Risk Management (SLIP) as released in December 2015 (updated 20/5/2016) Appendix A.

This document and the recommendations contained are aligned to the following policy and guidelines:

- AS 3959-2009 “Construction of Buildings in Bushfire Prone Areas” current and endorsed standards;
- State Planning Policy 3.7 (SPP 3.7) Planning in Bushfire-Prone Areas (WAPC, 2015b);
- Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a);
- *Fire and Emergency Services (Bush Fire Prone Areas) Order 2015;*
- *Planning and Development (Local Planning Scheme) Amendment Regulations 2015;*
- *Bushfires Act 1954;* and
- City of Rockingham annual Fire Control Notice.

2.2. Suitably Qualified Bushfire Consultant

This BMP has been prepared by Kathryn Kinnear (nee White), who has 10 years operational fire experience with the (formerly) DEC (1995-2005) and has the following accreditation in Bushfire Management:

- Incident Control Systems;
- Operations Officer;
- Prescribed Burning Operations;
- Fire and Incident Operations;
- Wildfire Suppression 1, 2 & 3;
- Structural Modules – Hydrants and hoses, Introduction to Structural Fires, and Fire extinguishers; and
- Ground Controller.

Kathryn Kinnear currently has the following Tertiary Qualifications:

- BAS Technology Studies & Environmental Management;
- Diploma Business Studies; and
- Graduate Diploma of Environmental Management.

Kathryn Kinnear is an accredited Level 1 BAL Assessor (Accreditation No: BPAD30794) and is classified as an Experienced Level 2/3 Practitioner pending accreditation. Kathryn Kinnear is presently a member of Fire Protection Australia Association and a committee member of the Bushfire Subcommittee Western Australia. Kathryn is a suitably qualified Bushfire Practitioner to prepare this Bushfire Management Plan.

3. Aims of this Plan

The aim of this BMP is to assess the bushfire risks associated with the existing subdivision and future subdivisions and to reduce the occurrence of, and minimise the impact of bushfires, thereby reducing the threat to life, property and the environment. It also aims to guide future development of the subject site by assessing the development to the Bushfire Protection Criteria Acceptable Solutions as outlined in the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a).

3.1. Planning Context

The BMP has been prepared to support a Structure Plan (SP) proposal on Lots 5, 6, 7 and 8 Kerosene Lane Baldvis (Appendix B). The BMP has been prepared as part of the planning process to prescribe bushfire management measures for the proposed development as per the State Planning Policy 3.7 Planning in Bushfire-Prone Areas (WAPC, 2015b), and the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) (Appendices, 2, 3 and 4). The BMP will guide the development design to implement bushfire protection and risk mitigation measures for the preservation of life, property and infrastructure.

3.2. Site inspection

To ensure that every aspect of the proposed subdivision meets the planning requirements as set out in Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) (Appendices, 2, 3 and 4) a site inspection was undertaken on the 19th June 2015 by Kathryn Kinnear (Bushfire Consultant, Bio Diverse Solutions) to assess the vegetation and the site conditions.

The site was assessed as having an **Extreme - Moderate** Bushfire Hazard Level (BHL) due to the site being adjacent to internal and external patches of remnant native vegetation areas (bushfire prone vegetation). Where a subdivision is located within an extreme or moderate BHL, the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) requires assessment to the bushfire protection criteria – a process where subdivisions are assessed for compliance to the criteria. The bushfire protection criteria (Appendix 4, WAPC, 2015a) are a performance based criteria in assessing bushfire risk management measures and they outline four “Elements”. The “Elements” which are to be met either through the objectives of the “Performance Principle” or “Acceptable Solutions” (WAPC, 2015a) for the subject site include:

- Element 1 - Location;
- Element 2 - Siting and design of development;
- Element 3 - Vehicular access; and
- Element 4 – Water.

(WAPC, 2015a)

This BMP has been prepared to assess the site suitability against the “Acceptable Solutions” of the bushfire protection criteria (WAPC, 2015a).

3.3. Objectives

The objectives of this BMP are:

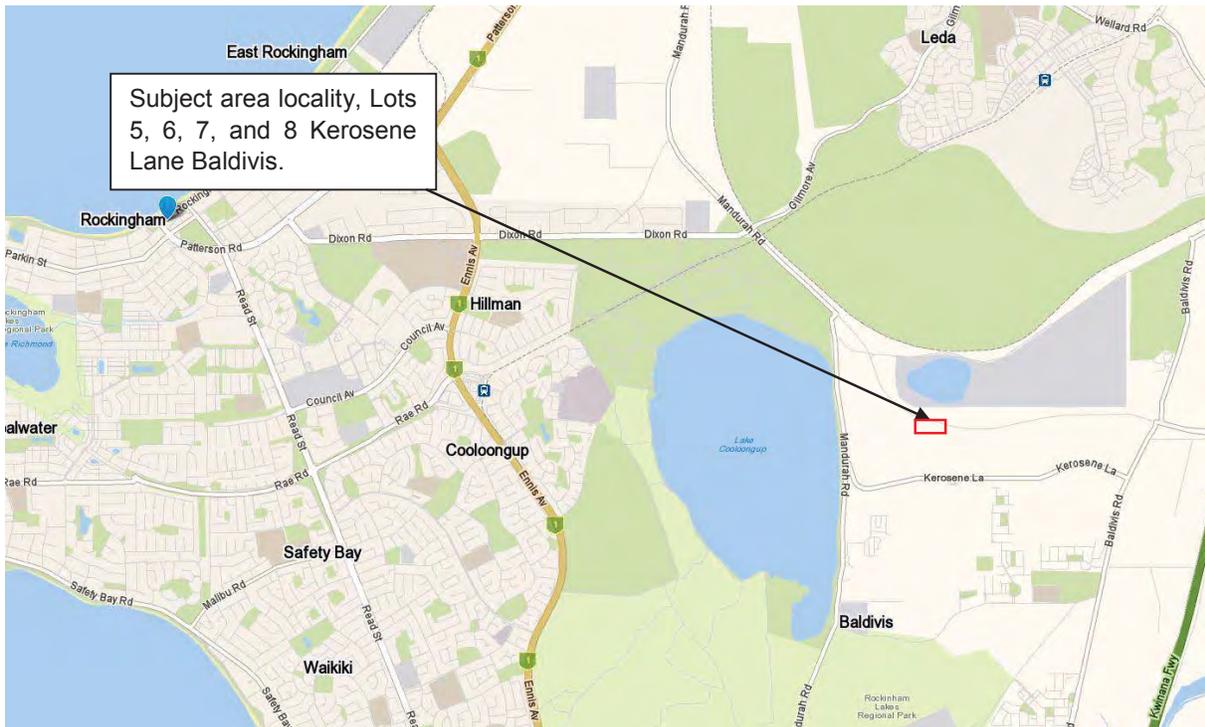
- Achieve consistency with objectives and policy measures of SPP 3.7 (WAPC, 2015b);
- Assess any building requirements to AS3959-2009 (current and endorsed standards) and BAL Construction;
- Assess the subdivision proposal against the Bushfire Protection Criteria Acceptable Solutions as outlined in the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a);
- Understand and document the extent of the bushfire risk to the subject site;
- Prepare bushfire risk management measures for bushfire management of all land within the subject area with due regard to people, property, infrastructure and the environment;
- Nominate individuals and organisations responsible for fire management and associated works within the subject area; and
- Aligned to the recommended assessment procedure which evaluates the effectiveness and impact of proposed, as well as existing, bushfire risk management measures and strategies.

4. Description of the area

4.1. Location

The subject site is 10 km east of Rockingham CBD, within the municipality of the City of Rockingham. The subject site is 8.1ha made up of 4 existing lots which have 2 existing dwellings on site (lot 5 and lot 7). Please refer to Figure 1 below - Locality Map, and Site Location Mapping Appendix A.

Figure 1 – Subject site locality



4.2. Development proposal

The SP at Lots 5, 6, 7 and 8 Kerosene Lane Baldvis contemplates residential development in the density range R30 and Public Open Space areas (POS). Please refer to the proposed SP in Appendix B. Adjacent properties to the east and south are proposed urban areas, refer to Appendix B for plans associated with these.

5. Desktop Assessment – Regional Setting

5.1. Current site land use

The site is currently 2 rural lots with remnant vegetation, two habitable dwellings (lot 5 and Lot 7) and one disused outbuilding (lot 6). Please refer to Photographs 1 to 4 below.



Photograph 1 – View of existing dwelling on Lot 5 Kerosene Lane.



Photograph 2 – View of disused outbuilding on Lot 6 Kerosene Lane



Photograph 3 – View of existing dwelling and outbuildings on Lot 7 Kerosene Lane.



Photograph 4 – View of Lot 8 from north west (off Kerosene Lane), predominantly vegetated with no existing dwelling on site.

5.2. Surrounding land uses

Adjacent to the subject site to the north is remnant vegetation contained in Reserve 22429 (north of lots 8, 7 and 6) and Lot 287 Kerosene lane (Lot 6 and 5). The remnant vegetation has recently sustained a bushfire (summer 2015) and is regenerating post fire. Refer to Photographs 5 and 6.



Photograph 5 – View of Reserve 22429 north of Kerosene Lane, recently burnt.



Photograph 6 – View of remnant vegetation to the north of Kerosene Lane on private property.

To the east of lot 5 there is market gardens which are not currently tended (Photograph 7) and to the west (adjacent to lot 8) is cleared paddock areas with some isolated trees, refer to Photographs 7 and 8.



Photograph 7 – View of market gardens to the east of the subject site (adjacent to Lot 5).



Photograph 8 – View of cleared paddock areas to the west of the subject site (adjacent to lot 8).

To the south is private property with some remnant vegetation (eastern extents) and cleared paddock areas with remnant trees (western extents), refer to Photographs 9 and 10.



Photograph 9 – View of cleared paddocks south of lot 7 and 8 Kerosene Lane.



Photograph 10 – View of remnant vegetation south of Lot 5 and 6 Kerosene Lane.

The lots adjacent to the subject site to the east, south and west are proposed to be developed into residential areas (refer to Section 5 for more detail).

5.3. Climate

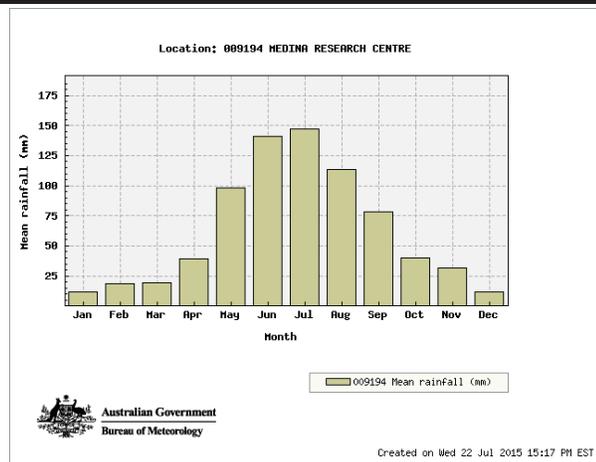
Perth experiences a Mediterranean climate, characterised by hot, dry summers and mild, wet winters. These seasons extend into the autumn and spring months, which are transitional periods between the main seasons (BoM, 2014).

The climate of the region is strongly influenced by the position of the axis of the band of high pressure known as the sub-tropical ridge, and in the warmer months by the development in the easterlies to the north of the ridge of a trough of low pressure near the West Coast. For much of the year the ridge is located to the south allowing the east or southeasterly winds to prevail. During the cooler months the ridge periodically moves to the north allowing cold fronts to pass over the west coast and deliver much of the annual rainfall. Sometimes these fronts interact with tropical cloud bands from the northwest and this can enhance the amount of rainfall produced.

5.3.1. Rainfall

Long term climate statistics from Medina Research Centre Bureau of Meteorology (BOM) station 9194 (13km north of subject site) indicates an annual mean rainfall of 752.7 mm (BOM, 2015), which occurs on 89 rain days, approximately 80% usually falls between May and September. Rain occurs on four days out of every seven on average during winter. Flooding is rare to the region, however heavy rain may be produced by strong winter cold fronts or, less frequently, by summer storms or, more rarely, by decaying tropical cyclones. The highest mean monthly rainfall is 147.2mm recorded in July, with the driest month being January with 2.2mm mean rainfall. It is not unusual for there to be extended dry periods during the warmer months. Please refer to Medina Research Centre (13km north of subject site) Annual Rainfall Graph (Figure 2).

Figure 2 – BoM Rainfall for Jandakot Aero Station (#009172)

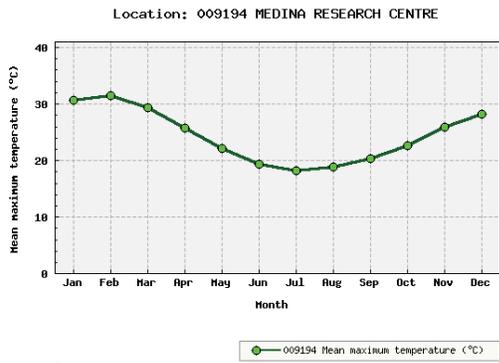


(BoM, 2015)

5.3.2. Temperature

Mean monthly air temperatures range from 31.5°C in February to 18.3°C in July (BoM, 2015). Summer maximum temperatures are strongly dependent upon the arrival time of the reliable sea breezes. On some days the difference between the maximum temperatures on the coast and the eastern suburbs may exceed 10°C. Heatwaves are associated with strong easterly winds and the late arrival or absence of the sea breeze. The highest temperature ever recorded is 46.2°C, however, the temperature exceeds 40°C on only three days per year on average. The average minimum temperature ranges from just 8.2°C in July and August to 17.6°C in February. Please refer to average temperatures over the page for Medina Research Centre (13km away), Figure 3 and Figure 4.

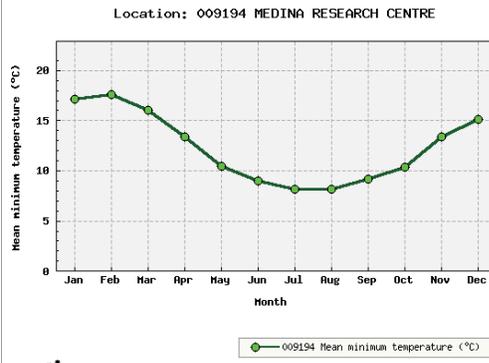
Figure 3 – Mean Max Temperatures



Australian Government
Bureau of Meteorology

Created on Wed 22 Jul 2015 15:19 PM EST

Figure 4 – Mean Min Temperatures



Australian Government
Bureau of Meteorology

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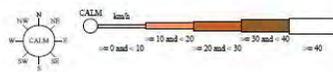
(BoM, 2015)

5.3.3. Wind

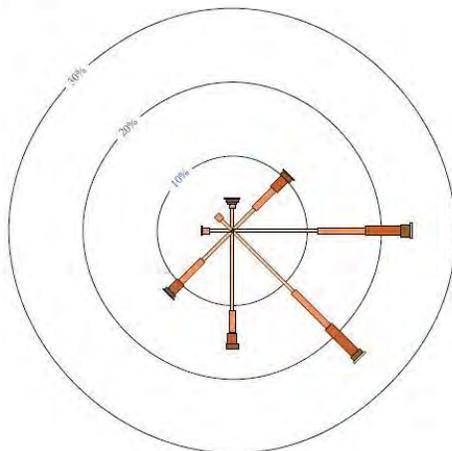
Winds are mainly easterly and south easterly but varied in the warmer months by reliable afternoon sea breezes from the south west and west. Summer morning (9am) winds are characterised by strong easterly and south easterly winds to 20-30k/hr occurring 20% of the time with lighter north east 10-20km/hr occurring 10% of the time. Afternoon (3pm) summer winds are characterised by strong south westerlies (prevailing afternoon sea breeze) up to 30-40km/hr occur close to 50% of the time. Westerly winds occur 10% of the time. In the cooler months winds are predominantly from the north in the morning and then westerlies in the afternoon that are associated with the bulk of the annual rainfall. Despite the occurrence of strong winds or gales, average wind speeds in winter are considerably lighter than in summer (BoM, 2015). Please refer to Figure 5 and 6 below.

Figure 5 – Summer (January 9am & 3pm) wind rose BoM

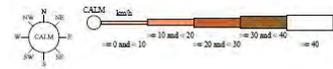
Rose of Wind direction versus Wind speed in km/h (01 Apr 1983 to 30 Sep 2010)
Custom times selected, refer to attached note for details
MEDINA RESEARCH CENTRE
Site No. 009194 - Opened Apr 1983 - S81 Open - Latitude: -32.2208° - Longitude: 115.8075° - Elevation 14m
An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



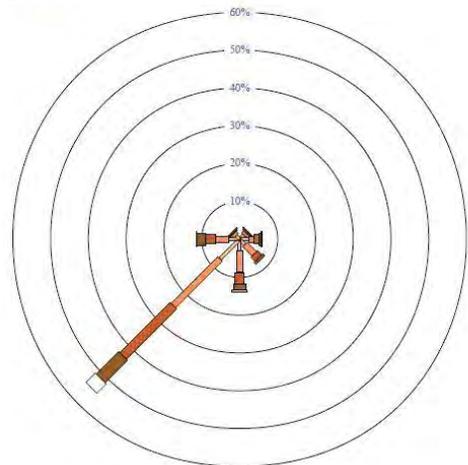
9 am Jan
796 Total Observations
Calm 1%



Rose of Wind direction versus Wind speed in km/h (01 Apr 1983 to 30 Sep 2010)
Custom times selected, refer to attached note for details
MEDINA RESEARCH CENTRE
Site No. 009194 - Opened Apr 1983 - S81 Open - Latitude: -32.2208° - Longitude: 115.8075° - Elevation 14m
An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.

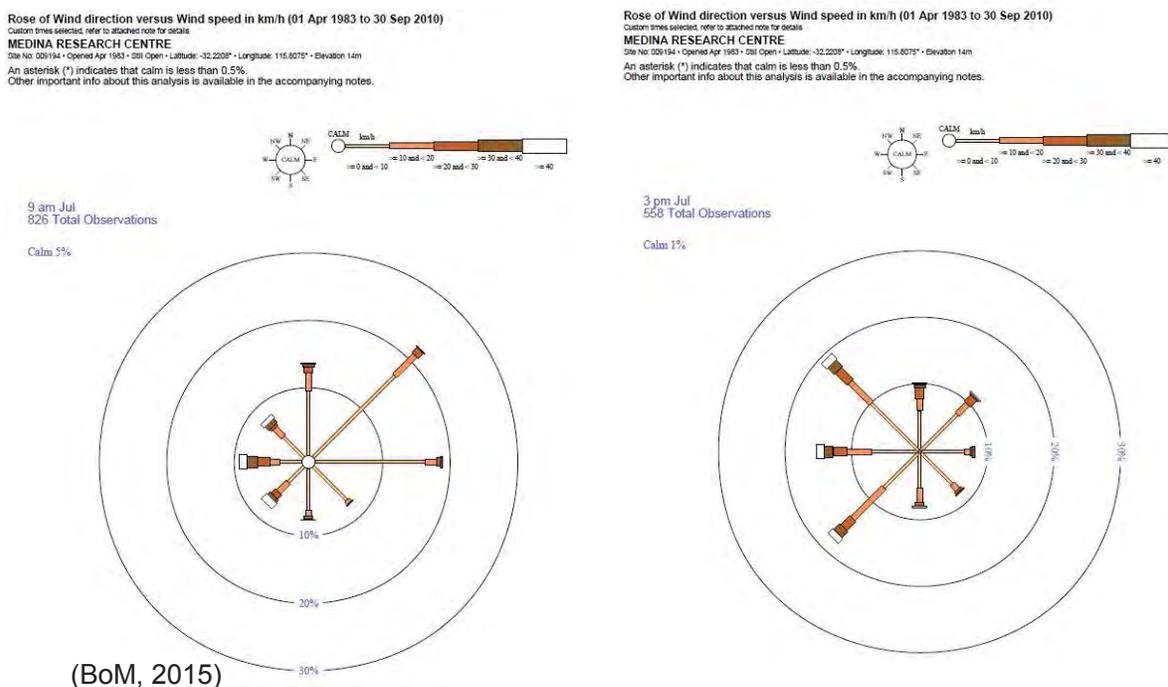


3 pm Jan
532 Total Observations
Calm *



(BoM, 2015)

Figure 6 – Winter (July 9am & 3pm) wind rose BoM



5.3.4. Prevalent Fire Weather

Weather significantly affects the behaviour of bushfires and time of low humidity and strong winds will lead to more aggressive bushfires and extreme bushfire events. Seasonal factors affect fuel moistures and fuel availability, and affect the intensity of fires. The south west of WA is one of the most bushfire prone regions in the world due to the combination of a Mediterranean-type climate with hot dry summers and the presence of large areas of flammable native vegetation (Bushfire CRC, 2015).

Fire weather is characterised by mid-level disturbances across the south west of Western Australia, bringing unstable atmospheric conditions (thunder and lightning) from the north or north-west wind directions. Very dangerous fire weather conditions often follow a sequence of hot days and easterly winds when the trough deepens near the coast and moves inland. Winds can change from easterly to northerly, then westerly very quickly during these climatic events. This is characteristic of “Extreme” Fire Weather conditions to the area with hot, dry conditions prior to storm events. Risk of lightning strikes, spark ignition, arson and other causes of fire give rise to uncontrolled bushfires under these conditions.

Prevalent winds which most bushfire events are associated with in the region during summer (bushfire season) are from the east (dry land based winds), south and south-west direction (afternoon sea breezes). Conditions tend to be dry through the day with low relative humidity. High winds and excess fuels can lead to hazardous conditions for residents. Strong south westerly winds exist at the subject site during dry (afternoon) summer periods (Figure 5). These circumstances place residential housing under the most risk from wildfire events.

5.3.5. Climate Change

Climate change is expected to impact on the future rainfall pattern of the area. It is recognised that the average rainfall has already declined by 20%-30% over the past few decades and that the long term impact of climate change may lead to a shift in rainfall, as well as dryer climatic conditions for the region. The long term changes are predicted to impact on the flora, fauna and water availability for the region. (Climate Commission 2010)

The Climate Commission (Climate Commission 2010) estimates that
“...Rainfall patterns in Western Australia have changed over the last 40 years. There is significant evidence that climate change has contributed to the marked drying trend in the southwest of the state.”

The construction of the proposed development is not predicted to be affected by sea-level rise, however could be affected from increased intensity rainfall events or extended drying periods. Increased extreme weather from climate change could affect fire frequency and behaviour in Western Australia (DEC, 2012), this Bushfire Management Plan has been prepared to reduce the risk of fire on the proposed residential dwellings in the newly created subdivision.

5.4. Topography

The subject site is located in an undulating landscape on the Swan Coastal Plain with the “Effective Slopes” (as per AS3959-2009) measured between 8-10° (degrees) (north of the site), 3.2°-4° (north east), and flat land (west, south and east). Please refer to the slope analysis on the Vegetation Mapping Appendix C.

Generally slopes surrounding the site are low not exceeding 5° (degrees). The effective slopes under classifiable vegetation to AS3959-2009 (Table 2.4.3) that to apply to this development include:

- Upslope and Flat Land; and
- Downslope >0 to 5 degrees.

5.5. Bushfire fuels – Vegetation

The subject site lies within the Swan IBRA bioregion. This bioregion is comprised of “low lying coastal plain, mainly covered with woodlands. It is dominated by *Banksia* or *Tuart* on sandy soils.” The area is located within the SWA1- Dandaragan Plateau. The plateau is bordered by Derby and Dandaragan Faults. Cretaceous marine sediments are mantled by sands and laterites. Characterised by *Banksia* low woodland, Jarrah - Marri woodland, Marri woodland, and by scrub-heaths on laterite pavement and on gravelly sandplains. (Hearn et al., 2002).

The vegetation has been mapped on a broad scale by JS Beard (Shepherd et al 2002) in the 1970’s, where a system was devised for state-wide mapping and vegetation classification based on geographic, geological, soil, climate structure, life form and vegetation characteristics (Sandiford and Barrett 2010).

A search of JS Beard’s vegetation classification database for the general area places the site within 1 broad Vegetation Association for the site:

1. System Association: Spearwood

Vegetation Association number: 998

Vegetation Description: Medium woodland; tuart (e4Mi)

The vegetation on site to the east forms an Open forest of mature *Eucalyptus gomphocephala* with an understorey dominated by weedy species and *Acacia Rostellifera*, *Acacia pulchella* (var. *goadbyi*) and *Olearia axillaris* (Lots 5 and 6) in good to degraded condition. To the west a low open forest of *Eucalyptus gomphocephala* with a variety of understories including a weedy understorey dominated by **Pelargonium capitatum* and **Pennisetum clandestinum*, as well as *Acacia sp. rostellifera*, *Acacia pulchella* (var. *goadbyi*) and *Olearia axillaris* (lots 7 and 8) in good to degraded condition. In the east of lot 8 a small patch of *Acacia rostellifera* occurs in a dense thicket/scrub to 2-3m.

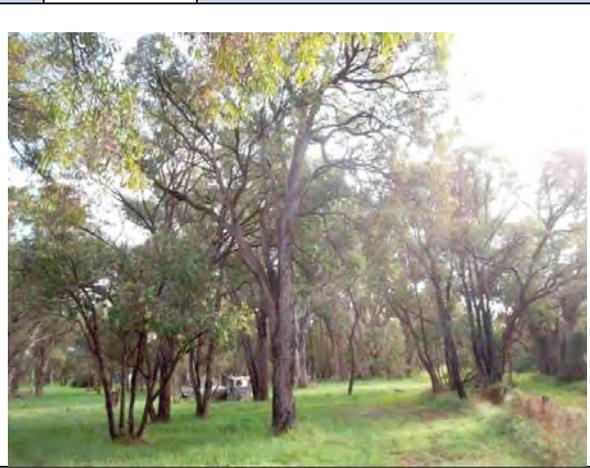
To the north of the site in Reserve 22429 is Low Open Forest of mature *Eucalyptus gomphocephala* and *E.marginata* over *Acacia sp. rostellifera*, *Acacia pulchella* (var. *goadbyi*) and *Olearia axillaris*. To the north and north east of lot 5, thickets (scrub) of *Acacia pulchella* and *A.rostellifera* occur.

To the south of Lot 5 and 6 there is Open forest of mature *Eucalyptus gomphocephala* with an understorey dominated by weedy species and *Acacia rostellifera*, considered degraded. To the south and south east of Lots 7 and 8 there is cleared paddock areas with isolated *Eucalyptus gomphocephala* and *E.marginata*. These areas had a completely weedy understorey and were considered completely degraded.

All vegetation within 100m of the site / proposed development was classified in accordance with Clause 2.2.3 of AS 3959-2009. Each distinguishable vegetation plot with the potential to determine the Bushfire Attack Level is identified below. Each plot is representative of the Vegetation Classification to AS3959-2009 Table 2.3 and shown on the Vegetation Classification Mapping Appendix C. Note the following vegetation plots differ to the original assessment undertaken by Bio Diverse Solutions and have been adapted to comply with CoR requests (COR assessment document dated 2/2/2016 E. Dawson). These are not necessarily agreed to or supported by Bio Diverse Solutions.

Plot	1	Classification or Exclusion Clause	Woodland Type B
			<p>North of the subject site in CoR Reserve. View of Reserve 22429 north of Kerosene Lane, recently burnt. Woodland Type B. Fuel loading 15T-25T/ha. Jarrah, Casuarina Low open Woodland. Grassy understorey. Effective slope – upslope. Located 20m from the lot boundary.</p>
Photo ID: Photo 1 View of Reserve 22429 north of Kerosene Lane, recently burnt (at time of assessment) view from south to north.			
Plot	2	Classification or Exclusion Clause	Scrub Type D
			<p>To the north of Kerosene Lane, north of the subject site. <i>Acacia</i> dominant, interspersed with grassy understorey. Average vegetation height 3-4m. Effective slope – upslope. Surface fuel loading 25 t/ha. Located 20m from the lot boundary.</p>
Photo ID: Photo 2 View of Acacia Scrub Vegetation Type D, north and north east of Lot 5 and 6. View from south to north			

Plot	3	Classification or Exclusion Clause	Forest Type A
			<p>North east of the subject site along Kerosene Lane. <i>Eucalyptus marginata</i> 6-8m. Multi layered. Total available fuels 25-35T/ha. Canopy cover >70%. Average height of trees 8-10m. Effective slopes 4 degrees downslope. Located 56m from the proposed lots in the subject site.</p>
<p>Photo ID: Photo 3 view of Forest Type A to the north east of the subject site. View from the southwest to the north east.</p>			
Plot	4	Classification or Exclusion Clause	Grassland Type G
			<p>Paddock grasses, old horticultural lot disused. Unmanaged grasses 100-400mm. Kikuyu, clover, fleabane, lupins, cape weed, marshmallow. No trees. 3-4 T/ha fuel loading. Effective Slope 3- 4 degrees downslope. 0m from eastern boundary to lot 5.</p>
<p>Photo ID: Photo 4 View of grassland Type G in horticultural lot to the east of lot 5, view from north to south.</p>			
Plot	5	Classification or Exclusion Clause	Forest Type A
			<p>Forest Type A. Tuarts 10-15m in height. Located within the subject site in lot 5 and 4m to the south of the subject site in adjacent private property. Multi layered. 25/35T/ha. Grassey understorey in some places. >30% vegetative cover. Effective Slope Flat land.</p>
<p>Photo ID: Photo 5 View of Tuart Forest, Vegetation Type A, view to the south of lot 5 and 6</p>			

Plot	6	Classification or Exclusion Clause	Scrub Type D
	<p>Located in Lot 8 (north west), northern edge of Lot 6 and to the south of the subject site in the south east. Surface fuel loading 25T/ha. 30% vegetative cover. Scrubs 3-4m high. Acacia dominant with grassy understorey. Effective Slopes 5.7 degrees downslope (lot 8), Upslope (Lot 6) and flat land (south of subject site).</p>		
<p><i>Photo ID: Photo 6 View of Scrub Type D in north west of subject site in Lot 8. View from north west to south east.</i></p>			
Plot	7	Classification or Exclusion Clause	Woodland Type B
	<p>Open Woodland Type B. Tuart dominant with understorey of paddock grasses and Acacia. 10-30% vegetative cover. 30% canopy cover. 15-25T/ha available fuel. Located within the subject site in Lot 7 and Lot 8. Located adjacent to the subject site to the south (0-10m). Effective slopes in the subject site 3.4 degrees and to the south of the subject site flat land (0 degrees).</p>		
<p><i>Photo ID: Photo 7 View of Woodland Type B in Lot 7, view from west to east.</i></p>			
Plot	8	Classification or Exclusion Clause	Grassland Type G
	<p>Thin strips of Grassland Type G on edge of firebreak throughout the lots and to the south and west in adjacent lots. Highly disturbed area, grasses and occasional Tuart trees. Fuel loading possibly reach 4.5 T/ha if left unmanaged. Effective slope 0 degrees in the south and to the west of the site >0-5 degrees downslope. <10% trees. Located 0m from west and between 0-10m in the south.</p>		
<p><i>Photo ID: Photo 8 view of Grassland Type G in the north west of the subject site. View from north east to south west.</i></p>			

Plot	9	Classification or Exclusion Clause	Forest Type A
			<p>Located in Lot 8 of the subject site. Previously disturbed in state of regrowth. Multilayered structure. Trees 6-12m. Occasionally a Woodland Type B structure but if left to regenerate will become a Forest Type A fuel loading. Surface fuel loads 25-35T/ha. Effective slopes 3.2 degrees downslope Located within the site 0m.</p>
<i>Photo ID: Photo 9 view of Forest Type A in north west corner of subject site in Lot 8. Photo view from north west to south east.</i>			
Plot	10	Classification or Exclusion Clause	Woodland Type B
			<p>Isolated Tuart trees forming connected canopy over grasslands. Located in the south west corner of the subject site and adjacent to the west and south. Available fuels could reach 15T/ha if left unmanaged. 10-30% vegetative structure. Trees 10-15m high. Located 0m (within the site) and 0m to the west and south (along the boundary). Effective Slopes flat land.</p>
<i>Photo ID: Photo 10 View of Open Woodland Type B to the south of the subject site. View from north east to south west.</i>			
Plot	11	Classification or Exclusion Clause	Low Fuel or non-vegetated areas Exc 2.2.3.2 (e)
			<p>Buildings in the existing lots.</p>
<i>Photo ID: Photo 11 View of existing dwelling in Lot 5. View from north east to south west.</i>			

Plot	12	Classification or Exclusion Clause	Low Fuel or non-vegetated areas Exc 2.2.3.2 (e)
		<p>Roads, driveways, bare areas and accessible firebreaks Located to the north in Kerosene Lane and within the lots.</p>	
<p>Photo ID: Photo 12 View of Low Threat and non-vegetated areas (AS3959-2009 Exc 2.2.3.2 (e)) – Kerosene Lane road reserve.</p>			
Plot	13	Classification or Exclusion Clause	Low Fuel or non-vegetated areas Exc 2.2.3.2 (f)
		<p>Low fuel areas associated with dwellings. Exclusion 2.2.3.2 (f). Located in lots 5 and 7.</p>	
<p>Photo ID: Photo 13 View of low fuel area in Lot 7. View from west to east.</p>			

5.6. Assets

The subject site has some areas of remnant vegetation, the site is valued for its proximity to the expanding residential areas of Rockingham, Leda and Wellard. Once developed, the values which will be potentially affected by fire include:

- **Human lives:** It is likely that more than 320 people could be resident at the newly created subdivision;
- **Assets:** The development will contain dwellings and valuable infrastructure; and
- **Environmental Conservation Values:** once developed there will be no conservation values for the site.

5.7. Access

Vehicle access to the subject site is from presently from Kerosene Lane into private driveways for lot 5 and 7 (limited formal access into Lots 6 and 8).

5.8. Water Supply

Water supply is presently from scheme mains resources.

5.9. Fire Breaks

There are existing firebreaks around the property, refer to Photograph 11. The adjacent properties to the east, west and south has 4m mineral earth firebreaks, refer to Photograph 12.



Photograph 11 – View of firebreak along the eastern boundary of lot 5 of the subject site.



Photograph 12– View of firebreak along the southern boundary of lot 5 of the subject site, and firebreak adjacent lot to the south (LHS).

6. Potential Bushfire Issues and Bushfire Hazards

The Bushfire Hazard Level (BHL) provides a “broad-brush” means of determining the potential intensity of a bushfire for a particular area (WAPC, 2015a). The BHL assessment process assists in informing the suitability of land contained within the strategic planning proposals for future subdivision and development (WAPC, 2015a). The BHL assessment process assigns land within a designated bushfire prone area as Low, Moderate or Extreme. Refer to the BHL categories Table 1 below.

The Vegetation type for the subject site (within 100m) has been classified as per AS3959-2009 as Forest Type A, Woodland Type B, Scrub Type D, Shrubland Type C, Grassland Type G and Low threat Vegetation (as per vegetation classifications outlined in AS3959-2009, Table 2.3). The bushfire hazard Level (BHL) ratings have been assessed as per the methodology as outlined in the Guidelines for Planning in Bushfire Prone Areas (2015) (Appendix 2). Please refer to Table 1 below.

Table 1 – Bushfire Hazard Level (BHL) Categories

Table 3: Hazard levels and characteristics

HAZARD LEVEL	CHARACTERISTICS
Low	<ul style="list-style-type: none"> • devoid of standing vegetation (less than 0.25ha cumulative area); • areas which, due to climatic conditions or vegetation (e.g. rainforest), do not experience bushfires; • inner urban or suburban areas with maintained gardens and very limited standing vegetation (less than 0.25ha cumulative area); • low threat vegetation, including grassland managed in a minimal fuel condition (i.e. to a nominal height of 100mm), maintained lawns, vineyard and orchards; and • pasture or cropping areas with very limited standing vegetation that is shrubland, woodland or forest with an effective up slope*, on flat land or an effective down slope* of less than 10 degrees, for a distance greater than 100 metres.
Moderate	<ul style="list-style-type: none"> • areas containing pasture or cropping with an effective down slope* in excess of 10 degrees for a distance greater than 100 metres; • unmanaged grasslands; • open woodlands; • open shrublands; • low shrubs on areas with an effective up slope*, on flat land or an effective down slope* of less than 10 degrees, for a distance greater than 100 metres or flat land; • suburban areas with some tree cover; and • forest and woodlands with a permanent grass understorey or at most, a scrub understorey structure consisting of multiple areas of <0.25ha and not within 20 metres of each other or single areas of <1ha and not within 100 metres of other scrub areas.
Extreme	<ul style="list-style-type: none"> • forests with a scrub understorey which is multi-tiered; • woodlands with a scrub understorey which is multi-tiered; • tall shrubs; and • any area of vegetation not otherwise categorised as low or moderate.

(WAPC, 2015a)

Internal Bushfire Hazard Level

The subject site has sustained some vegetation clearing on Lot 5, 7 and partially on lot 8 associated with dwellings, infrastructure and firebreaks. The remnant vegetation on the lots is predominantly Forest Type A, which is classified as an “**Extreme**” bushfire hazard (as per WAPC Guidelines, Table 1). There are some areas in Lot 8 and 6 which have Acacia scrub Vegetation Type D which is classified as a “**Moderate – Extreme**” bushfire hazard (as per WAPC Guidelines, Table 1). Grasslands adjacent to moderate or extreme classifiable vegetation is classified as Moderate BHL. Once developed the built form of the subdivision would be classified as “**Low threat vegetation and Non Vegetated areas**” (AS3959-2009), with the internal built landscape posing a “**Low**” threat of bushfire (as per WAPC Guidelines, Table 1).

Refer to Bushfire Hazard Mapping Appendix D.

External Bushfire Risks

To the east there is a disused horticultural lot with future planned urban areas (See Appendix B) these areas pose a **“Moderate”** threat of fire (as per WAPC Guidelines, Table 1). To the south, south west and west there is Grassland (Type G) with future planned urban areas (See Appendix B) which present a **“Moderate”** bushfire hazard (as per WAPC Guidelines, Table 1). These areas also have small patches of Woodland Type B which present a **“Moderate”** bushfire hazard (as per WAPC Guidelines, Table 1) and Forest Type A which present an **“Extreme”** bushfire hazard (as per WAPC Guidelines, Table 1). These areas to the south, west, south east and east are also planned future urban (see Appendix B).

The Bushfire Hazard associated with the site is the Woodland Type B to the north in Reserve 22429 and Tall Scrub Type D in private property which are classified as an **“Extreme”** bushfire hazards (as per WAPC Guidelines, Table 1). This bushfire prone vegetation will remain in perpetuity. The majority of this area to the north of the proposed subdivision is located upslope, excepting in the north east where the vegetation is located downslope (effective slopes 3.4° - 4°). Kerosene Lane intercepts this bushfire hazard, and the risk of bushfire and ember attack from upslope is reduced to the buildings located downslope. The north east corner (existing lot 5) of the subdivision poses the highest risk of bushfire from downslope ember attack and radiant heat.

There are proposed subdivision development(s) to the south (Lot 815 Mandurah Road), west (Lot 26 Kerosene Lane) and east (Lot 299 Kerosene Lane), these areas, once developed will be Low threat of fire (as per WAPC Guidelines, Table 1).

Refer to Bushfire Hazard Mapping Appendix D.

Proposed Subdivision Fire Risk Rating

The Bushfire Hazard within the proposed Structure Plan has proposed urban and landscaped areas containing low threat vegetation or non-vegetated areas with slopes <5°, or suburban areas with some native tree cover. This gives the newly built areas of the subdivision a **Low risk**.

The fire risk for this subdivision has been rated at an **Extreme - Moderate risk** due to the site being adjacent to external patches of forest remnant native vegetation areas to the north and scrub to the north east. The overall slopes for the scrub (Type D) vegetated areas are low (>5 degrees), however setback distances of over 100m from native vegetation cannot be achieved from the northern boundary. The Woodland Type D bushfire hazard to the north in Reserve 22429 has high effective slopes (8-10°) however is located upslope of the proposed dwellings and therefore has a reduced radiant heat and ember attack on the residences. Upon Completion of the subdivision Low BHL apply to the northern areas and when the adjacent subdivisions are completed to the east and the south.

Setback distances of over 100m from native vegetation (Bushfire Prone Vegetation) cannot be achieved for the development. Where 100m cannot be achieved to dwellings from Bushfire Prone Vegetation, the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) states that Building to Bushfire Attack Levels (BAL) and AS3959-2009 can apply to dwellings to assist in achieving “Acceptable Solutions” to the subdivision. Where a building is located within the State Gazetted Bushfire Prone Area Mapping (OBRM, 2015), the *Planning and Development (Local Planning Schemes) Amendment Regulations 2015* states that building to Bushfire Attack Levels (BAL) and AS3959-2009 is to apply to new dwellings.

The subdivision (and proposed dwellings) will be located within 100m of Bushfire Prone vegetation and is located within the WA State Bushfire Prone Area (SLIP, 2015 & 2016) mapping. The proposal will require assessment to the bushfire protection criteria as per the newly released “Guidelines for Planning in Bushfire Prone Areas” (WAPC, 2015a). These are outlined in **Section 6 Assessment to Bushfire Protection Criteria**.

7. Assessment to the Bushfire Protection Criteria

The Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) outlines bushfire protection criteria which subdivisions and development proposals are assessed for compliance. The bushfire protection criteria (Appendix 4, WAPC, 2015a) are a performance based criteria utilised to assess bushfire risk management measures and they outline four elements, being:

- Element 1: Location
- Element 2: Siting and Design of Development;
- Element 3: Vehicle Access; and ‘
- Element 4: Water.

(WAPC, 2015a)

The Structure Plan is required to meet the “Performance Principles” and/or “Acceptable Solutions” of each Element of the bushfire mitigation measures (WAPC, 2015a). The site has been classified as a having a “**Low**” future internal bushfire hazard in the development/building areas, with adjacent “**Extreme**” and “**Moderate**” bushfire hazards (as per WAPC Guidelines, Table 1) due to the presence of Forest Type A, Woodland Type B and Scrub Type D. Effective Slopes under vegetation are variable across the site but generally are upslope and flat land or Downslope >0 to 5 degrees.

The proposal will be assessed against the bushfire protection criteria Acceptable Solutions for Elements A1, A2, A3 and A4. The following sections of this report outlines how the proposal complies with the bushfire protection criteria Acceptable Solutions as per the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a).

7.1. Element 1: Location

Intent: To ensure that strategic planning proposals, subdivision and development applications are located in areas with the least possible risk of bushfire to facilitate the protection of people, property and infrastructure.

Assessment to the Acceptable Solutions.

Acceptable Solution applied A1.1: *the strategic planning proposal, subdivision and development application is located in an area that is or will, on completion, be subject to either a moderate or low Bushfire hazard level, or BAL-29.*

The publicly released Bushfire Prone Mapping (SLIP 2015 & 2016) indicates this area as bushfire prone. After completion of the subdivision, not all of the proposed lots and future dwellings are able to be located >100m from Bushfire Prone Vegetation (classified to AS3959). Proposed dwellings which cannot meet >100m HSZ from AS3959-2009 classifiable vegetation require a Bushfire Attack Level (BAL) and building to AS3959-2009 to apply to the lot (dwelling).

The AS3959-2009 construction standard that can apply to the dwellings in the subject site is shown in Table 3 – Minimum Setback Distances and Construction Standards. This is based on the BAL Contour with the legal agreements in place with adjacent developers and low fuel areas maintained as per AS3959-2009 Clauses 2.2.3.2.

Table 3 – Guide for minimum setback distances and construction standards

Lot Affected	Vegetation Type	Distance to Vegetation and Effective Slope	BAL Rating	Construction
Lots 124-133, 104-107 114-117, 93-96, 78-82, 67-72, 57-61	Woodland Type B	29-<100m All upslopes and flat land	BAL 12.5	AS3959-2009 to apply
52-49, 34-37, 25-30, 3-7	Scrub Type D	27m-<100m All upslopes and flat land	BAL 12.5	AS3959-2009 to apply
54-55, 66, 76, 77, 91, 92	Woodland Type B	20-<29m All upslopes and flat land	BAL 19	AS3959-2009 to apply
1, 2, 31-33, 53	Scrub Type D	19m-<27m All upslopes and flat land	BAL 19	AS3959-2009 to apply
1- 6	Forest Type A	50-<100m Downslope >0-5 Degrees	BAL 12.5	AS3959-2009 to apply
100-103, 120-123	Woodland Type B	14-<20m All upslopes and flat land	BAL 19	AS3959-2009 to apply

(AS3959-2009, Table 2.4.3 FDI 80)

Notes on BAL Contour Assessment:

- **Some allocated BAL's are from CoR site assessment and not reflected from the authors original assessment of the site.**
- **Sites will be subject to detailed feature survey and the mapping depicted in the BAL Contour Mapping Appendix E is a guide, with accuracy to within 5m.**
- **Detailed BAL Assessment (Method 1 AS3959-2009) is determined from the existing vegetation at time of feature survey and building construction/approval stages.**
- **Detailed assessment and re-assessment for BAL Construction as described in this document can be undertaken at construction stage/building approval stages by an accredited Level 1 BAL Assessor with approval from the City of Rockingham.**

- ***The BAL Contour Plan should be reviewed/updated at any staged construction, changes to the SP and/or at completion of the development construction.***

The development upon completion will have areas of internal **Low** bushfire hazard Levels and BAL – Low applied in developed areas of the subject site. The internal designated POS areas are proposed to be low fuel and landscaped areas, which is a Low BHL.

External to the site to the south there will remain an **Extreme and Moderate BHL's** if the adjacent property does not develop prior to the release of lots. Legal agreements are being generated to ensure that the developer clears and maintains to 100m from the adjacent road reserves developed by the client. The BAL Contour Plan generated in Appendix E is a “worst case scenario” whereby if all other lots are not developed adjacent to the subject site. The adjacent development to the south is dependent on the subject site being developed for infrastructure and therefore is anticipated to be built within 12 months of the subject site approvals.

To meet the Acceptable Solution the developer is proposing to clear and develop all external roads to ensure there is a separation for adjacent dwellings. Refer to Section 7.5.5 for further detail on staging. The client informed Bio Diverse Solutions that *“The clearing and earthworks will be completed in the first stage for the full development (stage 1 & 2) due to cut and fill requirements.”* (Pers comms L. Spencer, 2016)

Upon completion an updated BAL contour would be produced which (as noted in appendix E) will have BAL's associated only with the bushfire fuels from the CoR Reserve to the north of Kerosene Lane. A BAL Contour Plan has been prepared Appendix E which demonstrates the BAL Contours upon completed construction of the subdivision. This clearly demonstrates the dwellings will be subject to BAL 29-12.5 and no higher allocation of these BAL's will apply to completed subdivision.

Information for the lot owner on building to BAL is provided in Section 6.5.6 of this report.

The SP (and completed subdivision) is deemed to meet A1.1.

7.1.1. Recommendations arising from assessment to this element

The recommendations from assessment of the SP to Element 1: Location:

- SP development is deemed compliant to A1.1 due to :
 - No of the higher BAL allocation than BAL 29 will apply to buildings upon completion of construction development; and
 - Legal agreements are made to ensure the adjacent developers clear and maintain low fuel areas at all times 100m from the subject site boundary.

7.2. Element 2: Siting and design of development

Intent: To ensure that the siting of development minimises the level of bushfire impact.

Assessment to the Acceptable Solutions – To achieve compliance with this Element using an Acceptable Solution, either or both acceptable solutions (A2.1 and A2.2) must be met that it satisfies Element 2.

The Acceptable Solutions which will be applied to this subdivision include:

- **A2.1: Asset Protection Zone (APZ):** Every building is surrounded by a 20m APZ (see Section 5.2.2).
- **A2.2 Hazard Separation:** not applied to this development.

The subdivision will be assessed to the Acceptable Solutions for Element 2 as demonstrated in the following sections.

7.2.1. Asset Protection Zone (Acceptable Solution A2.1)

Acceptable Solutions applied

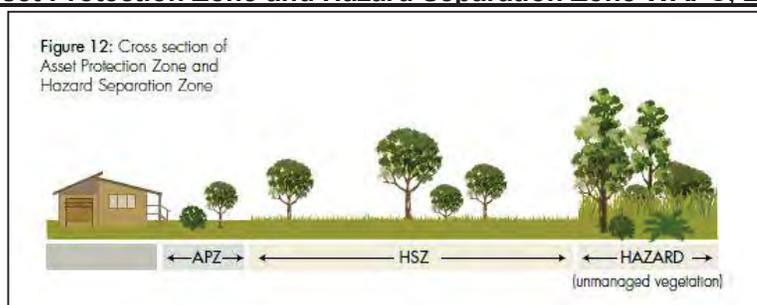
The aim of the Asset Protection Zone (APZ) is a low fuel area immediately surrounding a habitable building, and is designed to minimise the likelihood of flame contact with buildings WAPC, 2015a). APZ will minimise the risk of the building igniting, (thus protecting the occupants), and with the reduced fuel quantities, allow safer and more effective conditions for fire-fighters to contain wildfires. Roads, pathways, lawns, and other low hazard items should be placed within this zone to improve the effectiveness of the zone. The APZ are required in addition to Hazard Separation (see Section 5.2.2).

Every building must be surrounded by a 20 metre wide APZ, this is deemed by WAPC (2015) as the minimum width to be constructed around all buildings as a “defendable zone”. Activity within the APZ (as per WAPC, 2015) for each individual dwelling must meet the following requirements:

- a) Width: 20 metres measured from any external wall of the building or building envelope;
- b) Location: within the boundaries of the lot on which the building is situated;
- c) Fine fuel load: reduced to and maintained at 2 tonnes per hectare;
- d) Trees (crowns) are a minimum of 10 metres apart;
- e) Trees are low pruned at least to a height of 2 metres;
- f) No tall shrub or tree is located within 2 metres of a building;
- g) No tree crowns overhang the building;
- h) Fences and sheds within the APZ are constructed using non-combustible materials (e.g. colour bond iron, brick, limestone, metal post and wire); and
- i) Sheds within the APZ should not contain flammable materials.

An example of APZ from the “Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) is shown in Figure 8.

Figure 8 – Asset Protection Zone and Hazard Separation Zone WAPC, 2015a)



Most of the buildings utilise the Low threat and non-vegetated areas (as classified by AS3959-2009) for a 20m APZ (i.e. external roads, maintained POS or adjacent low fuel buildings) and this

can be contained within the parent lot. Lots adjacent to external Moderate BHLs in the south, west and east of the subject site require a will have a 100m low fuel area to be implemented by the adjacent developers and maintained at all times. As the subdivision is staged, the developer (and all title owners) are to maintain a minimum 20m APZ around any staged development. Refer to Section 6.5.6 for further detail on staging.

A 20m APZ is shown on the Bushfire Management Plan Mapping Appendix F.

The subdivision layout is deemed to be compliant with A2.1 with the adjacent Lots developed at the same time and with a low fuel area implemented to 100m as per the legal agreements.

Assumptions made in BAL Contour Mapping:

- The subject site will be cleared in entirety as shown on the SP.
- Low fuel areas of POS will be maintained as per AS3959-2009 clauses 2.2.3.2 (f) and has been applied to internal POS areas (See Section 6.5.2. for landscaping requirements).
- Reserve 22429 to the north will remain in current vegetative status.
- Adjacent developments will be maintained in a low fuel state as per AS3959-2009 Clauses 2.2.3.2 (f) at all times to 100m.

The subdivision will comply to Acceptable Solution A2.2 by applying either a 100m Hazard Separation Zone at the interface of the building and the bushfire hazard or a setback associated with BAL construction and AS3959-2009 as outlined in the BAL Contour Map(s) in Appendix E. No higher BAL allocation than BAL 29 is applied to the proposed buildings. In the south east and south west corners (if adjacent developer does not construct) a BAL 40 does overlay lots. If this occurs then these lots will not be able to be released and land banked by the current owner until a setback associated with BAL 29 can be achieved. As mentioned previously, it is understood that the adjacent developer to the south is dependent on construction of this project and development is anticipated within the timeframes of this proposal. Refer to the legal agreements prepared by Terranovis.

Staged construction is to be applied the developer will be responsible during staged construction to maintain 100m setback (internal) from any bushfire hazards to dwellings at all times or building to BAL/AS3959-2009 will apply to the buildings. Refer to Section 7.5.5 for more detail on Staging.

The subdivision is deemed to be compliant with A2.1.

7.2.2. Recommendations arising from assessment to A2

The recommendations from assessment of the SP to Element 2: Siting and design:

- The SP is deemed to be compliant with Element 2 by:
 - The application of a 20m APZ located within the parent lot; and
 - APZ setbacks associated with building to BAL/AS3959-2009 as it applies to the lots;
- The developer will be responsible for the implementation of a notification on title pursuant to Section 70A of the Transfer of Land Act 1893 for all lots affected by an increase in construction standards consistent with a BAL rating/AS3959-2009 allocation to the lot, and alerting the prospective owner(s) of the lots and successors in title of the Bushfire Management Plan.
- It is recommended that the developer clear all the area within the SP during development and prior to sale to ensure the APZ and setbacks are demonstrated to the purchaser at time of sale. The APZ areas are to be as per the standards in Section 6.2.1 and these areas are regularly maintained by the developer until all land is relinquished to the new lot owner(s).
- Maintain setbacks from dwellings and bushfire hazards at all times if the construction is staged construction and grasses maintained to <50mm at all times;
- The vegetation clearing required for POS area, street verges, APZ and HSZ areas does allow for the retention of significant trees, these should be clearly marked for the developer

prior to clearing operations on the site and shall be as per the standards of the APZ Section 6.2.1; and

- Individual BAL assessments may be considered on the lots by the new owners when dwelling design/placement is known and can be undertaken at building approval stages with the engagement of an Accredited Level 1 BAL Assessor.

7.3. Element 3: Vehicle Access - Performance Criteria

Intent: To ensure that the vehicular access serving a subdivision/development is available during a bushfire event.

Acceptable Solutions applied

The internal layout of the Subdivision's public roads and private access allows vehicles and other emergency vehicles to move through the subdivision at all times, meeting the Acceptable Solutions. Vehicle access technical standards as outlined in Table 4 are the minimum requirements from Guidelines for Planning in Bushfire Prone Areas WAPC, 2015a). Refer to Table 4 and Bushfire Management Plan Appendix F.

Table 4 – Vehicular Access Technical Standards

Technical requirements	Public Road	Cul-de-sacs	Battle Axes & Private Driveways	Emergency Access Ways (EAW)
Minimum trafficable surface (m)	6	6	4	6
Horizontal clearance (m)	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5
Maximum grades	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity(t)	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius(m)	8.5	8.5	8.5	8.5

(WAPC, 2015a)

Assessment of the subdivision to the Acceptable Solutions is outlined in the following sections.

7.3.1. Two access routes (A3.1)

The subdivision meets the Acceptable Solution, with the design allowing for two way traffic and safe egress from the subdivision via newly established road networks linking from the north to the east. Access to and from the subdivision (entry/exit points) will be from Kerosene Lane (north) via two entry points, and a future eastern access, which is proposed to be developed prior to the construction of this subdivision (*pers comms* L. Spencer Terranovis 2015). Please refer to the current SGP Appendix B and Bushfire Management Plan Appendix G. The adjacent proposed SGP's are shown in Appendix B which indicates the future access. Emergency access egress will be via the adjacent developer to the east and possibly future emergency access if required to the south west (this is yet to be confirmed by the adjacent developer).

Stage 1 construction (refer to Staging Plan Appendix B and overlaid on BAL Contour Appendix E and BMP report Appendix F) will allow for access to the north and the east to two different destinations. Legal agreements have been drawn up with the adjacent develop to the east to ensure the secondary access to the east is access is implemented.

The SP is deemed to meet the Acceptable Solution A3.1.

7.3.2. Public roads (A3.2)

All internal public roads shall be constructed with a minimum of 16-20m road reserves meeting the minimum construction requirements. The Vehicular Access Standards (Refer to Table 4 – Column 1) and relevant technical information shall be detailed in Civil Engineering Designs at subdivision stage. The SP is deemed compliant to Acceptable Solution A3.2.

7.3.3. Cul de Sacs (A3.3)

No cul-de-sacs are not proposed for this development, temporary cul-de-sacs may exist during staged development however is not anticipated to remain in perpetuity. The SP is deemed to comply to Acceptable Solution A3.3. T

7.3.4. Battle Axes (A3.4)

Battle Axes are not proposed for this development and therefore not assessed to Acceptable Solution A3.4.

7.3.5. Private Driveways (A3.5)

Private driveways will conform to the minimum technical standards as outlined in Table 4 – Column 4. The SP is deemed compliant to Acceptable Solution A3.5.

7.3.6. Emergency Access Ways (A3.6)

Temporary Emergency Access Ways (EAW) will apply to this development and are shown in the Bushfire Management Plan Appendix F. Once the adjacent developments are completed any emergency access will be along the established internal roads, with a separate dedicated Emergency Access Way not required. The SP is deemed compliant to this Acceptable Solution A3.6.

7.3.7. Fire Service Access Routes (A3.7)

Fire Service Access (FSA) Routes will be not be applied at this development. Any emergency access will be along the established internal roads, with a separate dedicated FSA not required. Subdivision upon construction is deemed compliant to this Acceptable Solution A3.7.

7.3.8. Firebreaks (A3.8)

Firebreaks are in existence on the subject site and maintained regularly by the current owners. These will be maintained as per the CoR Fire break notice (updated annually) until developed. The urban environment proposed will not require firebreaks in the future as per the current notice. The SP is deemed compliant to this Acceptable Solution 3.8.

Please refer to the CoR “Annual Fire Control Notice”, this is updated annually and the current versions should be obtained from the City of Rockingham website:

<http://www.rockingham.wa.gov.au>

7.3.9. Recommendations arising from assessment to this element

The recommendations from assessment of the SP to Element 3: Vehicular Access:

- Is deemed compliant with Element 3 as it meets the Acceptable Solutions as outlined A3.1 to A3.8;
- The developer implements the vehicular construction standards as outlined in Table 4;
- Engineering construction details on the road network particularly to meet maximum allowable grades is provided to the CoR prior to construction of each development stages.
- Fire breaks as per the requirements in the CoR Firebreak Notice maintained by the owner until the land is developed into urban land (annually updated).

7.4. Element 4 Water – Performance Criteria

Intent: To ensure that water is available to the subdivision, development or land use to enable people, property and infrastructure to be defended from bushfire.

Acceptable Solutions Applied

7.4.1. Reticulated areas (A4.1)

The development will be provided with reticulated scheme water in accordance with the specifications of the relevant water supply authority (Water Corporation WA (WCWA)) and DFES requirements. This will be detailed in the detailed engineering drawings and be subject to approval from WCWA and DFES at subdivision condition stages, meeting the Acceptable Solution. Fire hydrant (street) outlets are required, these must be installed to WCWA standards installed in accordance with the *Water Corporation's No 63 Water Reticulation Standard* and are to be identified by standard pole and/or road markings and installed by the Developer.

Subdivision upon construction is deemed compliant to this Acceptable Solution.

7.4.2. Non-reticulated areas (A4.2)

The subdivision will be connected to reticulated water, therefore water tanks will not be required, assessment to A4.2 not required.

7.4.3. Individual lots within non-reticulated areas

The subdivision will be connected to reticulated water, therefore water tanks will not be required and assessment to A4.3 not required.

7.4.4. Recommendations arising from assessment to this element

The recommendations from assessment of the SP to Element 4: Water:

- Is deemed compliant with Element 4 through the provision of reticulated water to the development which will be detailed in the engineering drawings at development stages; and
- Fire hydrant (street) outlets are required, these must be installed to WCWA standards installed in accordance with the *Water Corporation's No 63 Water Reticulation Standard* and are to be identified by standard pole and/or road markings and installed by the Developer.

7.5. Other Fire Mitigation measures

7.5.1. Reduction in Construction through Shielding

“Shielding” as defined by AS3959-2009 is the reduction in construction requirements (for an individual building) for the next lower BAL than determined for the site (individual dwelling) and may be applied to an elevation of a building where the elevation is not exposed to the source of the bushfire attack (AS3959-2009). Shielding applies where the an elevation of a building is not deemed to be exposed to the source of the bushfire attack due to other parts of the individual building obstructing the source of the bushfire attack.

Give the bushfire source is from the east, west and south, buildings in the northern area of the SP could possibly apply shielding whereby a lower BAL is applied to the northern elevations of a building. This would need to be assessed at building approval stages and be undertaken by an Accredited Level 1 BAL Assessor.

7.5.2. Landscaping/Streetscaping Areas

Landscaping and Streetscaping areas subject to similar standards that apply to the APZ and the following minimum standards shall apply:

- Trees (crowns) a minimum of 10m apart (no continuous crowns);
- Trees should have no dead material within the plant’s crown or on the bole;
- Fuel reduced to <2t/ha; and
- Shrubs should be no higher than 0.5 m.

A concept POS landscaping plan is presently being developed to retain significant trees (>500mm diameter) and example of the POS landscaping is shown below in Photograph 22 and meets the above requirements and thus does not increase the internal bushfire hazard.



Photograph 22: View of POS area in Baldvis with significant trees retained. This concept will be applied in the SGP at the subject site.

7.5.3. Evaporative air conditioners

Evaporative air conditioning units can catch fire as a result of embers from bushfire getting into the unit. These embers can then spread quickly through the home causing destruction. It can be difficult for fire-fighters to put out a fire in the roof spaces of homes. Information on Evaporative air conditioners is supplied in Appendix G of this document.

It is also recommended that home owners:

- Ensure that suitable external ember screens are placed on roof top mounted evaporative air conditioners compliant with AS3959-2009 (current and endorsed standards) and that the screens are checked annually; and
- Maintain evaporative air conditioners as per DFES guidance note provided Appendix G.

7.5.4. Barrier Fencing

In November 2010 the Australian Bushfire CRC issued a “Fire Note” (Bushfire CRC, 2010) which outlined the potential for residential fencing systems to act as a barrier against radiant heat, burning debris and flame impingement during bushfire. The research aimed to observe, record, measure and compare the performance of commercial fencing of Colourbond steel and timber (treated softwood and hardwood).

The findings of the research found that:

“.. Colourbond steel fencing panels do not ignite and contribute significant heat release during cone calorimeter exposure” (exposure to heat)

“..Colourbond steel (fencing) had the best performance as a non-combustible material. It maintained structural integrity as a heat barrier under all experimental exposure conditions, and it did not spread flame laterally and contribute to fire intensity during exposure”

Residents will be encouraged to build Colourbond or non-combustible fences in bushfire prone areas through dissemination of the CRC information “Fire Note” (Issue 70, Bushfire CRC, 2010) by the developer. It is also noted that non-combustible fences are recommended by WAPC refer to Section 6.2.1 of this document (APZ standards: Fences and sheds within the APZ are constructed using non-combustible materials (e.g. colour bond iron, brick, limestone, metal post and wire).

7.5.5. Staging

The subdivision is proposed to be staged (as shown on the BAL Contour Plan and the BMP Plan, Appendix E and F respectively), staged development will incorporate the following:

- Incorporation of “Low fuel zone” minimum of a 100m adjacent to any lots/proposed dwellings maintained as per AS3959-2009 Clause 2.2.3.2 (f). To be implemented by the developer and maintained at all times adjacent to the staged construction;
- Implementation of 100m “Low fuel zone” in adjacent subdivisions to be cleared and maintained but the adjacent developer as per the legal agreements and as per the standards in AS3959-2009 Clause 2.2.3.2 (f);
- Maintenance of fire protection measures in public areas (gates, access, landscaped areas etc.) until the developer has relinquished construction/maintenance responsibility of public use areas to the CoR;
- Provide the CoR prior to each subdivision stage and/or release of lots with a detailed plan showing the BAL Contour Plan for lots requiring increased construction standard for dwellings in accordance with AS3959-2009 Construction of Buildings in Bushfire Prone Areas (current and endorsed standards);
- Implementation of temporary EAW’s to the east and (possibly) the south by adjacent developers giving linking emergency access in alternative directions at all times;
- Maintenance of fire breaks as required by the CoR until the lots are relinquished to new lot owners;
- Depending on the timing of the future stages, a review of the endorsed Bushfire Management Plan is recommended every 3-5 years and will be the responsibility of the developer until the issue of final approval/clearances from CoR/WAPC; and
- Slashing of grasslands should occur to maintain low fuel areas (i.e. APZ) around housing and dwellings until the land is relinquished to new owners and/or CoR.

7.5.6. Information on Building to BAL/AS3959-2009

Bushfire Attack Level (BAL) is the process in AS3959-2009 for measuring the severity of a building’s potential exposure to ember attack, radiant heat and direct flame contact. The threat or risk of bushfire attack is assessed by an accredited BAL Assessor. BAL rating determinations are of 6 levels BAL-LOW, BAL-12.5, BAL-19, BAL-29, BAL-40, BAL FZ. Building is generally not recommended in BAL-40 or BAL-FZ areas. The BAL rating is determined by the distance of the building to vegetation, slope and vegetation type adjacent to the dwelling. Refer to Figure 9 over the page.

Figure 9 - - BAL Construction levels in context



(WAPC, 2015a)

Building design and construction to AS3959-2009 is a standard primarily concerned with improving the ability of buildings in designated bushfire prone areas to better withstand attack from bushfire thus giving a measure of protection to the building occupants (until the fire front passes) as well as to the building itself. The construction standards outlined in AS 3959-2009 provide reference to specific items of building and it is recommended that the future lot owner discuss these in detail with their builder or architect. Table 2 outlines some of the construction consideration to AS3959-2009 when building in bushfire prone areas. Construction standards are to be approved by the CoR prior to construction. Building to AS3959-2009 applies to buildings as defined in the Building Code of Australia (BCS).

Table 2 – AS3959-2009 Construction Requirement (Example)

Construction requirement AS3959-2009
Flooring systems
Supporting posts, columns, stumps, piers and poles
External Walls
Windows
External Doors
Vents and weep holes
Roof
Eaves
Fascia's
Gutters and downpipes
Veranda and decks
Service Pipes (water and gas)

AS3959-2009 disclaimer: It should be borne in mind that the measures contained within this Standard (AS3959-2009) cannot guarantee that a building will survive a bushfire event on every occasion. This is substantially due to the unpredictable nature and behaviour of fire and extreme weather condition.

(AS3959, 2009)

8. City of Rockingham Bushfire Protection Plan

The City of Rockingham has the assistance of the Baldivis Volunteer Fire Brigade which is made up of emergency trained personnel and volunteers. The CoR has volunteer bush fire fighting units and incident support teams within the brigade system. Training and induction courses are held regularly and land owners are encouraged to attend these. For more information refer to the City of Rockingham and DFES website:

<http://www.dfes.wa.gov.au>

<http://www.rockingham.wa.gov.au/>

8.1. Fire Fighting Facilities

The subject area is in the City of Rockingham in the locality of Baldivis. . The Baldivis Volunteer Fire Brigade attends bushfire emergencies within the region. The Volunteer BFB's services maintain 3.4 fire appliance vehicles/trucks and fast attack units, this is also backed up with a modern communication system for call outs as well as communication on the fire ground. These are typical of bush fire brigades for fire fighting services within Western Australia.

The Career Fire & Rescue Service have the following:

- Fully equipped fire station;
- Volunteer trained members;
- A communications and call out system;
- Protective clothing issue to volunteers; and
- DFES approved fire appliances.

Response times can vary depending on commitments of fire and rescue services, volunteers, fire events current at time and priority of the fire services in the south west of Western Australia during summer periods. DFES recommends that homeowners take care to prepare their individual dwellings for fire season and take precautions against fire as per the **'Bushfire Preparedness – Prepare. Act. Survive.'**

It is generally acknowledged that during large wildfire events, local resources may not be able to respond to every lot due to strategic deployments of services, priorities within the area or state and/or present commitments of volunteers and resources. It is therefore recommended that land owners implement strategies as recommended by DFES to protect life and property during the fire season.

8.2. Fire Suppression Actions CoR

The following protocols/actions for the subject site are recommended:

- Local Government (City of Rockingham) through their Bush Fire Brigade Organisation is the Controlling Authority for fire suppression operations on the area.
- Bushfire in or threatening the area will be contained to the smallest possible area, either by direct attack or by back burning from established buffers or fire lines taking into consideration the likely threats to life and property as well as the impact of suppression activity on the water quality and conservation objectives of the reserve.
- Irrespective of fire weather forecasts, whenever reserve vegetation will burn and whenever burns on adjoining lands are imminent, a high level of vigilance and preparedness will be maintained.

8.3. Homeowner Protection

It is the responsibility of homeowners to protect their property from fire. DFES have readily available information online which can assist homeowners in their preparedness during fire season (October to May). The DFES website "**Bushfire Preparedness – Prepare. Act. Survive.**" should be accessed by all owners in bushfire prone areas. A hard copy of the A4 book "Prepare. Act.

Survive” can be found at local City of Rockingham Offices or DFES offices, or downloaded off the above web address:

<http://www.dfes.wa.gov.au>

8.4. Bushfire Plan

Residents should prepare their own individual fire plans, as they need to make a commitment to develop a bushfire survival plan detailing preparations and actions to take if a bushfire threatens.

*“Before summer starts you need to decide what you will do if a bushfire threatens. If you live or work in a bushland area you need to **prepare** your home, family or business and have a plan so you can **act** to make sure you **survive**.”* (DFES 2010)

When developing a bushfire survival plan, the following should be considered:

- If you plan to leave for a safer place - where will you go and how will you get there? Your safer place could be with friends and family, and may not be far away. Know where you will go and never ‘wait and see’. Relocating at the last minute can be deadly
- Does your household include elderly relatives, young children, and people with disabilities or illness? When, where and how will they be relocated? Who will care for them?
- What will you do with your pets and livestock?
- Can your home be defended? Is it in a location that makes it difficult or dangerous to actively defend? (refer to DFES’s Homeowners Bushfire Survival Manual - PDF)
- Will your home provide shelter if you have to or decide to stay?
- Are you capable of defending your home without the support of fire fighters?
- Do you have the skills, knowledge and capacity to check for and put out spot fires for up to ten hours after the fire front has passed?
- Do you have the right equipment and resources to actively defend? (e.g. sufficient independent water supply of at least 20,000 litres and a petrol, diesel or generator powered pump capable of pumping 400 litres per minute)
- Will you cope with the noise and stress of a bushfire if you decide to actively defend? Being in a bushfire may be the most traumatic experience of your life.

(from DFES website, 2013)

By compiling information as outlined above, the individual lot owner can be prepared for their response in a bushfire emergency. Home owners should not rely on emergency personnel to attend their home and thus it is stressed to **prepare an individual bushfire emergency plan** regarding their intentions and property. This Bushfire Management Plan is **not** an individual bushfire emergency plan.

Information is also available on the City of Rockingham’s website and the ABC Radio website to guide homeowners in the event of a fire emergency, such information includes:

Planning for an Emergency Bushfire:

- Survival Kit
- Fire Emergency Services
- Before a Bushfire
- During a Bushfire
- After a Bushfire

Refer to the following links for more information on how to prepare a bushfire plan:

<http://www.rockingham.wa.gov.au/Services/Emergency-Services/Fire-Control#A>
and
<http://www.abc.net.au/news/emergency/?ref=front-page-slider-v2--emergencies>

9. Summary

9.1. Overall Fire Threat

Terranovis Pty Ltd commissioned Bio Diverse Solutions (Bushfire Consultants) to undertake a bushfire hazard assessment and prepare a Bushfire Management Plan to guide all future bushfire management for the proposed development of Lots 5, 6, 7 and 8 Kerosene Lane Baldivis Structure Plan and associated Subdivision Guide Plan. The proposed structure plan contemplates the creation of future lots in the density range of R30 and a public open space area.

To the west, south and east there is proposed urban development which will reduce the bushfire hazards to this development. The development to the east proposes to construct a road reserve to give access to the east, which assists the subject site achieving two opposing access/egress points. Legal agreements are presently being formed with adjacent neighbours to ensure there is access, sewer and maintenance of any bushfire hazards upon their land. Copies shall be forward to the CoR upon completion.

The subject site is has internal areas of Forest Type A and Scrub Type D which is proposed to be cleared for the subdivision. The adjacent land within 100m of the site is Forest Type A, Woodland (Type B), Scrub type D and cleared paddock areas (Type G). Bushfire Prone Vegetation within 100m of the site is located within Reserve 22429 and private property north/north east of Kerosene Lane. Urban growth the west, south and east are classified as future “*Low Threat Vegetation and Non Vegetated Areas*” (AS3959-2009). The majority of the site will be cleared for the subdivision with internal POS areas proposed to be landscaped public reserves (classified as low fuel areas).

The structure plan area has been rated as having an **Extreme-Moderate** bushfire hazard as defined by Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) and State Planning Policy 3.7 (WAPC, 2015b) due to adjacent Woodland, Forest and Scrub bushfire hazards. There are low effective slopes across the site and the majority of the long term bushfire risk (Woodland Type B vegetation (extreme)) is located upslope of the proposed dwellings. The external Scrub Type D vegetation (Moderate) is located downslope of the proposed subdivision.

This BMP report provides details of the fire management strategies proposed to be implemented across the site as it is subdivided and developed to ensure adequate protection of life, property and biodiversity assets. To ensure the mitigation measures are implemented responsibilities are outlined in the following sections for the Future Lot Owner, Developer and CoR.

9.2. Future Lot Owners Responsibility

It is recommended the Future Property Owners shall be responsible for the following:

- To take measures to protect their own assets on their property;
- Implement this document, Bushfire Management Plan of Lots 5, 6, 7 and 8 Kerosene Lane Baldivis as it applies to their individual property;
- Ensure that APZ's are maintained to a minimum of 20 metres around all buildings as per DFES and Planning for Bushfire Protection Guidelines;
- Where a lot has been identified as requiring an increased construction standard (i.e. BAL/AS3959-2009) ensure that the design and construction of any building is compliant with the requirements of AS3959-2009 (current and endorsed standards);
- Detailed BAL may be required by the individual lot owner with the BAL ratings supplied in this report as a guide to meet Acceptable Solutions. Detailed BAL should be undertaken by an accredited Level 1 BAL Assessor;
- Maintaining the property to minimise bushfire fuels and mitigate the risk of fire in accordance with CoR annual Fire Control Order;
- Ensuring that suitable external ember screens are placed on roof top mounted evaporative air conditioners compliant with AS3959-2009 (current and endorsed standards) and that the screens are checked annually;
- Each lot owner is aware of:
 - The endorsed and approved Bushfire Management Plan,

- A hard copy of the A4 book “Prepare. Act. Survive”,
 - Fire Control Information supplied by the City of Rockingham (annual updated advice brochure); and
- It is the responsibility of the individual property owner to maintain in good order and condition APZ and driveway standards. Future modifications other than requirements as set out in this Bushfire Management Plan can only be done with written agreement from the CoR.

9.3. Developers Responsibility

Prior to development being given final approval by the City of Rockingham, the Developer shall be required to carry out works that include the following but in respect to individual stages of development. Subsequent to the issue of final approval, the Developer shall have no further responsibilities to the provision of fire fighting facilities and fire management on individual lots that pass from their ownership.

It is recommended that the Property Developer shall be responsible for the following:

- Implement this document, Bushfire Management Plan of Lots 5, 6, 7 and 8 Kerosene Lane Baldivis as it applies to their development;
- Comply with standards as outlined by the CoR and WAPC conditions of subdivision;
- Ensure that property owners are aware of the endorsed and approved Bushfire Management Plan;
- Comply with minimum subdivision construction standards as outlined by this Bushfire Management Plan;
- Maintain any APZ and/or HS as Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) (as outlined in this plan) until the land is relinquished to new lot owners;
- Maintain fire protection measures in public areas (access, landscaped areas etc.) until the Developer has relinquished construction/maintenance responsibility of public use areas to the City of Rockingham;
- Implementing fire protection measures during staged development as per Section 7.5.5 of this Bushfire Management Plan;
- Maintaining the subject site to minimise bushfire fuels and mitigate the risk of bushfire in accordance with the CoR Fire Control Notice (yearly advice brochure updated annually);
- Implement a notification on title pursuant to section 70A of Land Act 1893 of lots affected by an increase in construction standards consistent with BAL rating/AS3959-2009 alerting owners of the lot and successors in title of the Bushfire Management Plan;
- In the event that the adjacent subdivisions to the east, west and south are not cleared or not constructed at the time of the release of any of the lots, a building setback will be required from all grassland, woodland and forest vegetation to assist in achieving a 20m APZ and BAL/AS3959-2009 may apply;
- Modify this Bushfire Management Plan to accord with any changes to the applicable structure plan(s);
- Construct access to meet Performance Criteria, with minimum standards outlined in Table 4;
- Provide reticulated to the subdivision water as per WCWA standards;
- Provide the City of Rockingham prior to each subdivision stage an updated BAL Contour Plan outlining lots requiring increased construction standard for dwellings in accordance with AS3959-2009 Construction of Buildings in Bushfire Prone Areas (current and endorsed standards);
- Provide each prospective owner with:
 - The endorsed and approved Bushfire Management Plan,
 - A BAL Contour Plan outlining BAL/AS3959-2009 applicable to individual lots.
 - A hard copy of the A4 book “Prepare. Act. Survive”; and

- Fire Control Information supplied by the City of Rockingham (yearly advice brochure updated annually).

9.4. City of Rockingham Responsibility

At approval and endorsement of this Fire Management Plan, the City of Rockingham has statutory control and responsibility to ensure that aspects of the Plan and community fire safety are maintained.

It is recommended the City of Rockingham be responsible for the following:

- Provide advice on standards and methods to achieve community fire protection to owners/occupiers of land through issue and enforcement of the current CoR Fire Control Notice (yearly advice brochure updated annually);
- Ensuring compliance with this Bushfire Management Plan with regard to any related conditions of subdivision approval;
- Developing and maintaining District Fire Fighting Facilities and related infrastructure;
- Maintaining roads consistent with the standards this Bushfire Management Plan and in the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a); and
- Maintaining the public open space (after the handover from the developer) in a manner that will minimise bushfire fuels and mitigate the risk of fire.

10. Conclusions

Terranovis Pty Ltd commissioned Bio Diverse Solutions (Bushfire Consultants) to undertake a fire hazard assessment and prepare a Bushfire Management Plan to guide all future fire management as part the planning process for a proposed development (Structure Plan) and subsequent subdivision of Lots 5, 6, 7 and 8 Kerosene Lane, Baldivis.

Such planning takes into consideration standards and requirements specified in various documents such as Australian Standard (AS) 3959-2009, Western Australian Planning Commission (WAPC) Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a) and State Planning Policy 3.7 (WAPC, 2015b). These policies, plans and guidelines have developed by WAPC to ensure uniformity to planning in designated “Bushfire Prone Areas” and consideration of the relevant bushfire hazards when identifying or investigating land for future development.

The Structure Plan is required to meet the “Performance Principles” and/or “Acceptable Solutions” of each Element of the bushfire mitigation measures (WAPC, 2015a). The site has been classified as a having a “**Low**” future internal bushfire hazard in the development/building areas, with adjacent “**Extreme**” and “**Moderate**” bushfire hazards (as per WAPC Guidelines, Table 1) due to the presence of Forest Type A, Woodland Type B and Scrub Type D. Effective Slopes under vegetation are variable across the site but generally are upslope and flat land or Downslope >0 to 5 degrees.

The bushfire protection criteria (Appendix 4, WAPC, 2015a) are a performance based criteria utilised to assess bushfire risk management measures and they outline four elements, being:

- Element 1: Location;
- Element 2: Siting and Design of Development;
- Element 3: Vehicle Access; and ‘
- Element 4: Water.

The proposal was assessed against the bushfire protection criteria Acceptable Solutions for Elements A1, A2, A3 and A4. This report outlines how the proposal complies with the bushfire protection criteria Acceptable Solutions as per the Guidelines for Planning in Bushfire Prone Areas (WAPC, 2015a).

There are specific key solutions to meet the above through:

- The layout of the subdivision and the facilities proposed have been designed to reduce the fire threat to persons and property within the development (i.e. Internal road design, access in alternative directions);
- Accessible “Fire Service Access” and “Emergency Access Ways” along established road reserves in opposing directions through the subdivision for access and egress in fire events;
- 20m APZ can be achieved through the increased construction of Kerosene Lane, POS areas and internal roads.
- Development is proposed to the west, east and south of the subject site reducing the bushfire hazards in the future and legal agreements are established to address any temporary bushfire protection issues.
- Legal agreements are presently being formed with adjacent neighbours to ensure there is access and maintenance of any bushfire hazards upon their land. Copies shall be forward to the CoR upon completion.
- Building to BAL/AS3959-2009 where 100m HS cannot be achieved to Bushfire Prone Vegetation to the north/north east in the SGP; and
- Reticulated scheme water to Water Corporation WA standards.

In summary it is recommended to the Developers that in building the proposed subdivision at Lots 5, 6, 7 and 8 Kerosene Lane Baldivis the Developer:

- Implements the fire protection standards as outlined in this document and by Planning for Bushfire Protection Edition 2 (WAPC 2010);
- Adheres to WAPC and CoR subdivision conditions;
- If any changes to structure plan designs occur, that this Bushfire Management Plan is updated to reflect these changes, with approval from the CoR and DFES; and
- Implement this document, Bushfire Management Plan Lots 5, 6, 7 and 8 Kerosene Lane Baldivis standards of construction and recommendations.

11. References

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Appendices

Appendix A – Location Mapping

Appendix B –Structure Plan(s)

Appendix C - Vegetation Mapping

Appendix D – Bushfire Hazard Mapping

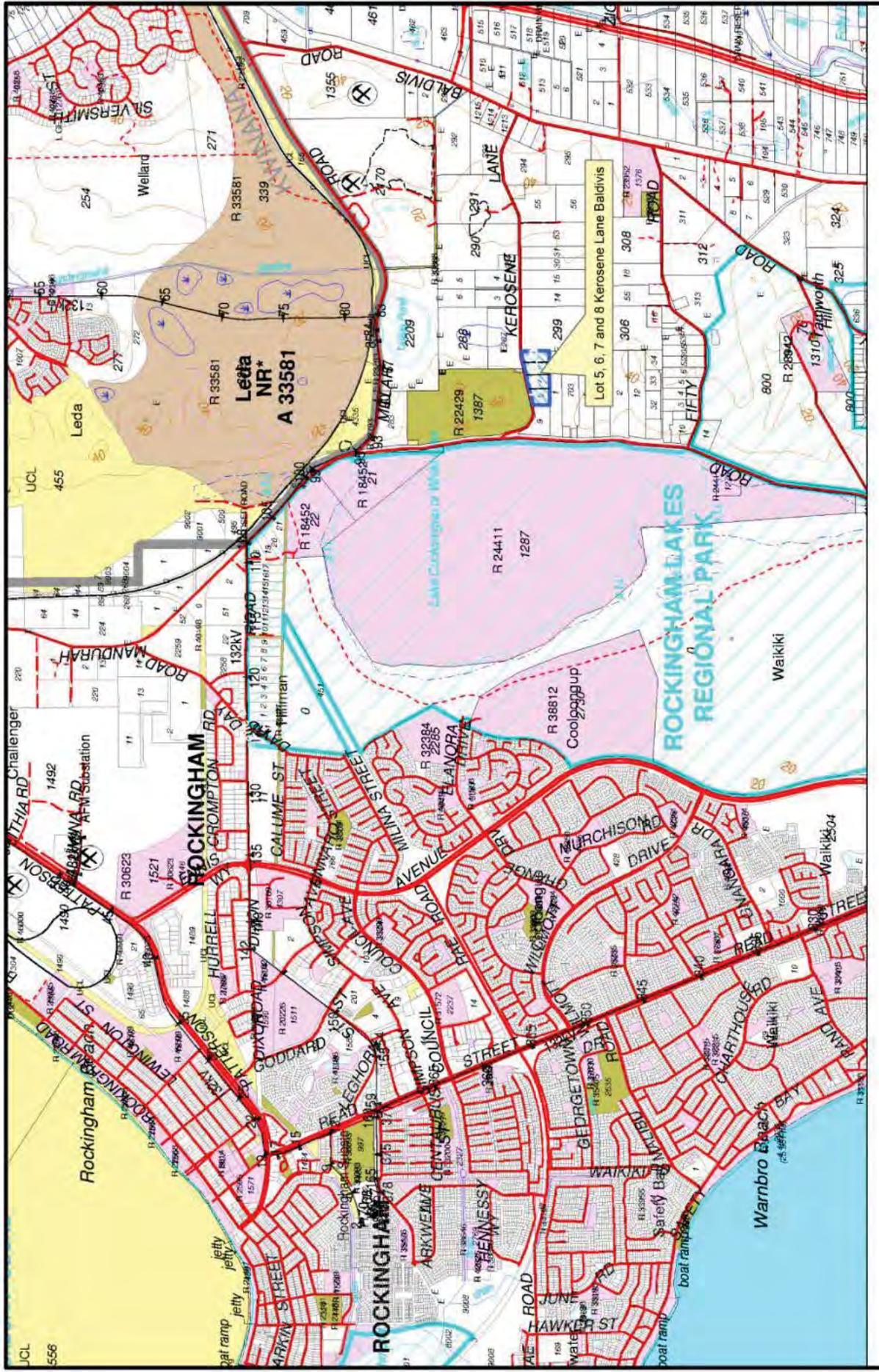
Appendix E- BAL Rating Plan

Appendix F – Bushfire Management Plan

Appendix A

Location Mapping

& OBRM Bushfire Prone Area Mapping



CLIENT
 Terranovis
 PO Box 1320 Canning Bridge
 Applecross WA 6153

Regional Location Mapping

STATUS: FINAL FILE: TER006 DATE: 17/7/2015

BIO DIVERSE SOLUTIONS

55 Peppermint Drive
 Albany, WA 6330
 Australia
 Tel: 08 9841 3939
 Fax: 08 9841 3936
 Mob: 0447 555 516

Scale
 1:30,000 @ A3
 GDA MGA 94 Zone 50

0 220 440 880 1,320 1,760 Meters

Legend

 Subject site



Legend

— Subject site



Scale
1:1500 @ A3
GDA MGA 94 Zone 50



55 Pepperment Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

CLIENT
Terranovis
PO Box 1320 Canning Bridge
Applecross WA 6153

Location Mapping

STATUS	FILE	TERMOB	DATE
FINAL			17/07/2015

OBRM BUSHFIRE PRONE MAPPING 7/12/15 & 21/5/2016



<https://maps.slip.wa.gov.au/landgate/bushfireprone/>

Appendix B

Subject Site Structure Plan

Adjacent properties structure plans



**SUBDIVISION CONCEPT PLAN
LOTS 5 - 8 KEROSENE LANE
BALDWIN**

DATE DRAWN/REVISED: 10/1/2017/01/2017
DRAWN BY: J. DUNN
CHECKED BY: J. DUNN
SCALE: 1:1000 (AS SHOWN)

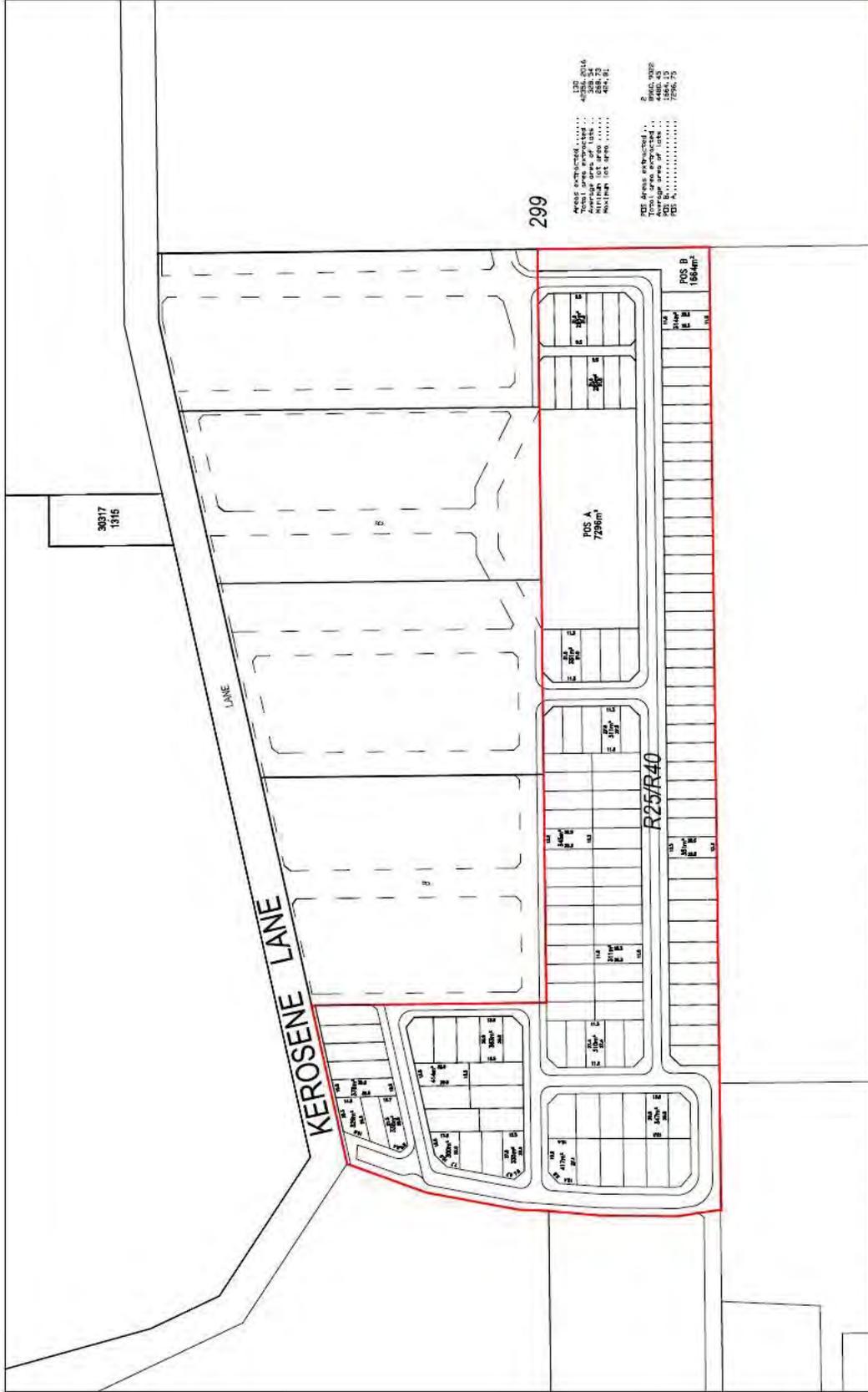
- LEGEND**
- Solid Wall
 - ← Dwelling Orientator
 - - - Structure Plan Boundary
 - - - Pipeline
 - - - Existing parent lot boundary
 - - - Pipeline 32m setback

10/1/2017

Plan No. : 00843
Revision : REC 8
Scale : 1:2000 @ A3 1:1000 @ A1

Site 7 First Floor Board Plans 4th 10/1/17 www.whelans.com.au





299

POS A 7286m²
 POS B 1584m²

R25/R40

PROPOSED DEVELOPMENT PLAN - Option 24

Lot 1 Mandurah Road and Lot 9 Kerosene Lane
 Baldvis - City of Rockingham



date: 10/06/21 | scale: A3 (1:2000) | ref: 177A_S0104_Mandurah Lane | rev: 03 (1.0) (1/1)

DECLARED AREA SUBJECT TO APPLICATION - DIMENSIONS AND DIMENSIONS ARE APPROXIMATE ONLY AND ARE SUBJECT TO OTHER SURVEY ENGINEERING AND DETAIL DESIGN





whelans
TOWN PLANNING

**PROPOSED SUBDIVISION
STAGE 6 - PARADISE ESTATE
LOT 299 KEROSENE LANE
BALDIVIS**

Enlargement 'A'
SCALE 1:2000

■ Lot 299 (this sheet)
 ■ Lot 299 (other sheets)
 ■ Lot 299 (other sheets)
 ■ Lot 299 (other sheets)

LEGEND

- Water Mains
- Sewer Mains
- Power Lines
- Contours
- Proposed Boundary
- Application Area
- Subject Area of the application
- Proposed Lots
- Public Open Space
- Parmelia Pipeline Centre and 12m easement
- Alcoa easement
- WAPC 151237, 151108 & 147467

Plan No. 2007/4-5
 Revision RE/1.5
 Scale 1:2000@A3
 Scale: NTS
 Lot 299 original lot area = 21,19ha
 Site 4 Free 40 Nando Road Orléans Park WA 6117 www.whelans.com.au



Appendix C

Vegetation Mapping



CLIENT	
Terranovis PO Box 1320 Canning Bridge Applescross WA 6153	
Vegetation Classes	
STATUS	FILE
FINAL	TER006
DATE	8/8/2016

BIO DIVERSE SOLUTIONS

55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3936
Mob: 0447 555 516

Legend

- Photo id
- 100m Bushfire Prone distance
- 5m Contours
- Forest Type A
- Woodland Type B
- Closed Scrub Type D
- Grassland Type G
- Low Threat Vegetation
- Subject site

Scale
1:1800 @ A3
GDA MGA 94 Zone 50

0 15 30 60 90 120 Meters

Forest Type A	Grassland Type G
Woodland Type B	Low Threat Vegetation
Closed Scrub Type D	Subject site

Appendix D

Bushfire Hazard Mapping



CLIENT		Terranovis PO Box 1320 Canning Bridge Applescross WA 6153	
STATUS		FINAL	8/8/2016

BIO DIVERSE SOLUTIONS

55 Peppermint Drive
Albany, WA 6330
Australia
Tel: 08 9841 3936
Fax: 08 9841 3926
MOB: 0447 555 516

Legend

- 100m Bushfire Prone distance
- 100m AHD
- 30m AHD
- 20m AHD
- 10m AHD
- 5m Contours
- Extreme BHL
- Moderate BHL
- Low Threat Vegetation
- Subject Site

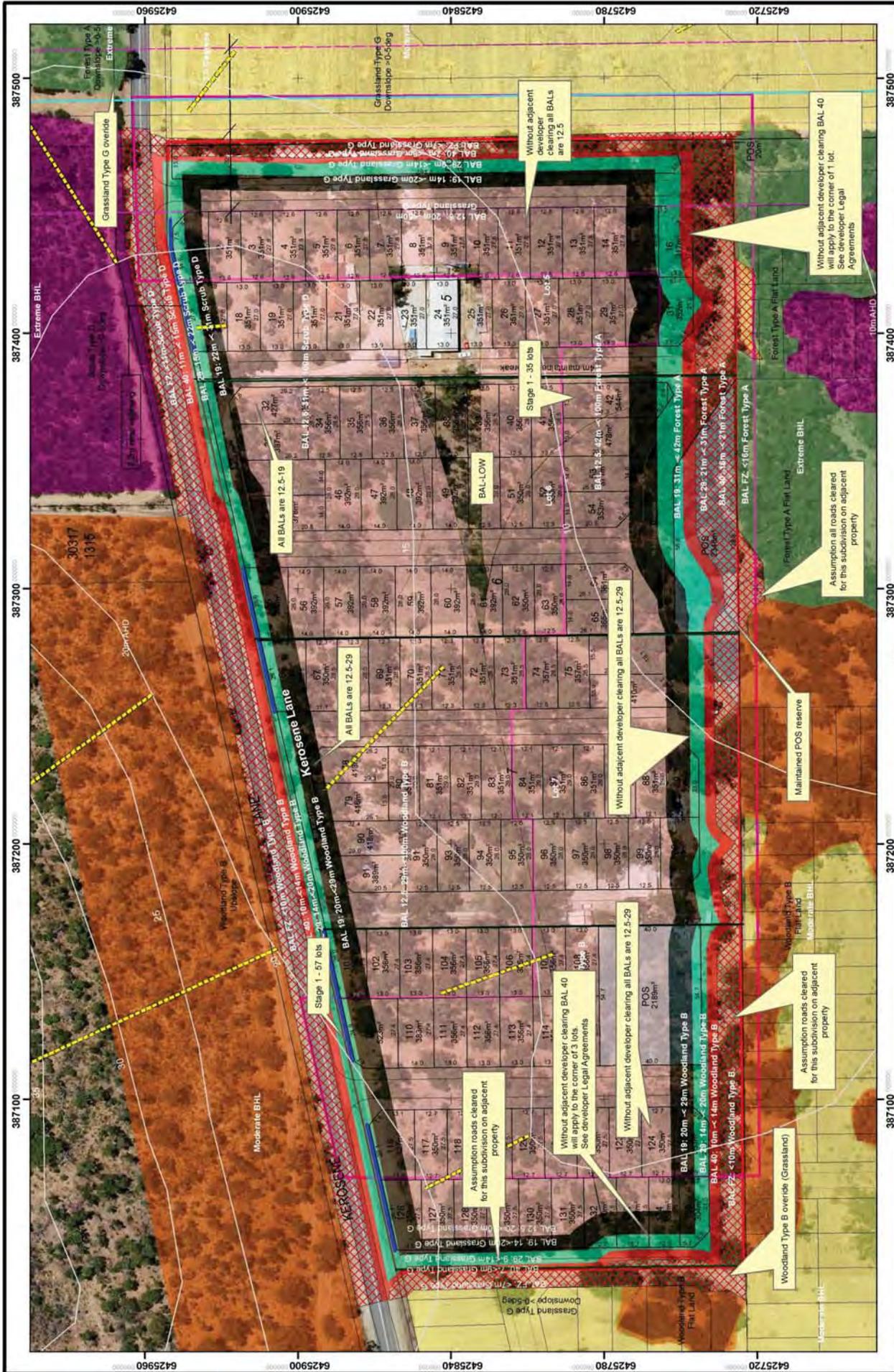
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GDA MGA 94 Zone 50

0 30 60 90 120 Meters

Extreme BHL	Moderate BHL
Woodland Type B	Low Threat Vegetation
Extreme BHL	Subject Site

Appendix E

BAL Rating Plan(s)



Legend

- Subject site
- Staging Plan - Stage 1
- Slope degrees
- 5m Contours
- BAL 12.5
- BAL 19
- BAL 29
- BAL 40
- BAL FZ
- Forest Type A
- Woodland Type B
- Closed Scrub Type D
- Grassland Type G
- Low Threat Vegetation
- Subdivision Plan

Scale
1:1400 @ A3
GDA MGA 94 Zone 50

0 12.5 25 50 75 100 Meters

Client
Terranova
PO Box 1320 Canning Bridge
Applecross WA 6155

Project
BAL Contour Plan

Status
FINAL

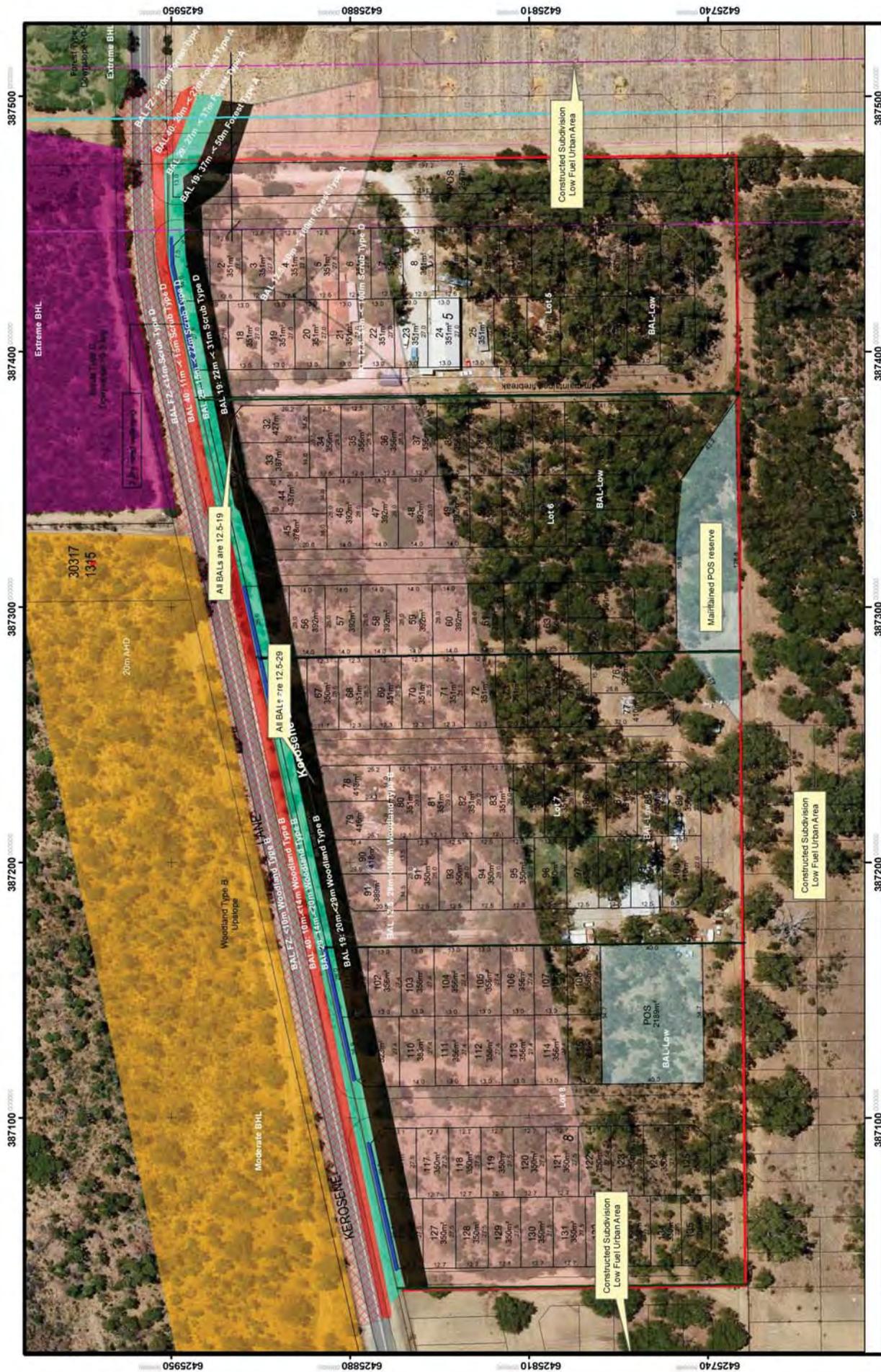
File
TER006

Date
29/08/16

This BAL Contour Plan was prepared by:
 Bio Diverse Solutions
 Accreditation No: BADC00784
 Valid to: Feb 2017
 Jurisdiction: Level 1 - WA

BPAD
 Building
 Planning & Design
 Level 1

BIO DIVERSE SOLUTIONS
 Unit 5A, 209
 Chester Pass Road
 Albany, WA 6330
 Australia
 Tel: 08 9842 1575
 Fax: 08 9842 1575



Legend

- Forest Type
- BAL 19
- Woodland Type B
- BAL FZ
- BAL 12.5
- Closed Scrub Type D
- BAL 40
- Subject site
- BAL 29
- Low Threat Vegetation

CLIENT
Terranovis
PO Box 1320 Canning Bridge
Applecross WA 6153

BIO DIVERSE SOLUTIONS
55 Peppermint Drive
Abany WA 6330
Australia
Tel: 08 9841 9936
Fax: 08 9841 9936
Mob: 0447 559 916

STATUS
FINAL

FILE
TER006

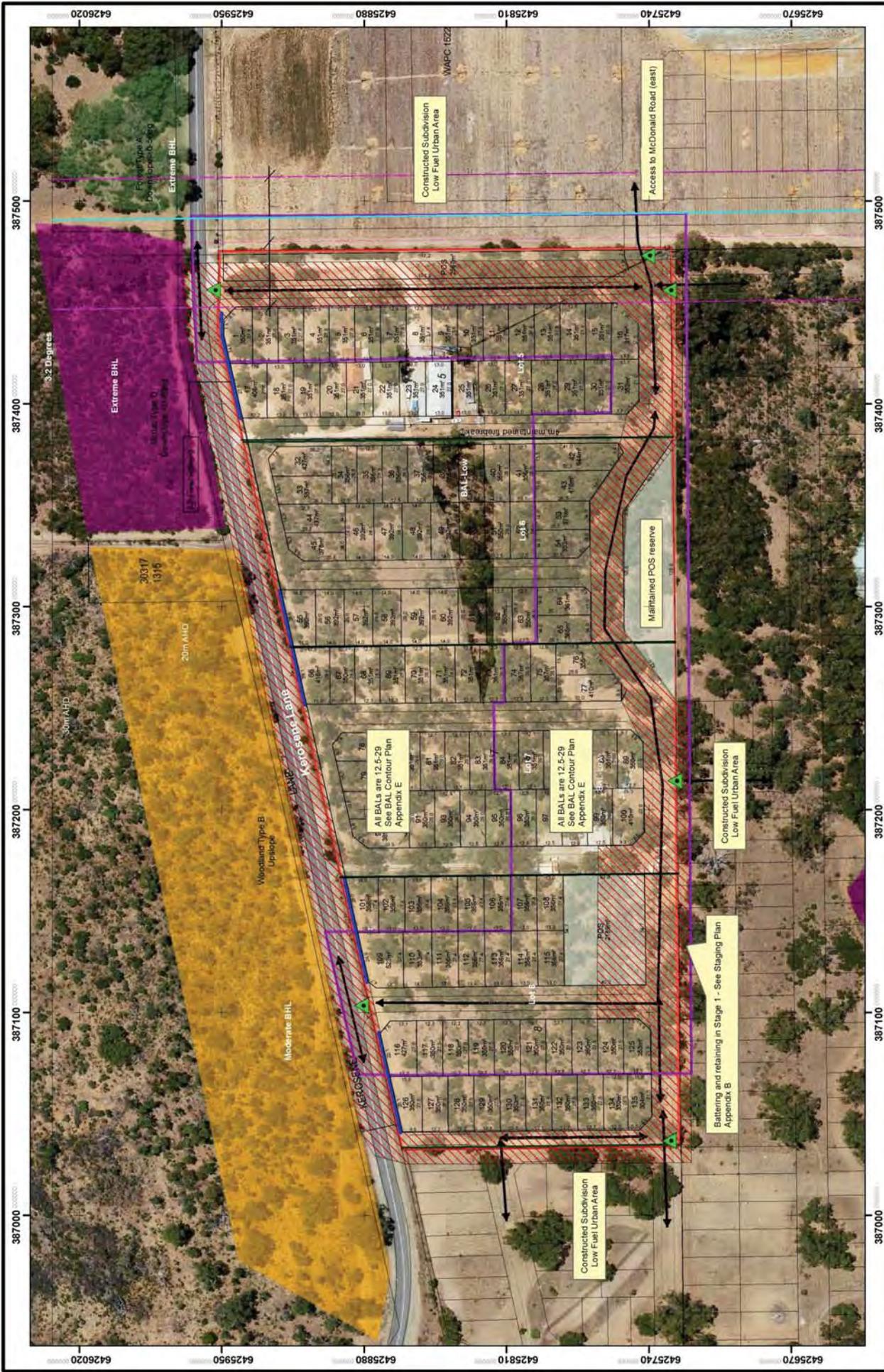
DATE
28/8/2016

Scale
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GDA MGA 94 Zone 50

0 15 30 60 90 120 Meters

Appendix F

Bushfire Management Plan



Legend

- Subject site
- Staging Plan
- Access points
- APZ
- Access (EAW)
- Subject to BAL
- Forest Type A
- Woodland Type B
- Closed Scrub Type D
- Low Threat Vegetation
- Subdivision Plan

Scale
1:1400 @ A3
GDA MGA 94 Zone 50

0 12.5 25 50 75 100 Meters

CLIENT
Terranovis
PO Box 1320 Canning Bridge
Applecross WA 6153

STATUS
FINAL

FILE
TER006

DATE
28/02/2016

CLIENT
Unit 54, 209
Chester Pass Road
Abany, WA 6330
Australia
Tel: 08 9942 1575
Fax: 08 9942 1575

BIO DIVERSE SOLUTIONS

BPAD
Accreditation No. BPAD30784
Valid to: Feb 2017
Jurisdiction: Level 1 - WA

BPAD
Accreditation No. BPAD30784
Valid to: Feb 2017
Jurisdiction: Level 1 - WA

BPAD
Accreditation No. BPAD30784
Valid to: Feb 2017
Jurisdiction: Level 1 - WA

BPAD
Accreditation No. BPAD30784
Valid to: Feb 2017
Jurisdiction: Level 1 - WA

BPAD
Accreditation No. BPAD30784
Valid to: Feb 2017
Jurisdiction: Level 1 - WA

APPENDIX 5 PIPELINE PROTECTION PLAN

Planning Solutions
Baldivis Development
Lots 14, 15, and 299
Kerosene Lane, Baldivis

AS2885 Pipeline Protection Plan



A10526-PSO-RX-001

REV 0

REVISION RECORD

Revision	Date	Description	Originator	Checked	Approved
A	11 June 2010	Issued for client review	TD	DFB	BPF
0	2 July 2010	Issued for use	TD	IMM	PMB



CONTENTS

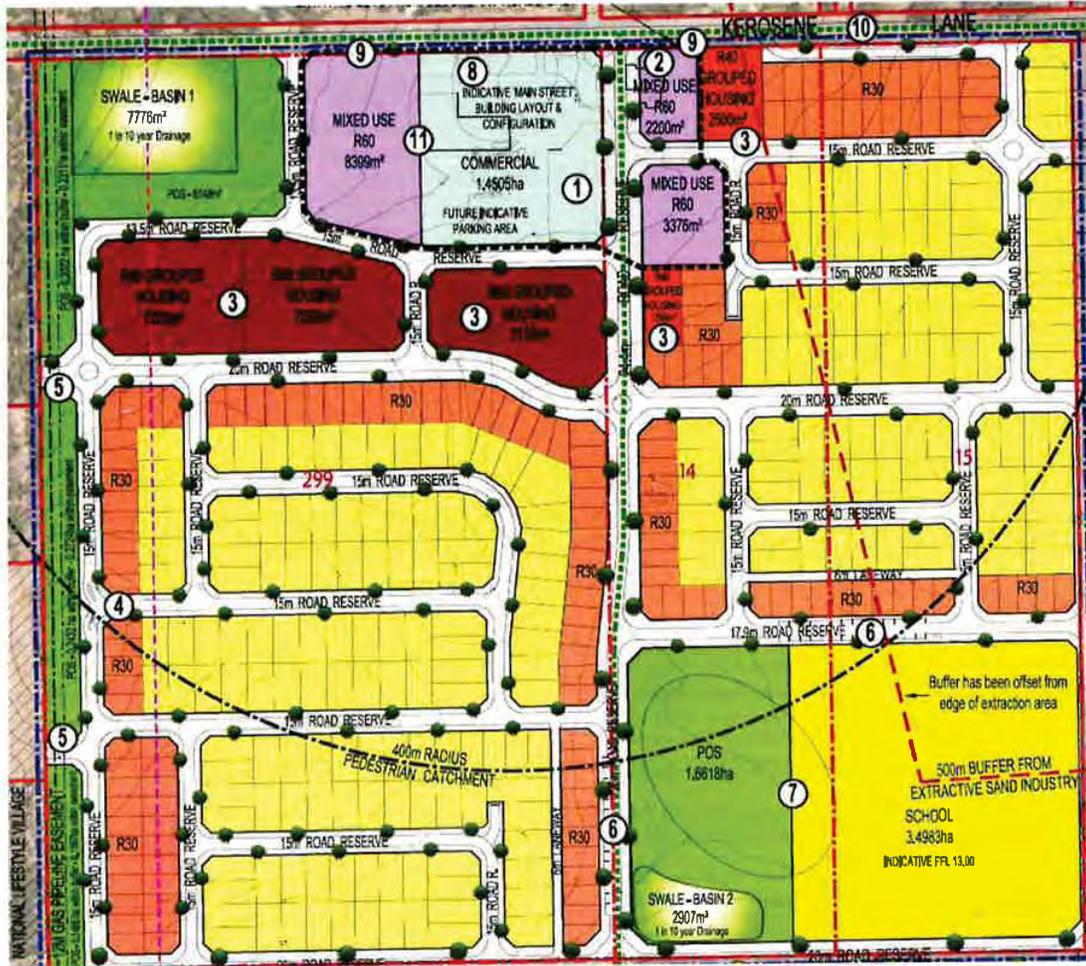
1. INTRODUCTION	3
1.1. Purpose	5
1.2. Scope	5
1.3. Definitions	5
2. PIPELINE PROTECTION PLAN REQUIREMENTS	7
2.1. AS 2885 Standard Requirements	7
2.2. AS 2885 Compliance	8
3. FORMAL SAFETY STUDIES	9
3.1. Formal Risk Assessment Studies	9
3.1.1. Threat Identification, Risk Assessment and Control	9
4. RISK ASSESSMENT PROCESS	10
4.1. Risk Identification	10
4.1.1. Location Analysis	10
4.1.2. Threat Analysis	10
4.1.3. Threat Assessment / Consequence Analysis	10
4.1.4. Mitigation by Design and Procedures	10
4.1.5. Risk Evaluation and Risk Management	11
4.2. Risk Ranking	11
4.3. Location class	12
4.4. Safeguards / Control Measures	13
4.5. Risk Assessment Activities	13
5. RISK ASSESSMENT KEY FINDINGS	14
5.1. Recommendations/ Actions Close-out	14
5.2. Risk Summary	14
6. CONTROLS	15
6.1. Direct Threat - Physical and Procedural Controls	15
6.1.1. Pipeline Condition	15
6.1.2. Excavation	16
6.1.3. Backfill / Spreading	16
6.1.4. Horizontal Boring	16
6.1.5. Movement of Machinery / Vehicles	17
6.1.6. Landscaping	17
6.2. Generic Procedural Controls	18
6.2.1. Site Inductions	18
6.2.2. Review of Easement Access	19
6.2.3. Review of Maintenance Procedures	19
6.2.4. Dial Before You Dig	19
6.2.5. Permitting Procedures	19
6.2.6. Signage	19
6.2.7. Marker Tape	19
6.2.8. Patrols	19
6.2.9. Landowner, Occupier and other Authority Liaison	19
7. REFERENCES	20
APPENDIX A- AS2885.1 COMPLIANCE TABLE	21
APPENDIX B – PIPELINE RISK ASSESSMENT MINUTES / DATA.	27
APPENDIX C – WORKSHOP RISK ASSESSMENT TEAM	36
APPENDIX D - PARMELIA PIPELINE MATERIAL SPECIFICATION AND OTHER PROPERTIES.....	38



1. INTRODUCTION

Galati Nominees Pty Ltd (the developer) is proposing to subdivide a section of land into separate property dwellings and commercial operations at Lots 14, 15 and 299 Kerosene Lane, Baldvis, in Perth WA. The proposed development interfaces directly with the Parmelia Gas Pipeline (PGP) easement adjacent to Lot 299. A general schematic is shown as Figure 1.1 below:

Figure 1.1 Lots 14, 15 and 299 Kerosene Lane, Baldvis, in Perth WA



STRUCTURE PLAN NOTES	
①	Spud Shed Commercial Premises - (2500m ² retail NLA max)
②	Existing House (to be demolished).
③	Grouped housing, Mixed use and Commercial sites subject to DAP to ensure high quality main street built form and streetscape is achieved.
④	Traffic calming treatment at intersection.
⑤	Potential future east-west road linkages across gas pipeline.
⑥	On-street carparking surrounding school site.
⑦	POS (active playing field) and school site. Site to be flat as per City of Rockingham and Department of Education and Training requirements.
⑧	Single access for Commercial premises shown on plan.
⑨	No direct access from Kerosene Lane, entry to lots from secondary roads only.
⑩	Future upgrading of Kerosene Lane as per Baldvis Road, needs Study Slip lane servicing Residential Lots fronting Kerosene Lane as shown.
⑪	Acoustic and visual buffer between mixed use development and commercial premises.



Vanguard Solutions Pty Ltd has been contacted by Planning Solutions on behalf of Galati Nominees Pty Ltd to prepare a Pipeline Protection Plan (PPP) for the pipeline located adjacent to the development area (Lot 299).

This report details the Pipeline Protection Plan based on the findings of the pipeline risk assessment (Appendix B) and other supporting technical documents such as Stress Analysis / Fracture Control Plan, Isolation Plan etc. (Refs. 3 and 4).



1.1. Purpose

The purpose of the Pipeline Protection Plan is to:

- Ensure compliance with the safety management requirements of AS2885.1–2007 Pipelines – Gas and Liquid Petroleum, Part 1: Design and Construction (Ref. 1);
- Describe the risk assessment process, hazard controls in terms of physical means, administrative controls and procedures etc. to ensure public safety and pipeline protection during the proposed development and post development activities associated with Lots 14, 15 and 299; and
- Assist in planning approvals and compliance with Western Australian Planning Commission, Planning Bulletin 87, High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region; October 2007 (Ref. 5).

1.2. Scope

The scope of work for this AS2885 Pipeline Protection Plan includes:

- The buried PGP adjacent to the proposed development of Lots 14, 15 and 299;
- The construction of two road crossings over the easement namely (named north and south crossings);
- Construction of a storm water drainage swale adjacent to the easement at the north of the development;
- Construction of the road reserve at the western edge of the development adjacent to the pipeline easement;
- Future maintenance and operational access to the PGP; and
- Other miscellaneous features associated with the project.

1.3. Definitions

The definitions used in this report or relevant references are listed below.

Table 1.1: Definitions

Item	Definition
As Low As Reasonably Practicable (ALARP)	ALARP means the cost of further risk reduction measures is grossly disproportionate to the benefit gained from the reduced risk that would result.
Failure	Failure has occurred if one or more of the of the following conditions apply: (a) There is any loss of containment; (b) Supply is restricted; (c) Maximum Allowable Operating Pressure (MAOP) is reduced; (d) Immediate repair is required in order to maintain safe operation; and NOTE: It is emphasised that failure is not restricted to loss of containment.
Gas	Any hydrocarbon gas or mixture of gases, possibly in combination with liquid petroleum, condensates or water.
Piping	An assembly of pipes, valves and fittings associated with a pipeline.



Item	Definition
Pressure, design	The pressure nominated in the Design Basis for the purpose of performing calculations on the mechanical and process design of the pipeline.
Protection measures, physical	Measures for protection of a pipeline which prevent external interference from causing failure, either by physically preventing contact with the pipe or by providing adequate resistance to penetration in the pipe itself.
Protection measures, procedural	Measures for protection of a pipeline which minimize the likelihood of human activities with potential to damage the pipeline.
Regulatory authority	An authority with legislative powers relating to petroleum pipelines.
Rupture	Failure of the pipe such that the cylinder has opened to a size equivalent to its diameter.
Threat	A threat is any activity or condition that can adversely affect the pipeline if not adequately controlled.
Wall thickness, design pressure _(tp)	The wall thickness of pipe required to contain the design pressure, based on steel grade and design factor.
Wall thickness, required _(tw)	The greatest of the wall thicknesses required to meet the various design requirements nominated in Section 5.4.2.(AS2885.1)
Wall thickness, nominal _(IN)	The wall thickness nominated for pipe manufacture or certified on supplied pipe.



2. PIPELINE PROTECTION PLAN REQUIREMENTS

The Pipeline Protection Plan will be validated to ensure it complies with the agreed elements of the pipeline operator's engineered systems and management of safety objectives as required under AS2885.1. The following section identifies the standard requirements that will be applied.

2.1. AS 2885 Standard Requirements

AS 2885:1 2007 Section 2 – Safety was examined to determine the key Standard Requirements (SR) deemed pertinent to this development including, but may not be limited to, the following table:

Table 2.1: AS 2885.1:2007 Standard Requirements

AS 2885:1 2007 Standard Requirements		AS2885:1 Standard Section
SR-01	Implementation - All actions arising from the safety management study shall be implemented and the implementation documented. Where ongoing action is required, a reporting mechanism to demonstrate action shall be established, implemented and audited.	2.2.3
SR-02	Safety Management Study Validation - Each detailed safety management study shall be validated by a properly constituted workshop which shall critically review each aspect of the safety management study.	2.2.4
SR-03	Operational Review - An assessment of the implementation and effectiveness of all threat controls shall be made at each operational review.	2.2.5
SR-04	Safety Management Process – The pipeline safety management process consists of the following: <ul style="list-style-type: none"> • Threat identification; • Application of physical, procedural and design measures to identified threats; • Review and control of failure threats; and • Assessment of residual risk from failure threats. 	2.3.1
SR-05	External Interference Protection-The pipeline shall be protected from external interference by a combination of physical and procedural controls at the location of each identified threat. All reasonably practicable controls should be applied.	2.3.3.2
SR-06	Control by Design and/or Procedures - Design and/or procedures shall be applied to threats other than external interference threats in accordance with Standard	2.3.3.3
SR-07	Failure Analysis – where controls may not prevent failure for a particular threat, the threat shall be analysed to determine the damage that it may cause to the pipeline.	2.3.4.1
SR-08	Treatment of Failure Threats – where a failure event is identified additional controls to prevent failure shall be investigated and applied where applicable.	2.3.4.2



AS 2885:1 2007 Standard Requirements		AS2885:1 Standard Section
SR-09	Documentation –The failure analysis for the specific threat shall be documented.	2.3.4.3
SR-10	Demonstration of Fault Tolerance – To demonstrate the fault tolerance of the pipeline design, a situation where failure of threat control measures leads to pipe damage or loss of containment shall be considered as a threat.	2.3.6
SR-11	Environmental Management – The threats to the environment from each part of the life cycle of the pipeline to be identified and control measures shall be given to ensuring environmental threats are managed by avoidance.	2.5
SR-12	Environmental Management – An environmental impact assessment shall be conducted in accordance with standard along with length of pipeline route. The environmental impact assessment report shall form the basis of the environmental management plan.	2.5
SR-13	Environmental Management –Threat of damage to the environment from operational maintenance and abandonment activities shall be identified and control measures developed.	2.5
SR-14	Electrical – A pipeline in the vicinity of electricity supply power lines or facilities shall be analysed to determine if controls are required to provide for electrical safety.	2.6
SR-15	Construction Safety – A construction safety plan shall be prepared, reviewed by appropriate personnel, and approved. This review shall take the form of a construction safety plan workshop.	2.7.1
SR-16	Testing Safety – The construction safety plan shall address safety through all phases of testing of the pipeline during construction.	2.7.2
SR-17	Commissioning Plan – The commissioning plan shall consider the safety of the activities undertaken through all phases of commissioning and, where required, develop specific procedures to manage the safety during commissioning of the pipeline.	2.7.3

2.2. AS 2885 Compliance

Refer to Appendix A for AS2885.1 Compliance table with respect to table 2.1 above and the proposed development.



3. FORMAL SAFETY STUDIES

3.1. Formal Risk Assessment Studies

The following study has been carried out as part of the risk assessment process:

- Pipeline Risk Assessment (including Hazard Identification).

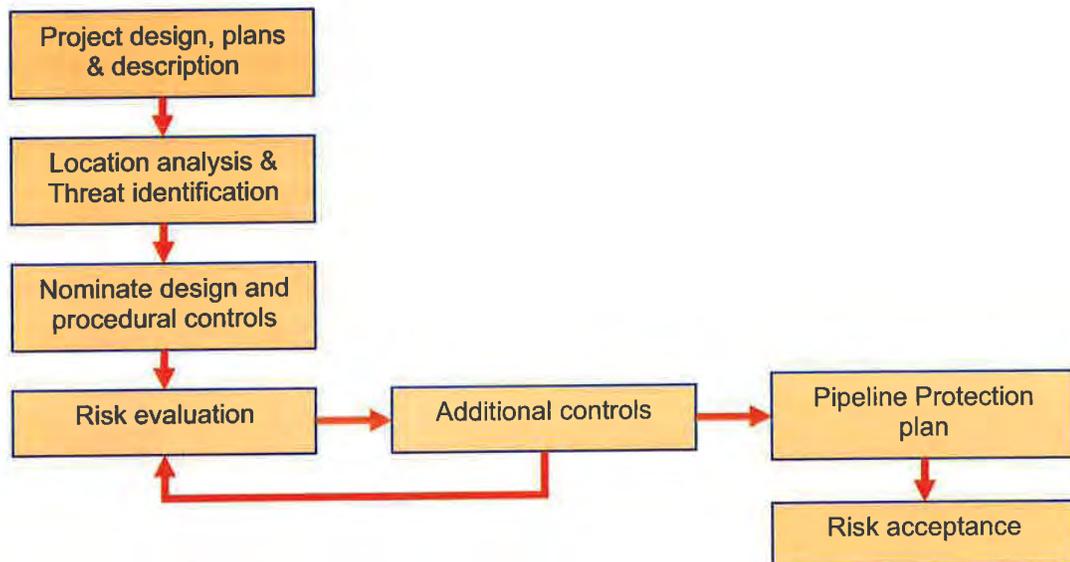
In addition APA have previously conducted Stress Analysis study on the pipeline to determine its resistance to events that may cause stress and potentially lead to pipeline failure (Ref. 3).

3.1.1. Threat Identification, Risk Assessment and Control

Threats were identified by conducting a formal risk assessment workshop with the involvement of relevant parties. Attendees at the workshop are listed in Appendix C. A site survey was carried out (prior to the workshop) and inputs from all relevant APA Group personnel were also used to identify the possible hazards.

From the hazard, threat scenarios / risks were identified along with their likelihood and consequence severity. Risk management controls were proposed and if they were not considered sufficient further actions were recorded and assigned to relevant personnel. Figure 3.1 below illustrates the risk assessment process:

Figure 3.1: Simplified overview of the AS 2885 Risk Assessment Process



The risk assessment data was collected in a worksheet which can be found in Appendix B.



4. RISK ASSESSMENT PROCESS

4.1. Risk Identification

The AS2885 risk assessment methodology requires that a location and threats analysis is performed for the area affecting the pipeline. The intention of this is to identify the possible causes of failure of the pipeline and the mitigation measures that are or need to be in place. The AS2885 risk identification process can be broadly defined into the following activities:

- Location analysis;
- Threat analysis;
- Mitigation by design and procedures;
- Failure analysis;
- Risk evaluation; and
- Risk Management.

4.1.1. Location Analysis

For this project the key locations that have potential to impact upon the PGP are the:

- Swale drainage basin;
- The construction of two road crossings over the easement; and
- The construction of the normal to medium density residential areas and adjacent roads parallel to the easement ;

4.1.2. Threat Analysis

This process is the identification of possible threats from the project, which may impact the pipeline. The analysis includes both location specific and overall non-location specific threats. Location specific threats could be external interference activities, such as deep excavation for adjacent services, or effects on corrosion protection from high voltage transmission lines. Non-location specific threats refer to a broader range of potential threats that could have an impact on the pipeline, such as internal/external corrosion, pressures in excess of design pressure or natural disasters such as earthquakes or cyclones.

4.1.3. Threat Assessment / Consequence Analysis

Failure analysis combines the design features of the pipeline with the identified threats to determine the failure mode. Threats that have not been eliminated or reduced to a level as low as reasonably practicable (ALARP) must be subject to further analysis.

4.1.4. Mitigation by Design and Procedures

This aspect of the risk assessment process involves identifying the mitigation measures which are required to reduce the risk from the threats (if credible) to As Low As Reasonably Practicable (ALARP). The requirements under AS2285 call for a number of mitigation measures that should be introduced for external interference protection and procedural /



design prevention measures. Also within the AS2885 standard are a number of design requirements for corrosion, electrical protection and natural events.

It should be also noted that judgement by the team was used to determine the effectiveness of controls as to whether they would be in place at the time of the project or likelihood of the threat consequence occurring. For example, a concrete slab over the pipeline at the road crossings was deemed to be in place (and effective) as the road crossings would not be constructed without it, even though it was not physically in place at the time of this assessment. However, a procedural control such as APA supervision has the potential not to be in place at the time of the project if the risk management process fails. Consequently, this latter type of control was deemed to be less effective. This aligns with the well known Hierarchy of Controls methodology shown in Figure 4.1.

Figure 4.1 – Hierarchy of Controls



4.1.5. Risk Evaluation and Risk Management

The effectiveness of the design measures and procedures were assessed during the workshop. If the initially identified design and procedural controls are unable to reduce the risks to an acceptable level, further risk evaluation and risk management control measures are required to reduce the risks to ALARP. AS2885 contains risk ranking frequency and consequence tables to assist with assessment of the risk and guidance on the acceptability of the risk, refer to section 4.2 below.

4.2. Risk Ranking

A risk ranking was assigned to the identified hazards based on the AS2885.1 risk assessment matrix that is shown in Table 4.1. The frequency and consequence classification tables from AS2885 are presented in Tables 4.2 and 4.3 respectively. The risk ranking was performed by using the safety and environmental related consequences of an event.



Table 4.1– AS2885 Risk Assessment Matrix

	Catastrophic	Major	Severe	Minor	Trivial
Frequent	Extreme	Extrema	High	Intermediate	Low
Occasional	Extreme	High	Intermediate	Low	Low
Unlikely	High	High	Intermediate	Low	Negligible
Remote	High	Intermediate	Low	Negligible	Negligible
Hypothetical	Intermediate	Low	Negligible	Negligible	Negligible

Table 4.2 – Frequency Classification Table

Frequency Class	Frequency Description
Frequent	Expected to occur typically once per year or more.
Occasional	Expected to occur several times in the life of the pipeline.
Unlikely	Not likely to occur within the life of the pipeline, but possible.
Remote	Not likely or anticipated to occur for this pipeline at this location.
Hypothetical	Theoretically possible, but has never occurred on a similar pipeline.

Table 4.3– Consequence Classification Table

	Severity Class				
	Catastrophic	Major	Severe	Minor	Trivial
Dimension	Measures of Severity				
People	Multiple fatalities	Few fatalities with several people with life threatening injuries	Injury or illness requiring hospital treatment	Injuries requiring first aid treatment	Minimal impact on health and Safety
Supply	Long term Interruption to supply	Prolonged interruption, long term restriction of supply	Short term interruption; prolonged restriction of supply	Short term interruption; restriction of supply but shortfall met from other sources	No impact; no restriction of pipeline supply
Environment	Effects widespread; viability of ecosystems or species affected; permanent major changes	Major off-site impact; long term sever effects; rectification difficult	Localised (<1ha) and short term effects (< 2yr) easily rectified	Effect localised (<0.1ha) and very short term (weeks), minimal rectification	No effect, minor on-site effects rectified rapidly with negligible residual effect.

4.3. Location class

The PGP risk assessment was undertaken in accordance with the AS2885 location class requirements. The classification of the proposed project has three types as per section 4.3.4 of AS2885.1 namely:

- Residential (T1) as the type at the southern part of the easement will have domestic single dwelling houses adjacent to it;



- Residential (T1, I) as the type east of the northern part of the easement will have commercial properties within the hazard zones (the swale basin is between the easement and the commercial area); and
- Residential (T1) as higher density R60 zoning residences south of the Swale Basin and adjacent to the easement. Although higher density it is not considered enough to rate a T2 classification.

4.4. Safeguards / Control Measures

The AS2885.1 standard (section 5.5.4 a) and b)) specifies that external interference threats in areas assigned a T1 and T2 (Residential) location class should have a minimum of two physical and two procedural mitigation measures to achieve a minimum compliance. By comparison, a R1 (Rural) or R2 (Rural Residential) zoned location requires a minimum of one physical and two procedural measures.

For this study, the design and procedural measures were identified and assessed in the workshop to determine whether they were considered adequate or if further measures were required for mitigation against the pipeline threat. If the existing (or likely to be present) controls were not deemed adequate, a risk rating was noted that would then be reviewed when additional actions had been completed. Additionally, if two physical and two procedural measures were noted then APA personnel present at the work shop indicated that no further risk assessment was required.

4.5. Risk Assessment Activities

At the start of the risk assessment workshop, an overview of the project and work activities was given by Mr. Paul Ellenbroek of Planning Solutions.

The workshop was conducted by reviewing the proposed project using a set of standard industry accepted guidewords consistent with AS 2885.1 to prompt discussion on the development and assist the progressing the hazards.

The relevant columns were then completed on the spreadsheet attached as Appendix B.



5. RISK ASSESSMENT KEY FINDINGS

This section summarises the key findings of the risk assessment. The results from this study are used as a basis for the Pipeline Protection (Risk Management) Plan to be incorporated in the existing APA pipeline protection systems for the PGP and used by the contractors during the proposed development. The worksheet and recorded data for the risk assessment is presented in Appendix B.

The risk assessment study identified and reviewed 11 threats for all location and non-location specific threats. However, several of the threats are duplicated at more than one location. These have been identified in the workshop data table at Appendix B. For example there are two road crossings proposed over the pipeline easement. The threat list for each crossing is essentially identical with only the location class being different.

Four of the identified threats were discussed but nominated as not credible due to the controls that are or will be in place. The other seven identified threats deemed credible were assessed as ALARP and have an intermediate risk ranking.

The intermediate ranked items are deemed ALARP as although the catastrophic consequence is theoretically possible it is not deemed foreseeable and the likelihood is hypothetical for these circumstances providing the nominated controls are in place and effective. Should these controls not be in place or ensured to be effective then the risk from the threats would be higher.

All other items in the data sheet were considered to have no credible threats.

5.1. Recommendations/ Actions Close-out

As the project is at an early planning approval stage the nomination of individuals responsible for completing actions was not possible. However either a representative of Planning Solutions (Paul Ellenbroek) or APA Group (Paul Revell) will be responsible in due course. The allocation is noted in Appendix B.

As a minimum (some may be subdivided) 13 individual actions will require implementation at the relevant time by the nominated party (or delegate) prior to commencement of / or during the works as relevant. In particular additional job specific risk assessments with the relevant sub contractors prior to commencement of work are required.

5.2. Risk Summary

Overall the project hazards are well understood and this proposal does not present any unusual or difficult to manage threats with only the construction of the swale drainage basin and two straightforward road crossing directly affecting the easement.

As is typical with this type of development, the threats will require a high degree of supervision / coordination between APA, Galati Nominees and their subcontractors to ensure that the controls nominated in the risk assessment table are followed and the work progresses in the required order to protect the pipeline.



6. CONTROLS

Physical and procedural controls will be applied to all credible external interference threats by application of multiple independent protective measures in accordance with AS2885.1. These physical and procedural controls were identified during the Risk Assessment Workshop (Appendix B).

The following hierarchy of controls is applied to the credible threats:

- Elimination;
- Physical controls;
- Procedural controls;
- Reduction; and
- Mitigation.

Controls will be incorporated into the safety management systems of the selected contractors during the development activities that are associated with pipeline.

The following physical and procedural controls (other than the design conditions of the pipeline as noted in Appendix D) are proposed to manage the credible threats, ensure safety at site and provide compliance with AS2885:1. The controls are presented in two groups:

- Section 6.1 lists both physical and procedural controls that are aimed at managing the specifically identified (Ref. 2) direct threats; and
- Section 6.2 lists the generic procedural controls that are aimed at managing risks across many or all of the direct threats.

6.1. Direct Threat - Physical and Procedural Controls

These controls are grouped by the main threats as follows:

- Pipeline Condition;
- Excavation,
- Backfill / Spreading;
- Horizontal Boring (if required);
- Movement of Machinery / Vehicles; and
- Landscaping.

Details of these controls are given below.

6.1.1. Pipeline Condition

Prior to the commencement of the site works adjacent to the pipeline easement, APA will examine the length of the pipeline associated with the proposed development. This will involve examining the weld joints and replacing the protective wrapping in accordance with the pipeline operator's requirements and procedures.



6.1.2. Excavation

Prior to carrying out any excavation an approved Permit to Dig must be obtained which requires that all known services in the work area have been identified and located. The completed Permit to Dig application will include all specific details, such as those provided by APA relating to work within the vicinity of a particular service (Ref. 4).

The purpose of locating the services is to confirm they are located more than 5m away from any part of the planned excavation. If it is not possible to confirm that they are more than 5m away then excavation will be by hand digging only (Ref. 4).

APA's requirements are that:

- All mechanical equipment shall be approved by APA prior to use on the easement or in the vicinity of the pipeline. No tiger teeth devices are allowed;
- The maximum size of mechanical excavators is 15 tonnes;
- Excavation machinery within 1m on either side of the pipeline will not be used. Trenching or excavation within these limits will be done by hand;
- Protective wrapping will be applied if the pipeline is to be exposed for more than a few hours;
- The pipeline will be located by authorised personnel and soil probes will not be used;
- If rock breakers are used (for limestone areas) vibration monitoring to ensure no exceedances of peak particle velocity of 10mm/s must be implemented;
- Barriers, signs and lights will be erected as necessary if excavation is not immediately backfilled; and
- A concrete slab, to APA specification, will be installed 300mm above the pipeline for the length of the Lots adjacent to the development prior to the release by APA of any subdivided lots within the setback distance. This is being done as a requirement of the WAPC Planning Bulletin 87 Table 6 (Ref. 5) to permit development up to the boundary of the easement.

6.1.3. Backfill / Spreading

In order to ensure that the pipeline will not be subject to excessive additional loads due to backfilling or spreading of materials during the construction activities, special attention / supervision will be required and approved / supplied by APA. This will be particularly relevant for the two road crossings construction.

All mechanical equipment shall be approved by APA prior to use on the easement or in the vicinity of the pipeline. No tiger teeth devices are allowed.

The maximum sized vibratory roller used in standard construction practice is 12 tonne. Additionally, APA requires that vibrating compaction equipment is not permitted to be used within 10m of the pipeline. (Note small 500mm plate compactors can be approved for some circumstances).

Prior to work commencing adjacent to the easement, a concrete slab, to APA specification, will be installed 300mm above the pipeline for the length of the Lots adjacent to the development prior to the release by APA of any subdivided lots within the setback distance.

6.1.4. Horizontal Boring

Horizontal boring may be required when connecting services from the proposed development to any future development on the western side of the easement. This activity



presents a significant hazard to the pipeline. As nothing is known about the development details in the area of the road crossings now a separate risk assessment would be required with the APA and Galati Nominees' subcontractors prior to any work involving horizontal boring commencing at any time during the development or at a future date.

As an example, a typical physical control to manage this type of hazard is the placement of vertical or side concrete slabs / barriers to protect the pipeline where the horizontal boring is likely to occur. This will be confirmed during the specific risk assessment should side slabbing be required.

Additionally APA have a work instruction "Easement Crossing Construction" that requires the pipeline to be uncovered at the horizontal boring location up to 300mm below the pipeline (Ref. 6). This enables visual confirmation that the horizontal drill can be physically seen to miss the pipeline.

6.1.5. Movement of Machinery / Vehicles

For this project vehicles will cross the pipeline easement only for the construction of the two road crossings. The remainder of the easement will be fenced off during the development to prevent access at all times. For the road crossings the following control measures will be adhered to during movement of construction machinery and vehicles:

- All mechanical equipment shall be approved by APA prior to use on the easement or in the vicinity of the pipeline. No tiger teeth devices are allowed.
- The use of any vibratory equipment will not be permitted within 10m of the pipeline;
- The construction zone will be marked and the pipeline easement will be temporarily fenced which will be maintained until the construction works, including dwellings, is completed;
- The Galati Nominees (and subcontractors) will ensure that construction traffic does not cross the Parmelia pipeline easement, outside the designated crossing points in the construction zone(s). Any crossing within the construction zone will be in accordance with the details in the pipeline stress analysis;
- No machinery of any kind will be stationed / parked within 1.5m of the buried pipeline or facilities;
- Vehicular crossings will have a minimum cover of 1.2m above the top of pipeline crossing, for heavy equipment the depth of cover may be greater. The current site conditions have a ground cover of between 1.7 and 2.2m depending upon the location; and
- Prior to work commencing adjacent to the easement, a concrete slab, to APA specification, will be installed 300mm above the pipeline for the length of the Lots adjacent to the development prior to the release by APA of any subdivided lots within the setback distance.

6.1.6. Landscaping

- Landscaping details associated with the easement and adjacent public open space are not known at this time. However, the landscape architect and installers should be made aware of the following requirements.
- Installation of irrigation lines will require a separate risk assessment once the design is known. Typically the design should minimise or eliminate crossings over the easement;



- There is to be no mechanical digging within 1m of the pipeline;
- For path construction the depth of cover is to be a minimum of 750mm. There can be no dumping of materials within five metres of the pipeline;
- The maximum sized vibratory roller used in standard construction practice is 12 tonne. Additionally, APA requires that vibrating compaction equipment is not permitted to be used within 10m of the pipeline. (Note small 500mm plate compactors can be approved for some circumstances eg path base material compaction);
- Prior to work commencing adjacent to the easement, a concrete slab, to APA specification, will be installed 300mm above the pipeline for the length of the Lots adjacent to the development prior to the release by APA of any subdivided lots within the setback distance.
- Holes for planting trees and shrubs on the easement to be no deeper than 300mm. Tree planting requiring deeper holes needs to be done under the supervision of an APA Permit to Work officer; and
- Trees and shrubs with a height greater than 3m with a root depth greater than 300mm are not permitted within the easement.

6.2. Generic Procedural Controls

The following procedural controls are proposed:

- Site Inductions;
- Review of easement access;
- Review of existing drainage location;
- Review of maintenance procedures;
- Dial before you dig;
- Permitting procedures;
- Signage;
- Marker Tape;
- Patrols; and
- Landowner, Occupier and other Authority Liaison.

6.2.1. Site Inductions

All personnel new to the Lots 14, 15 and 299 Kerosene Lane, Baldivis development, including Contractors and Visitors will be required to attend a site induction briefing upon arrival and prior to commencing work. The induction details aspects of the development, site safety requirements (including pipeline protection measures) and procedures, which apply when working on site.

Details are provided to attendees of emergency responsibilities and actions including (but not limited to) the following:

- Health, Safety Requirements;
- Safety Responsibilities and Safety Management;



- Communications;
- Emergency Response Plan;
- Site Familiarisation; and
- Hazard / Risk Awareness.

6.2.2. Review of Easement Access

A review of the type of vehicles that will be permitted to operate within the pipeline easement (for the road crossings) will be conducted by APA. The findings from this review will restrict access into the easement to the permitted site vehicles.

6.2.3. Review of Maintenance Procedures

APA will perform regular review of their maintenance procedures to ensure regulatory compliance of their safety management systems.

6.2.4. Dial Before You Dig

Galati Nominees / APA will obtain information, such as pipeline location and third party service routes from the Dial before you Dig service prior to any work activities conducted on site. This will be particularly relevant for the road crossing construction. However a concrete slab will be installed above the pipeline prior to the road construction commencing. This will only prevent hand tools and small equipment damaging the pipeline.

6.2.5. Permitting Procedures

Galati Nominees and all subcontractors shall communicate their proposed activities in advance to allow APA to organise and provide direct supervision of required activities. Additionally a permit to dig procedure shall be used as part of the site safety management system. This will take into account the proposed work and the location of the services (pipeline or others) in the vicinity.

6.2.6. Signage

Signage on the Parmelia Gas Pipeline shall be visible in both directions along the section of pipeline adjacent to the Lots 14, 15 and 299 Kerosene Lane, Baldivis development with spacing not exceeding 50m. An emergency contact number will be shown on the sign to alert emergency services in the event of an incident.

6.2.7. Marker Tape

In locations where additional protection is deemed necessary, marker tape shall be installed above the pipe to warn third parties of the presence of the buried Parmelia Gas Pipeline.

6.2.8. Patrols

Routine patrols of the pipeline easement will be performed by the pipeline operator (APA), which shall not exceed the six monthly intervals.

6.2.9. Landowner, Occupier and other Authority Liaison

The Pipeline Operator (APA) will inform all landholders, occupiers and other utility providers within Lots 14, 15 and 299 Kerosene Lane, Baldivis area of any proposed maintenance activities that may arise at least on an annual basis. This is part of APA's public awareness procedures.



7. REFERENCES

1. Australia standard AS2885.1 2007, "Pipelines – Gas and Liquid Petroleum, Part 1: Design and Construction", Standards Australia.
2. Parmelia Gas Pipeline, Lots 14, 15 and 299 Kerosene Lane, Baldivis development - AS 2885.1 -2007 Pipeline Risk Assessment, Appendix B and C Vanguard Solutions.
3. Penetration Resistance, Fatigue & Radiations Contour Calculations Parmelia Gas Pipeline, APA document PAM-DC-624, APA Group
4. Instructions for Work Near Gas Pipelines, APA Group-Parmelia Operations.
5. Western Australian Planning Commission, Planning Bulletin 87, High Pressure Gas Transmission Pipelines in the Perth Metropolitan Region; October 2007.
6. APA Work Instruction document, WI-4.9.43 "Easement Crossing Construction".

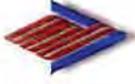


APPENDIX A- AS2885.1 Compliance Table



Table A.1 - Compliance Table

Compliance Table for Pt Lot 26, Lots 1 and 11, South Baldivis development				
Ref.	AS2885.1 2007 Standard Requirement	AS2885.1 2007 Standard Section	Documentation	Notes for Client Use
SR-01	Implementation - All actions arising from the safety management study shall be implemented and the implementation documented. Where ongoing action is required, a reporting mechanism to demonstrate action shall be established, implemented and audited.	2.2.3	All actions from the Risk Assessment Workshop (RA), have been documented in the RA worksheet (Appendix B) Actions requiring on-going reporting have been recommended in the RA worksheet and PPP report which are to be included in APA's Safety Management System to ensure ongoing management of this item.	
SR-02	Safety Management Study Validation - Each detailed safety management study shall be validated by a properly constituted workshop which shall critically review each aspect of the safety management study.	2.2.4	The safety management study has been conducted as a result of new threats associated with the construction activities on Lots 14, 15 and 299 Kerosene Lane, Baldivis development. The scope of the study has been restricted to only the area that is changed. An assessment of the existing and agreed recommended controls has been undertaken during the Risk Assessment workshop.	
SR-03	Operational Review - An assessment of the implementation and effectiveness of all threat controls shall be made at each operational review.	2.2.5	The operational reviews are conducted by APA on a regular basis. However they are not part of the scope of this development work.	



Compliance Table for Pt Lot 26, Lots 1 and 11, South Baldivis development				
Ref.	AS2885.1 2007 Standard Requirement	AS2885.1 2007 Standard Section	Documentation	Notes for Client Use
SR-04	<p>Safety Management Process – The pipeline safety management process consists of the following:</p> <ul style="list-style-type: none"> • Threat identification; • Application of physical, procedural and design measures to identified threats; • Review and control of failure threats; and • Assessment of residual risk from failure threat. <p>An assessment of the implementation and effectiveness of all threat controls shall be made at each operational review.</p>	2.3.1	The Risk Assessment Workshop was performed in accordance with the Safety management Process as stated in Section 2.3 of AS2885.1 – 2007.	
SR-05	<p>External Interference Protection-The pipeline shall be protected from external interference by a combination of physical and procedural controls at the location of each identified threat. All reasonably practicable controls should be applied.</p>	2.3.3.2	All external interference threats identified in the Risk Assessment have been protected by a combination of physical and procedural controls to ensure that the risks of impact to the pipeline are ALARP (Appendix B), except where a further risk assessment is noted as being required.	
SR-06	<p>Control by Design and/or Procedures - Design and/or procedures shall be applied to threats other than external interference threats in accordance with Standard</p>	2.3.3.3	Failure analysis is addressed in the Risk Assessment Data (Appendix B), which covered all identified pipeline threats associated with the Lots 14, 15 and 299 Kerosene Lane, Baldivis development.	
SR-07	<p>Failure Analysis – where controls may not prevent failure for a particular threat, the threat shall be analysed to determine the damage that it may cause to the pipeline.</p>	2.3.4.1	Failure analysis is addressed in the Risk Assessment Data (Appendix B), which covers all identified pipeline threats and foreseeable maximum consequences.	



Compliance Table for Pt Lot 26, Lots 1 and 11, South Baldivis development				
Ref.	AS2885.1 2007 Standard Requirement	AS2885.1 2007 Standard Section	Documentation	Notes for Client Use
SR-08	Treatment of Failure Threats – where a failure event is identified additional controls to prevent failure shall be investigated and applied where applicable.	2.3.4.2	Refer to comment SR-07. Additional controls, where necessary have been addressed in the Risk Assessment Data (Appendix B) and recommendations noted as actions were made where insufficient existing controls were identified.	
SR-09	Documentation – The failure analysis for the specific threat shall be documented.	2.3.4.3	Refer to comment SR-07. However items f) and g) in AS 2885.1 section 2.3.4.3 have not been specifically documented as it is obvious that the fluid is natural gas and further QRA to that referred to in Western Australian Planning Commission Planning Bulletin 87 (Ref. 5) would provide no benefit in determining setback distances etc. for this development.	
SR-10	Demonstration of Fault Tolerance – To demonstrate the fault tolerance of the pipeline design, a situation where failure of threat control measures leads to pipe damage or loss of containment shall be considered as a threat.	2.3.6	Residual risks have been assessed during the Risk Assessment Workshop for threats taking into account the potential effectiveness of the nominated controls as per the hierarchy of controls Fig. 4.1, refer to the Risk Assessment Data (Appendix B).	
SR-11	Environmental Management – The threats to the environment from each part of the life cycle of the pipeline to be identified and control measures shall be given to ensuring environmental threats are managed by avoidance.	2.5	No potential threats to the environment were identified during the workshop.	



Compliance Table for Pt Lot 26, Lots 1 and 11, South Baldvis development				
Ref.	AS2885.1 2007 Standard Requirement	AS2885.1 2007 Standard Section	Documentation	Notes for Client Use
SR-12	Environmental Management – An environmental impact assessment shall be conducted in accordance with the standard along the length of pipeline route. The environmental impact assessment report shall form the basis of the environmental management plan.	2.5	The environmental impact assessment for the operating aspects Parmelia Gas pipeline is outside the scope of this study as the pipeline is in place. The development by Galati Nominees does not generate additional environmental impact from the pipeline.	
SR-13	Environmental Management – Threat of damage to the environment from operational maintenance and abandonment activities shall be identified and control measures developed.	2.5	Refer to comment SR-11.	
SR-14	Electrical – A pipeline in the vicinity of electricity supply powerlines or facilities shall be analysed to determine if controls are required to provide for electrical safety.	2.6	The impact from third party service providers was addressed within the Risk Assessment Data (Appendix B). Galati Nominees and subcontractor prior to construction activities requests Dial before you Dig documentation. This information will be communicated to all third party contractors (Appendix B, and Ref. 4).	
SR-15	Construction Safety – A construction safety plan shall be prepared, reviewed by appropriate personnel, and approved. This review shall take the form of a construction safety plan workshop.	2.7.1	There will be no pipeline construction activities taking place during the development of Lots 14, 15 and 299 Kerosene Lane, Baldvis. Therefore, this requirement is not applicable.	
SR-16	Testing Safety – The construction safety plan shall address safety through all phases of testing of the pipeline during construction.	2.7.2	Refer to comment SR-15.	



Compliance Table for Pt Lot 26, Lots 1 and 11, South Baldivis development				
Ref.	AS2885.1 2007 Standard Requirement	AS2885.1 2007 Standard Section	Documentation	Notes for Client Use
SR-17	Commissioning Plan – The commissioning plan shall consider the safety of the activities undertaken through all phases of commissioning and, where required, develop specific procedures to manage the safety during commissioning of the pipeline.	2.7.3	Refer to comment SR-15.	



APPENDIX B – Pipeline Risk Assessment Minutes / Data.



AS 2885 Risk Assessment **Project: A10526 - Lots 14, 15 & 299 Kerosene Lane, Baldivis, WA**

Pipe Type: Gas		Pipe Internal Diameter: 355.6mm (14")		Facilitator: Tony Davies											
Location Class: T1, T1.i, T2		Wall Thickness: 5.5 - 6mm		Note: If 2 physical and 2 procedural controls are / will be present no further risk assessment is required by APA Group.											
Land Use: Residential / Light Commercial		Pressure: 5.6MPa													
HAZ ID #	Location Class	Location Description	Threat	Threat Analysis	Is the threat credible? (Y/N)	Safeguards - External Interference Protection	Safeguards - Procedural/ Design - Safeguards	Reduced to ALARP	Actions	Action By	Action due date	Consequence	Frequency	Risk Ranking	Comment
L1	Swale drainage basin														
HAZ 1	T1.i	Inundation of pipeline from storm water collection.		A 1 in 10 year fill of swale basin may affect pipeline easement causing erosion or flotation of pipeline.	N	Existing depth of cover is 1.7-2.2m. A concrete slab (150mm thick) will be placed over the pipeline.	Pipe coating - No. 1 Yellow Polyethylene Jacket, (0.031" thickness) Cathodic protection for pipeline.	Y							The pipeline is under the water table in similar locations for part of year so swale is not considered significant additional threat. Due to existing cover flotation is not possible. Proposed contours (minor changes from existing) mean that significant erosion is not considered possible.
	Road Crossings		No credible threats at this location.												
	Services		No credible threats at this location.												
HAZ 2	T1.i	Regrading of swale contours		Heavy machinery could impact pipeline via vibration or direct contact.	N	Signage Existing depth of cover is 1.7-2.2m. No mechanical digging within 1m of pipeline. Limit the size of the excavator to 15 tonne. No tiger teeth devices. A concrete slab (150mm thick) will be placed over the pipeline.	Easement delineation with star picket fence and designated crossing locations Pipeline design details in table header - 55 tonne penetration resistance for general purpose teeth (10 tonne for tiger teeth) APA document PAMDC624 penetration resistance calculations APA representative on site during construction. No large vibratory compaction to be used within 10m of pipeline. Small 500mm plate compactors are generally approved.	Y	Fencing and exclusion of all vehicles from easement during earthworks. No work is to be performed on or that could affect the easement Vehicles to cross the easement at designated points only. If rock breakers are used (for limestone areas) vibration monitoring to ensure no exceedances of peak particle velocity of 10mm/s must be implemented.	Galati Nominees, (Planning solutions - PE)	At subdivision approval stage			T1 threat is not considered to be credible. However this does depend upon the fences being in place prior to work commencing and no large vibrating equipment being used during swale contouring.	



AS 2885 Risk Assessment Project: **A10526 - Lots 14, 15 & 299 Kerosene Lane, Baldvis, WA**

AS 2885 Risk Assessment		Project: A10526 - Lots 14, 15 & 299 Kerosene Lane, Baldvis, WA		Facilitator: Tony Davies													
HAZ ID #	Location	Location Class	Location Description	Threat	Threat Analysis	Is the threat credible? (y/n)	Safeguards - External Interference Protection	Safeguards - Procedural/ Design - Safeguards	Reduced to ALARP	Actions	Action By	Action due date	Consequences	Frequency	Risk Ranking	Comment	
	Filling / Back Filling	T1,1		AS per HAZ 2			Signage Existing depth of cover is 1.7-2.2m.	Easement delineation with star picket fence and designated crossing locations									
	Spreading	T1,1		AS per HAZ 2			No mechanical digging within 1m of pipeline. Limit the size of the excavator to 15 tonne.	Pipeline design details in table header. 55 tonne penetration resistance for general purpose teeth (10 tonne for tiger teeth)									
HAZ 3	Access to / across Easement	T1,1		Construction activity heavy vehicles	Heavy machinery could impact pipeline via vibration or stressing from mass of vehicle.	N	No tiger teeth devices. A concrete slab (150mm thick) will be placed over the pipeline.	APA document PAMDC624 penetration resistance calculations APA representative on site during construction.		As per HAZ 2						Threat is not considered to be credible. However this does depend upon the fences being in place prior to work commencing and no large vibrating equipment being used during swale contouring.	
	Future Services	T1,1		No credible threats at this location													
	Lighting	T1,1		No credible threats at this location													
L2	Location Specific		R60 grouped housing (zone 3)														
	Drainage	T1		No credible threats at this location													Drainage is either soak wells or will be directed to the swale basin
	Road Crossings	T1		No credible threats at this location													
	Services	T1		No credible threats at this location													
	Excavations																



AS 2885 Risk Assessment **Project: A10526 - Lots 14, 15 & 299 Kerosene Lane, Baldvis, WA**

Pipeline Type: Gas		Pipe Internal Diameter: 355.6mm (14")		Facilitator: Tony Davies											
Location Class: T1, T1, T2		Wall Thickness: 5.5 - 6mm		Note: If 2 physical and 2 procedural controls are / will be present no further risk assessment is required by APA Group.											
Land Use: Residential / Light Commercial		Pressure: 5.6MPa													
HAZ ID #	Location Class	Location Description	Threat	Threat Analysis	Is the threat credible? (y/n)	Safeguards - External Interference Protection	Safeguards - Procedural/ Design - Safeguards	Reduced to ALARP	Actions	Action By	Action due date	Consequence	Frequency	Risk Ranking	Comment
	T1		No credible threats at this location												
	Filling / Back Filling		No credible threats at this location												
	Spreading		No credible threats at this location												
	Access to / across Easement		No credible threats at this location												
HAZ 4	T1		Construction activity heavy vehicles (As per HAZ 3)	Heavy machinery could impact pipeline via crushing or stressing from mass of vehicle.	N	Signage Existing depth of cover is 1.7-2.2m. No mechanical digging within 1m of pipeline. Limit the size of the excavator to 15 tonne. No tiger teeth devices. A concrete slab (150mm thick) will be placed over the pipeline.	Easement delineation with star picket fence and designated crossing locations Pipeline design details in table header. 55 tonne penetration resistance for general purpose teeth (10 tonne for tiger teeth) APA document PAMDC624 penetration resistance calculations APA representative on site during construction. No large vibratory compaction to be used within 10m of pipeline. Small 500mm plate compactors are generally approved.	Y	Fencing and exclusion of all vehicles from easement during earthworks. No work is to be performed on or that could affect the easement Vehicles to cross the easement at designated points only. If rock breakers used vibration monitoring to ensure no exceedances of peak particle velocity of 10mm/s	Galati Nominées, (Planning solutions - PE)	At subdivision approval stage				The north / south road running parallel to the easement is approximately 13m from pipeline to the edge of the road reserve and 20m to the edge of the road from the pipeline. Providing heavy vehicles are excluded from the easement and use designated crossings the threat is not credible.
	Future Services		No credible threats at this location												
	Lighting		No credible threats at this location												
L3	Location Specific		Road crossing North with roundabout												



AS 2885 Risk Assessment Project: **A10526 - Lots 14, 15 & 299 Kerosene Lane, Baldvis, WA**

Pipeline Type: Gas		Pipe Internal Diameter: 355.6mm (14")		Facilitator: Tony Davies											
Location Class: T1, T1, T2		Wall Thickness: 5.5 - 6mm		Note: If 2 physical and 2 procedural controls are / will be present no further risk assessment is required by APA Group.											
Land Use: Residential / Light Commercial		Pressure: 5.6MPa													
HAZ ID #	Location Class	Location Description	Threat	Threat Analysis	Is the threat credible? (y/n)	Safeguards - External Interference Protection	Safeguards - Procedural/ Design - Safeguards	Reduced to ALARP	Actions	Action By	Action due date	Consequence	Frequency	Risk Ranking	Comment
	Access to / across Easement														
	Future Services														
T1	T1		AS per HAZ 3	Future development west of easement may require services from east of the easement	Y	Signage Depth of existing 1.7-2.2m cover No mechanical digging within 1m of pipeline. Limit the size of the excavator to 15 tonne. No tiger teeth devices.	Diagrams before you dig Contractors to communicate details of work to allow APA to provide supervision. Pipeline design details in table header. 55 tonne penetration resistance for general purpose teeth (10 tonne for tiger teeth)	Y	Concrete sidewalks will be required as additional protection at the road crossings or points where services may cross easement for future western development. Sidewalls should be put in place at the time of construction of the road crossing.	Galati Nominees, (Planning solutions - PE)	When road crossings are developed or when western developments required services from the eastern side of the easement.	Catastrophic	Hypothetical	Intermediate	Hypothetical rating given due to side walls being present. Sidewalls will only need to go in if development takes place on the west that requires horizontal boring or similar from east.
	Lighting			Side drilling for services links under the easement / pipeline from west to east side roads could damage pipeline depending upon distance the side drilling has to surface from easement. Sewerage services may have to go under the pipeline.											
L4	Location Specific	Road crossing South		No credible threats at this location The threats for the south crossing are the same as that for the north (the south crossing is less complex). However the location class changes here so potential consequences are lower due to lower people density.											
	Drainage			As per HAZ 5											



AS 2885 Risk Assessment Project: **A10526 - Lots 14, 15 & 299 Kerosene Lane, Baldvis, WA**

Pipeline Type:		Gas		Pipe Internal Diameter:		355.6mm (14")		Facilitator		Tony Davies					
Location Class:		T1, T1.i, T2		Wall Thickness:		5.5 - 6mm		Note		If 2 physical and 2 procedural controls are / will be present no further risk assessment is required by APA Group.					
Land Use:		Residential / Light Commercial		Pressure:		5.6MPa									
HAZ ID #	Location Class	Location Description	Threat	Threat Analysis	Is the threat credible? (y/n)	Safeguards - External Interference Protection	Safeguards - Procedural/ Design - Safeguards	Reduced to ALARP	Actions	Action By	Action due date	Consequence	Frequency	Risk Ranking	Comment
	Road Crossings		As per HAZ 6												
	Services		As per HAZ 7												
	Excavations		As per HAZ 8												
	Filling / Back Filling		As per HAZ 8												
	Spreading		As per HAZ 8												
	Access to / across easement		As per HAZ 3												
	Future Services		As per HAZ 9												
	Lighting														
NL1	Non location specific														
HAZ 10	External interference														
	Overall														
	Overall														
	Corrosion														
	Overall														



AS 2885 Risk Assessment Project: **A10526 - Lots 14, 15 & 299 Kerosene Lane, Baldvis, WA**

Pipeline Type:		Pipe Internal Diameter:		Facilitator		Tony Davies									
Location Class:		Wall Thickness:		Note		If 2 physical and 2 procedural controls are / will be present no further risk assessment is required by APA Group.									
Land Use:		Pressure:													
HAZ ID #	Location Class	Location Description	Threat	Threat Analysis	Is the threat credible? (y/n)	Safeguards - External Interference Protection	Safeguards - Procedural/ Design - Safeguards	Reduced to ALARP	Actions	Action By	Action due date	Consequence	Frequency	Risk Ranking	Comment
	Overall		No credible threats relevant to this proposal												
	Overall		As per HAZ 9												
	Overall		No credible threats relevant to this proposal												
	Overall		No credible threats relevant to this proposal												
	Overall		No credible threats relevant to this proposal												
	Overall		No credible threats relevant to this proposal												
HAZ T1	Overall		Pipeline may have deteriorated since construction	As the land use is changing any deterioration in the conditions of the pipeline since construction may now have larger consequences	Y	N/A	Cathodic corrosion protection The pipeline will be uncovered and all joints / welds will be visually inspected, any action required taken and the pipeline re-wrapped prior to concrete top slab placement. APA group maintenance system and checks	Y	Prior to development pipeline inspection (joints / welds) to be completed.	APA group	Prior to concrete top slab placement prior to the start of the site works	Catastrophic	Hypothetical	Inherently	As the pipeline is buried (1.7 - 2.2m) and will be covered in concrete slab. There are no surface features so this threat is not considered credible



APPENDIX C – Workshop Risk Assessment Team



Name	Company	Position
Paul Ellenbroek	Planning Solutions	Senior Planner
Clayton Wylie	APA Group	Mechanical Engineer
Paul Revell	APA Group	Land Coordinator
Gerry Connell	APA Group	Lands Officer
Warren Guthrie	APA Group	Operations Team Leader
Tony Davies	Vanguard Solutions	Facilitator / Scribe Lead Risk & Safety Engineer

Name	Company	Position
Tony Davies	Vanguard Solutions Pty Ltd	Facilitator / Risk and Safety Engineer
Paul Ellenbroek	Planning Solutions	Senior Planner
CLAYTON WYLIE	APA	MECHANICAL ENGINEER
PAUL REVELL	APA	LAND CO-ORDINATOR
GERRY CONNELL	APA	LANDS OFFICER
Warren Guthrie.	APA.	Operations Team Leader.



APPENDIX D - Parmelia Pipeline Material Specification and other properties.



Pipeline Property	Pipeline Name: Parmelia
Pipe Material	API 5L x52, Butt welded along trunk line
Pipe outside diameter	356mm (14")
Pipe Maximum allowable operating pressure (MAOP)	5.61 MPa
Depth of Cover	1300mm
Pipe Coating	No. 1 Yellow Polyethylene Jacket. (0.031" thickness)
Pipe length affected by the project	Approx. 600m
Design Factor	50%
AS2885 Design Location Classification	T1, I (refer section 2.3)
AS2885.1 Resistance to Penetration Calculations. <i>(Reference - Penetration Resistance, Fatigue & Radiations Contour Calculations Parmelia Gas Pipeline, AGY-007-TR-003, APA Group)</i>	The largest excavator that the pipeline can resist is a 15 tonne 'tiger' tooth excavator. Other excavators with "standard" teeth could be larger. However, any contact by any machinery of any type will likely cause damage to the pipe coating which is inherent to corrosion mitigation

*



DOCUMENT TRANSMITTAL

To : Paul Ellenbroek
Company : Planning Solutions
Copy : Paul Revell – APA Group
Email : pellenbroek@planningsolutions.com.au; Paul.Revell@apa.com.au
From : Tony Davies
Date : 2/7/2010
Subject : PGP Risk Assessment and Pipeline Protection Plan Report Rev 0
Ref. : A10526-TRANS-001

Issued for/as:	Final	✓	Review		Information	-
Comments due by		NA				

We hereby transmit the following:

Quantity	Description
1	Revision 0 of Kerosene Lane development, PGP Risk Assessment and Pipeline Protection Plan Report A10526-PSO-RX-001

RECEIPT

Please acknowledge receipt of the above by signing and returning an e-copy of this notification by email to the following address(es), subject Header as per Ref. above:

To: tony.davies@vanguardsolutions.com.au;

DOCUMENT DISTRIBUTION

- N/A

NOTES OR REVIEW INSTRUCTIONS/REQUESTS:

- N/A

Signed for
Vanguard Solutions Pty Ltd

Name (please print): Tony Davies

Date: 02/07/2010

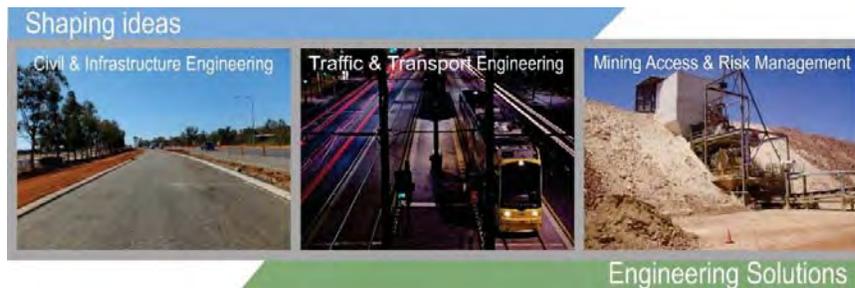
Acknowledgment of receipt

Name (please print) _____ Date: _____

APPENDIX 6 TRANSPORT ASSESSMENT



CONSULTING CIVIL & TRAFFIC ENGINEERS, RISK MANAGERS.



Project: Lots 5, 6, 7 & 8 Kerosene Lane, Baldvis
Transport Assessment

Client: Whelans

Author: Angela Wetton

Signature:

Date: 22/05/17

1 ST. FLOOR, 908 ALBANY HIGHWAY, EAST VICTORIA PARK WA 6101.
PHONE +61 8 9355 1300
FACSIMILE +61 8 9355 1922
EMAIL admin@shawmac.com.au



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SHAWMAC PTY LTD
ABN 51 828 614 001
PO BOX 937
SOUTH PERTH WA 6951
T: + 61 8 9355 1300
F: + 61 8 9355 1922
E: admin@shawmac.com.au
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CONTENTS

1. Summary	1
2. Introduction and Background	2
2.1. General	2
2.2. Transport Statement Objective	2
2.3. Site Location	2
2.4. Surrounding Major Attractors and Generators	3
3. Existing Situation	4
3.1. Land Use	4
3.2. Zoning	4
3.3. Existing Road Network	4
3.4. Road Hierarchy vs Actual Flows	5
3.5. Public Transport Facilities	6
3.6. Existing Pedestrian and Cycling Network	6
4. Development Proposal	8
4.1. Subdivision Proposal	8
4.2. Proposed Land Use	8
4.3. Changes to External Transport Networks	9
5. Transport Assessment	10
5.1. Assessment Period	10
5.2. Traffic Generation	10
5.3. Traffic Distribution	11
5.4. Design Traffic Flows	12
5.5. External Traffic Flows	13
6. Roads and Intersections	14
6.1. Proposed Internal Transport Networks	14
6.2. Road Hierarchy and Reserves	14
6.2.1. Intersection Analysis	16



6.3. Pedestrian/ Cyclist Access	16
6.4. Public Transport Access	17
6.5. Safety issues	17
6.6. Noise	18
7. Conclusions	19
Appendix A – Subdivision Concept Plan	20
Appendix B - Kerosene Lane Traffic Counts	21
Appendix C - Road Hierarchy Criteria.....	25



FIGURES

Figure 1 - Regional Context.....	2
Figure 2 - Local Context	3
Figure 3 - Extract of City of Rockingham TPS 2	4
Figure 4 - Road Hierarchy	5
Figure 5 - Cycling network.....	7
Figure 6 - Proposed Subdivision Concept Plan	8
Figure 7 - Traffic Assessment Zones (TAZ's).....	10
Figure 8 - Future Daily Traffic Volumes	12
Figure 9 - Proposed Transport Network	14
Figure 10 - Access Street D indicative cross section.....	15
Figure 11 - Access Street C indicative cross section.....	15
Figure 12 - Suggested Bus Route (Extract from City of Rockingham <i>Baldivis (North) District Structure Plan</i>	17

TABLES

Table 1 - Road Classification and Current Traffic Volumes	6
Table 2 - Proposed Land Use	8
Table 4 - Trip Generation.....	11
Table 5 - Internal Roads - Future Daily Traffic Volumes	12
Table 6 - Existing Road Network - Predicted Flows.....	13
Table 7 - Proposed Road Hierarchy and Road Reservations	15
Table 7 - Intersection Analysis Warrants.....	16



1. Summary

Whelans Town Planning has developed a Subdivision Concept Plan for Lots 5-8 Kerosene Lane, Baldivis. The subject site is located in the City of Rockingham, approximately 7.5 kilometres south-east from the Rockingham Town Centre, and 40 kilometres south of the Perth CBD.

This Transport Assessment has been prepared by Shawmac Pty Ltd to support the Subdivision Concept Plan and outlines the likely impact of the proposed subdivision on network traffic flows, safe access, pedestrian and cycle facilities and local amenity.

The subject site is currently zoned "Development" under the City of Rockingham *Town Planning Scheme No 2* (TPS 2). The subdivision proposes 135 single dwellings with a series of local access roads servicing the properties.

Kerosene Lane forms the northern boundary to the site, with future urban development to the west, east and south. A 2.2 metre road widening is proposed for Kerosene Lane, near the eastern entrance road to the subdivision.

There are currently no pedestrian or public transport facilities within a 400m walkable catchment of the subject site, however Kerosene Lane has been identified as a suggested bus route under the Baldivis (North) District Structure Plan.

A trip generation and distribution exercise was completed and determined that the proposed subdivision would generate 1,080 vehicular trips per day. The trips would permeate through the local road network up to Kerosene Lane via two proposed access roads, with an additional 595 trips heading to the east, and 475 trips travelling to the west. The road classification of Kerosene Lane may require review as the predicted traffic volumes are greater than desirable for the current classification of Access Road.

The traffic generated was not large enough to warrant any intersection analysis, under the Table 6.1 of Austroads Guide to Traffic Management Part 3, Traffic Studies and Analysis, and there are no safety or operational issues expected.

Footpaths should be provided on at least one side of Kerosene Lane and each of the internal local roads with connections to the established pedestrian and cycling network external to the area as well as to future urban development east of the subject site.

A review of the overall transport proposal for the site did not identify any specific issues that present unacceptable risks to the road user or that cannot be managed through appropriate design protocols.

The proposed development is not likely to generate any traffic noise or result in any vibration issues

2. Introduction and Background

2.1. General

This Transport Assessment has been prepared by Shawmac Pty Ltd, on behalf of Whelans Town Planning to support a Subdivision Concept Plan for Lots 5-8 Kerosene Lane, Baldivis, in the City of Rockingham.

2.2. Transport Statement Objective

This Transport Assessment outlines the likely impact of the proposed subdivision on network traffic flows, safe access, pedestrian and cycle facilities and local amenity. As part of the assessment, Shawmac considered the likely traffic demand that would be generated through the proposed development.

The assessment considers aspects associated with:

- Generation of traffic including impacts on roads;
- Integration with the surrounding land uses;
- Use of public and other transport modes such as walking and cycling; and
- Safety and access issues.

2.3. Site Location

The subject site is located approximately 40 kilometres south of the Perth CBD and 7.5km south-east of the Rockingham Town Centre. **Figure 1** below shows the broad the location of the site.

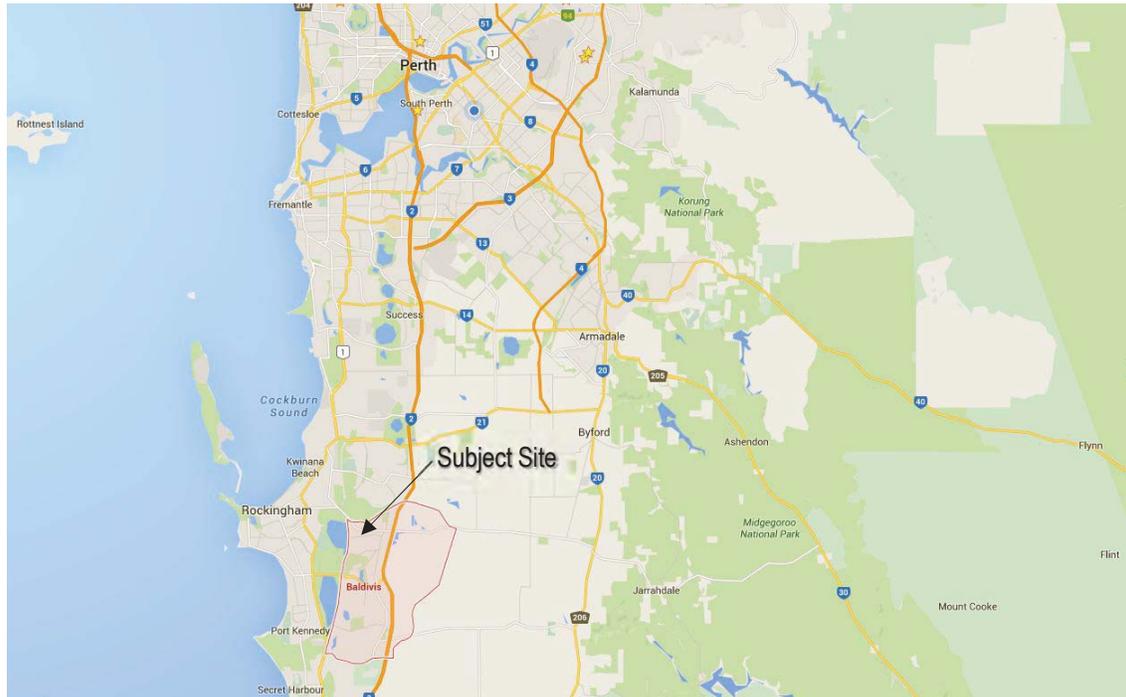


Figure 1 - Regional Context

The subject site is located on the southern side of Kerosene Lane, approximately 200m east of Mandurah Road. There is undeveloped bush land to the north and west, with existing and future urban development to the south and east.

Figure 2 shows the location of the site in the context of the local area.

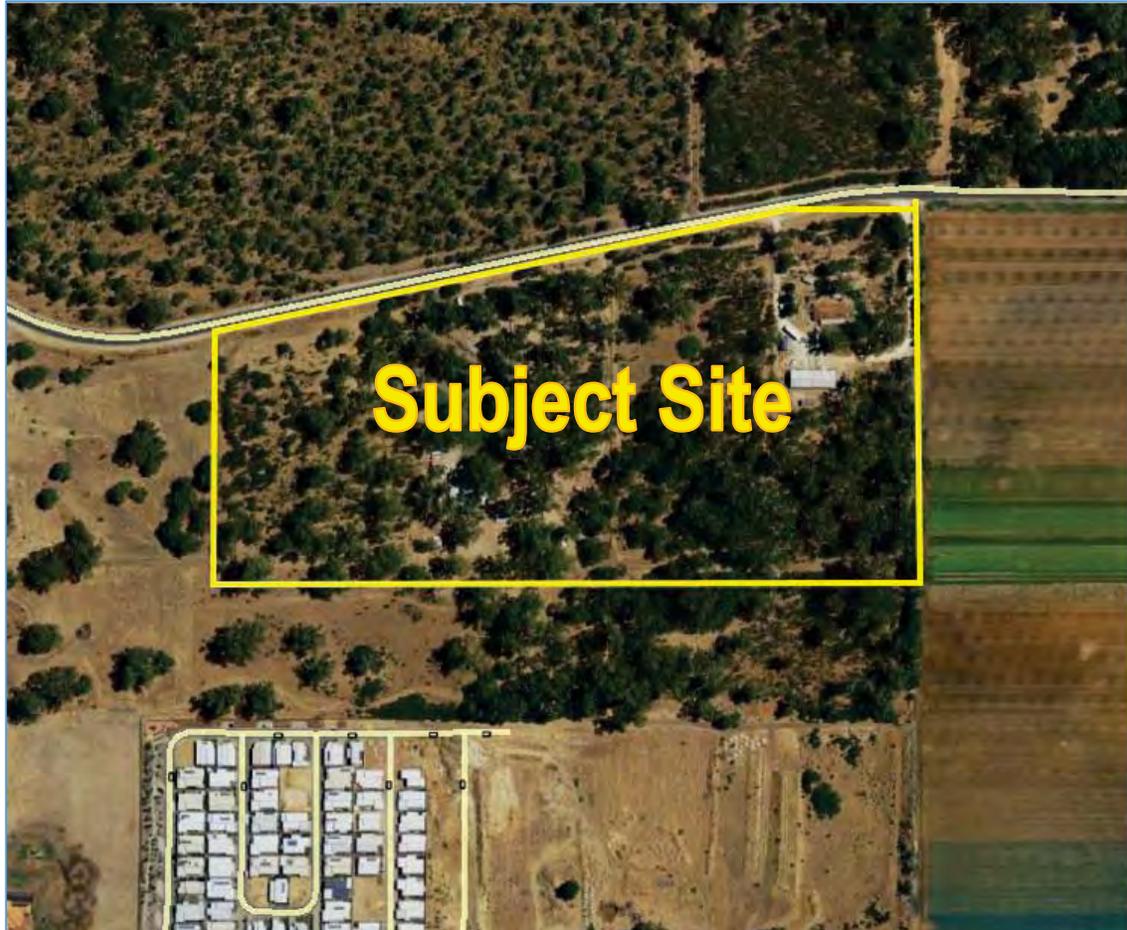


Figure 2 - Local Context

2.4. Surrounding Major Attractors and Generators

There is a Spud Shed supermarket located on Kerosene Lane, approximately 250m east of the subject site. Stockland Baldivis Shopping Centre is located on Safety Bay Road, approximately 7km drive to the south via Mandurah Road or Baldivis Road. The nearest Kwinana Freeway access is on Mundijong Road, approximately 3km north east.

The Rockingham Town Centre is approximately 8km away to the north and east and the Kwinana town site and surrounding industrial areas are located further north of Rockingham.

3. Existing Situation

3.1. Land Use

The subject site is predominantly undeveloped bush land, with a single residential development and shed located on Lot 5, the eastern-most lot in the Subdivision Concept Plan. There is cleared land to the east of the subject site and residential development to the broader east and south of the site.

3.2. Zoning

The subject site is currently zoned “Development” under the City of Rockingham *Town Planning Scheme No 2* (TPS 2). An extract from the planning scheme is shown below in **Figure 3**.

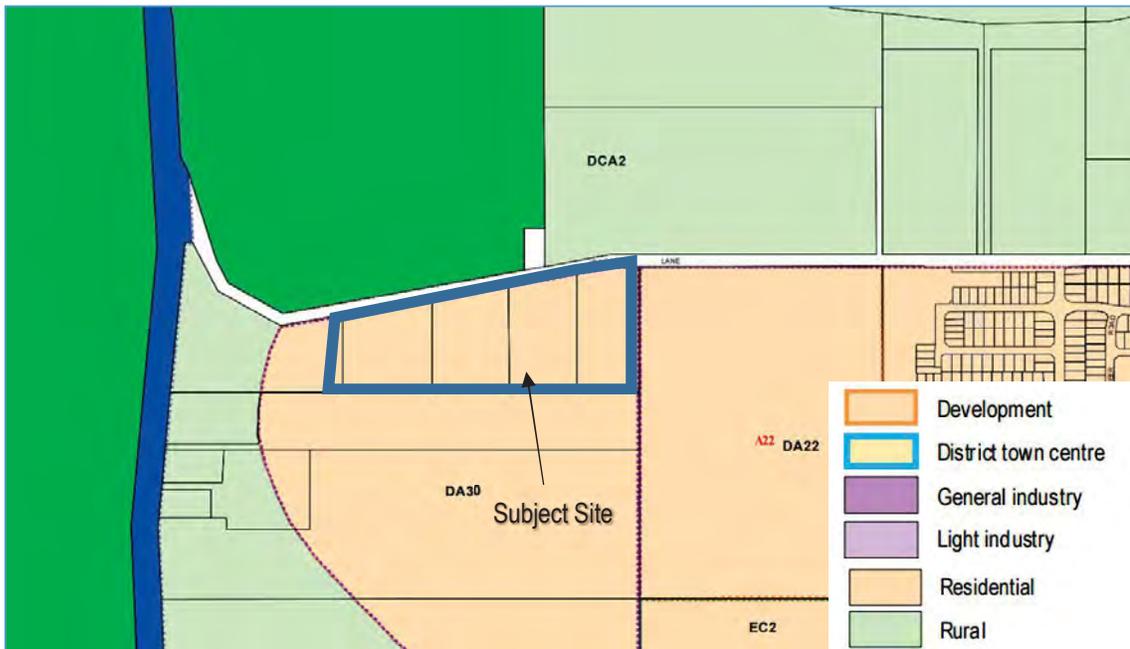


Figure 3 - Extract of City of Rockingham TPS 2

3.3. Existing Road Network

Kerosene Lane forms the northern boundary to the site and provides a connection between Mandurah Road in the west and Baldivis Road in the east. Kerosene Lane is classified as an *Access Road* under the MRWA regional hierarchy and has a posted speed limit of 80 km/hr. In the vicinity of the subject site, Kerosene Lane is described as a single undivided carriageway with an 8 metre wide seal and 3 metre wide unsealed shoulders. There is no formal drainage in place

The road classification for each road surrounding the proposed development site is shown on **Figure 4** as an extract from Main Roads Western Australia (MRWA) *Road Information Mapping System*.



Figure 4 - Road Hierarchy

3.4. Road Hierarchy vs Actual Flows

Traffic counts taken between 12 June 2013 and 27 June 2013 were provided by the City of Rockingham for Kerosene Lane, west of Spud Shed. This data indicated an average weekday traffic volume of 2,990 vehicles per day (vpd). The traffic count data is attached in **Appendix B**.

Traffic counts for Mandurah Road and Baldivis Road were obtained from Main Roads Western Australia's *Reporting Centre* and indicated average weekday traffic volumes of 9,178 vpd for Mandurah Road, north of Safety Bay Road (15 to 21 April 2010); and 9,331 vpd for Baldivis Road, south of Mundijong Road (30 October - 4 November 2014).

Table 1 details the comparison of actual flows against the recommended maximum flows under the *Liveable Neighbourhood* guidelines. The table indicates that all roads in the vicinity of the subject site are currently operating within their classification.

Kerosene Lane is currently operating near the upper limit of its desired traffic volumes. A review of the current classification is recommended as the surrounding area becomes increasingly urbanised.



Table 1 - Road Classification and Current Traffic Volumes

MRWA Road Classification	Road Category.	Road Name.	Desirable Max. Traffic Volume. (vpd)	Current Traffic Volumes (vpd)	Date
Access Road	Access Road	Kerosene Lane	3,000	2,990	27 June 2013
Regional Distributor	Integrator B Road	Mandurah Road	15,000	9,178	21 April 2010
Regional Distributor	Integrator B Road	Baldivis Road	15,000	9,331	4 November 2014

3.5. Public Transport Facilities

There are currently no public transport facilities within a 400m walkable catchment of the subject site. The nearest bus service is the Transperth Route 568 which operates between Wanbro Train Station and Baldivis. The closest bus stop is located on Fifty Road, approximately 2.7 kilometres from the subject site.

As the suburb of Baldivis becomes increasingly urbanised, there will be a need for more public transport services. Kerosene Lane is expected to become a major connecting road for residential development and a bus service along this corridor may need to be considered by the Public Transport Authority.

3.6. Existing Pedestrian and Cycling Network

Figure 5 illustrates the existing pedestrian and cycling network in the vicinity of the subject site. Kerosene Lane is shown on the *Perth Bicycle Network Map* extract as providing a good road riding environment.

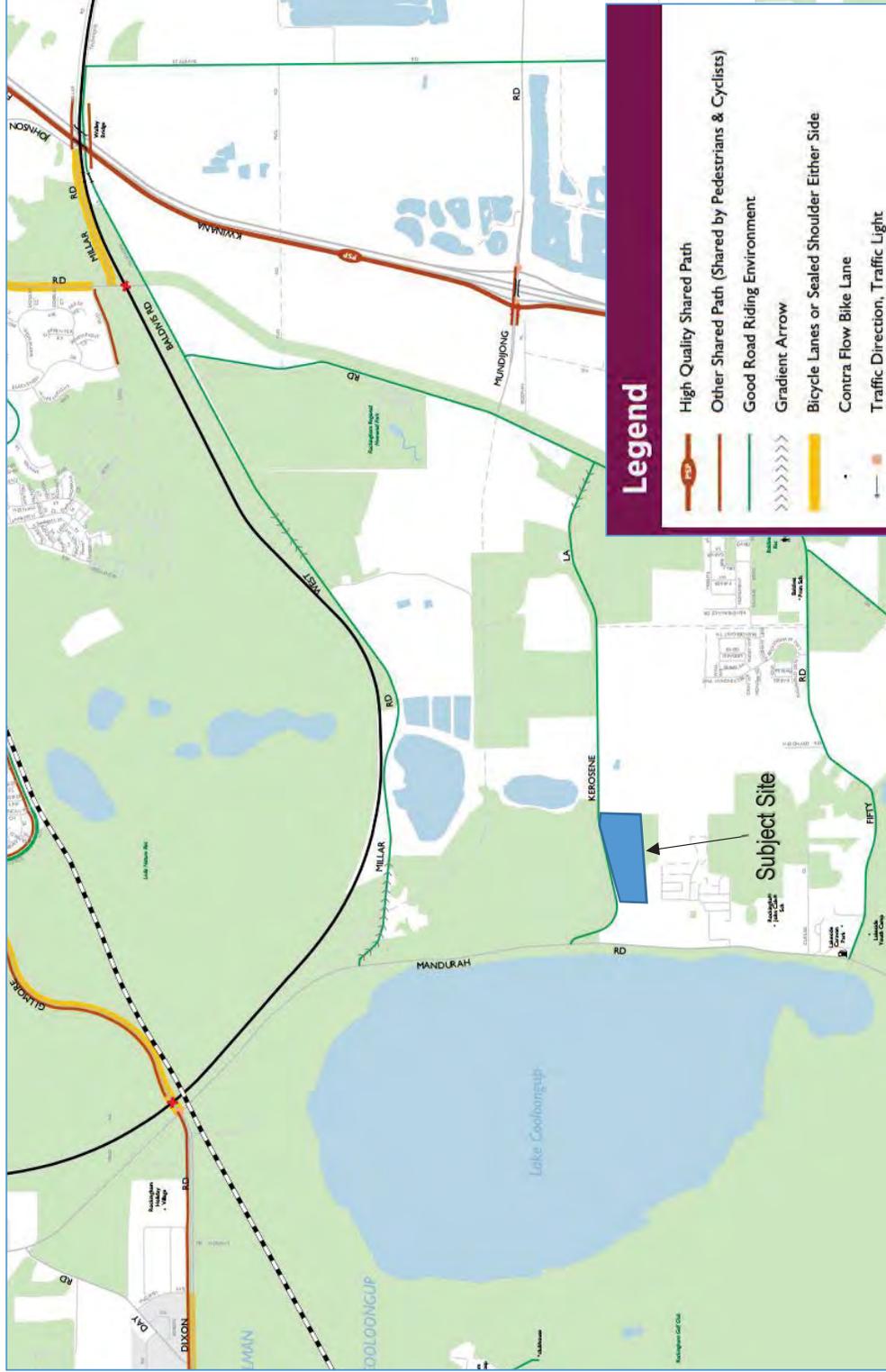


Figure 5 - Cycling network

4. Development Proposal

4.1. Subdivision Proposal

The proposed subdivision concept plan is attached in **Appendix A** and shown in **Figure 6**.



Figure 6 - Proposed Subdivision Concept Plan

The majority of the subject site is undeveloped bush land with a single residential property and shed on Lot 5. The proposed subdivision land use is residential lots zoned R25 and Public Open Space (POS)

4.2. Proposed Land Use

The proposed subdivision as shown in **Figure 6** consists of 135 dwellings and public open spaces. The proposed land use and areas is shown in **Table 2** below

Table 2 - Proposed Land Use

Land Use	Area	Number of Dwellings
Residential	4.82 hectares	135
Public Open Space (POS)	0.71 hectares	N/A
Road Reservation	2.80 hectares	N/A



4.3. Changes to External Transport Networks

A 2.2 metre road widening is proposed for Kerosene Lane, near the eastern entrance road to the subdivision as shown in **Figure 6** and it is expected that this will be adopted for all future subdivisions along Kerosene Lane.

Two intersections to Kerosene Lane are proposed, with two connections to the future subdivision to the south and one connection to the future subdivision to the east.

5. Transport Assessment

5.1. Assessment Period

The time periods for assessment were chosen based on the full development of the proposed subdivision.

5.2. Traffic Generation

Trip Generation rates were applied using the Institute of Transportation Engineers (ITE) *Trip Generation Manual 8th Edition*.

Assessed generation is shown on **Table 3** and is based on Traffic Assessment Zones (TAZ's) shown in **Figure 7**.

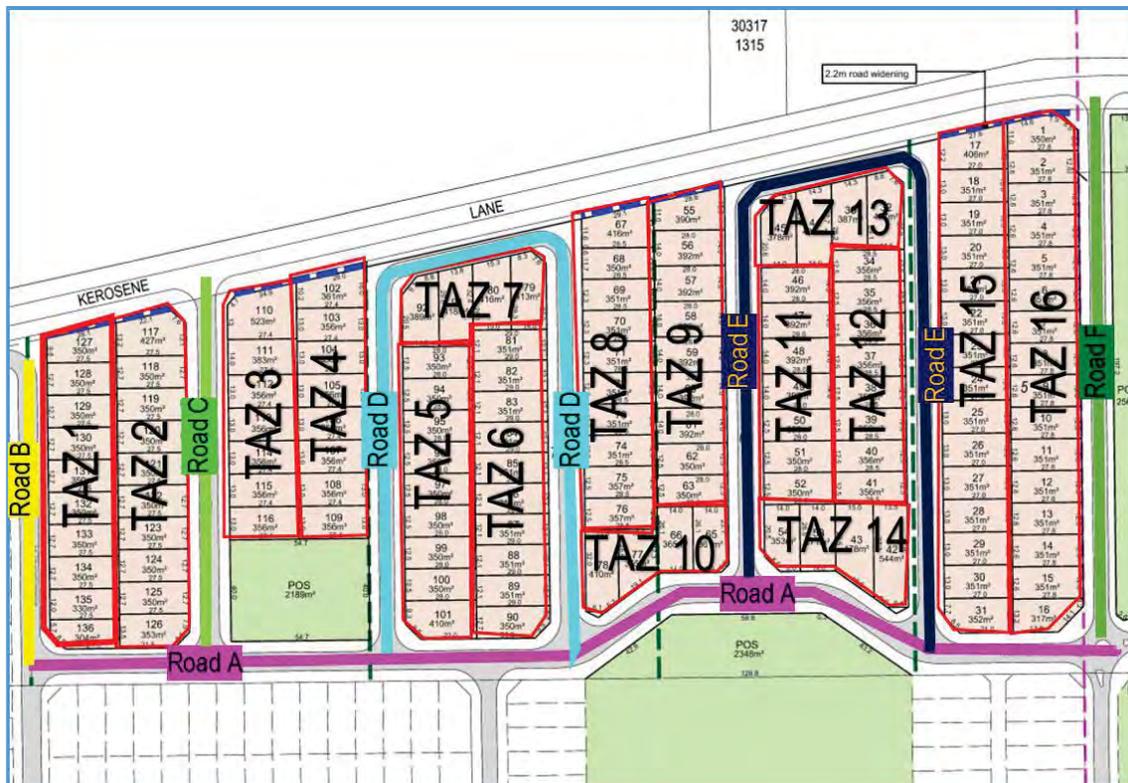


Figure 7 - Traffic Assessment Zones (TAZ's)

Table 3 - Trip Generation

Trip Assessment Zone	Land Use	Area	Dwellings	trips per dwelling	Daily Trips
TAZ 1	R25	3434	10	8	80
TAZ 2	R25	3580	10	8	80
TAZ 3	R25	2684	7	8	56
TAZ 4	R25	2853	8	8	64
TAZ 5	R25	3210	9	8	72
TAZ 6	R25	3509	10	8	80
TAZ 7	R25	1636	4	8	32
TAZ 8	R25	3586	10	8	80
TAZ 9	R25	3442	9	8	72
TAZ 10	R25	1491	4	8	32
TAZ 11	R25	2618	7	8	56
TAZ 12	R25	2848	8	8	64
TAZ 13	R25	1629	4	8	32
TAZ 14	R25	1746	4	8	32
TAZ 15	R25	5321	15	8	120
TAZ 16	R25	5581	16	8	128
TOTAL		49168	135		1080

5.3. Traffic Distribution

Based on the location and connectivity of the surrounding network and the major attractors / generators discussed in Section 2.4, the following assumptions have been made for the distribution of the site-generated traffic:

- 40% will enter and exit from the western access on Kerosene Lane, travelling to the east or west via Kerosene Lane
 - 30% to the east via Kerosene Lane towards Rockingham or Baldivis Town Centre
 - 10% to the west via Kerosene Lane towards the Freeway or Baldivis Town Centre
- 60 % will enter and exit from the eastern access on Kerosene Lane, travelling to the east or west via Kerosene Lane
 - 45% to the west via Kerosene Lane towards the Freeway or Baldivis Town Centre
 - 15% to the east via Kerosene Lane towards Rockingham or Baldivis Town Centre

For the future build out of the surrounding areas, the following scenarios are also considered and noted in **Figure 8** in italics.

- 10% will enter and exit the site from the future subdivision to the east of the site
- 5% will enter and exit the site through the local road network from the future subdivision to the south of the site

5.4. Design Traffic Flows

The traffic flows of the network were modelled using QRS II software as shown in **Figure 8**. **Table 4** lists the predicted traffic flows for the internal road network.



Figure 8 - Future Daily Traffic Volumes

Table 4 - Internal Roads - Future Daily Traffic Volumes

Road Name.	Predicted Traffic Volumes (vpd)
Road A	570
Road B	80
Road C	370
Road D	160
Road E	190
Road F	650



5.5. External Traffic Flows

The predicted flows were added to the existing volumes of traffic as shown in **Table 5** below. As noted in Section 3.4, Kerosene Lane is currently operating near the upper limit of its desired traffic volumes. New development has occurred along Kerosene Lane since the last traffic counts were taken in 2013, and it is likely that the current traffic volumes are already greater than 3,000 vehicles per day. With the additional traffic from the subject site and other new developments, a review of the road classification may be required.

The traffic increases on Mandurah Road and Baldivis Road are not expected to impact the operation of the roads.

Table 5 - Existing Road Network - Predicted Flows

Road Name.	Desirable Max. Traffic Volume. (vpd)	Current Traffic Volumes (vpd)	Predicted Traffic Volumes (vpd)	Change in Traffic
Kerosene Lane	3,000	2,990	3,526	+ 595 vpd
Mandurah Road	15,000	9,178	9,553	+ 485 vpd
Baldivis Road	15,000	9,331	9,867	+ 595 vpd

6. Roads and Intersections

6.1. Proposed Internal Transport Networks

Figure 9 indicates the proposed internal transport routes which have been developed based on the predicted traffic volumes.



Figure 9 - Proposed Transport Network

A roundabout is proposed for the intersection of Road A and Road F, connecting to new subdivisions to the south and east. Traffic calming is recommended on Road A opposite the POS to slow down traffic on the long, straight section of road to reduce speeds to improve safety for residents using the space.

6.2. Road Hierarchy and Reserves

The road cross section requirements have been based on recommendations contained within Liveable Neighborhoods and the Austroads Guide to Traffic Engineering Practice which is attached in **Appendix C**.

Table 6 - Proposed Road Hierarchy and Road Reservations

Road Name.	Predicted Traffic Volumes (vpd)	Proposed Road Reservation	Liveable Neighbourhoods Road Classification	Indicative Carriageway Width
Road A	540	17.9	Neighbourhood Connector	11.2 metre lane.
Road B	80	14.2	Access Street D	5.5 – 6.0 metre lane
Road C	370	16.4	Access Street C	7.2 (7.0 – 7.5) metre lane.
Road D	160	14.2	Access Street D	5.5 – 6.0 metre lane
Road E	190	14.2	Access Street D	5.5 – 6.0 metre lane
Road F	470	12.9	Access Street D	5.5 – 6.0 metre lane

Road F on the eastern side of the subject site, has a proposed road reservation of 12.9 metres running parallel with the POS. The POS can accommodate footpaths, services and landscaping thereby mitigating the need for a 14.2m road reserve recommended by *Liveable Neighbourhoods*. The indicative cross section Road A will initially have a 16.4m road reserve which will widen to 17.9m when the adjacent Lot 302 Mandurah Road is developed.

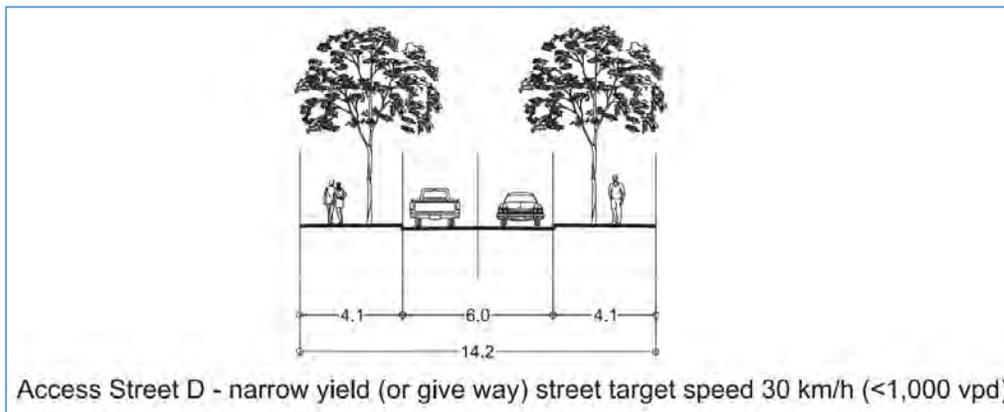


Figure 10 - Access Street D indicative cross section.

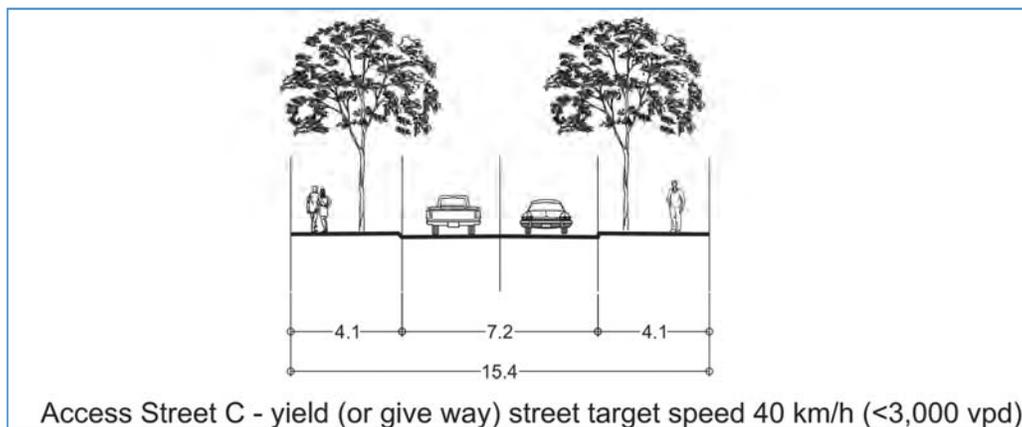


Figure 11 - Access Street C indicative cross section

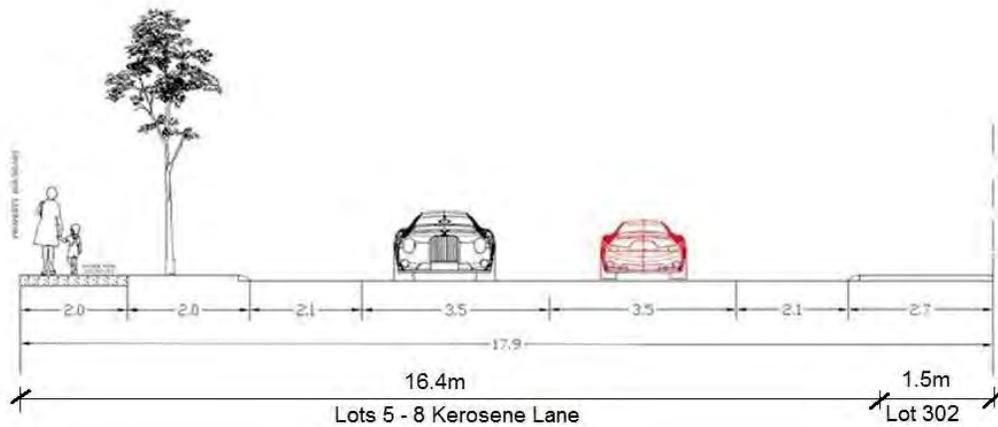


Figure 12 – Neighbourhood Connector indicative cross section.

6.2.1. Intersection Analysis

Internal peak hour traffic volumes within the development are generally small and as such negligible impacts are predicted. Warrants for analysis for each intersection as shown in Table 6.1 of Austroads Guide to Traffic Management Part 3, Traffic Studies and Analysis, shown below as **Table 7**, were applied and determined that no intersections required capacity analysis. Peak hour traffic volumes were assumed to be approximately 10% of predicted daily traffic.

Table 7 - Intersection Analysis Warrants

Intersection	Hourly volume major road	Hourly volume minor road	Comment.
Warrants as per Table 6.1 of Austroads Guide to Traffic Management Part 3, Traffic Studies and Analysis - Two Lane Major Road Cross Road	400 vph 500 vph 650 vph	250 vph 200 vph 100 vph	Table details flows that initiate intersection analysis. As major flows increase, there is reduced capacity to accept minor flows.
Kerosene Lane - Road C	350	37	3 way intersection – Analysis not required.
Kerosene Lane - Road F	350	47	3 way intersection – Analysis not required.
All others intersections	<100	<100	Analysis not required.

6.3. Pedestrian/ Cyclist Access

Footpaths should be provided on at least one side of each of the internal local roads with connections to the established pedestrian and cycling network external to the area as well as to future urban development east of the subject site. It is recommended that all footpaths are constructed with a minimum width of 1.5 metres.

Due to the low volumes of traffic and the low speed environment on the internal access roads, on-road cycle lanes are not required and cyclists are able to safely share the roadway with motorised vehicles.

Kerosene Lane is described as a good road riding environment under the Department of Transport *Cycling Maps*, however there are no formal facilities for cyclists or pedestrians along Kerosene Lane. It is recommended that paths and on-road cycling facilities be constructed along Kerosene Lane.

6.4. Public Transport Access

As discussed in Section 3.5, there are limited public transport services in the area. As shown in **Figure 12** below, Kerosene Lane was identified as a bus route in the Baldavis (North) District Structure Plan. It is recommended that the Public Transport Authority review the requirements for this area as urban development progresses.

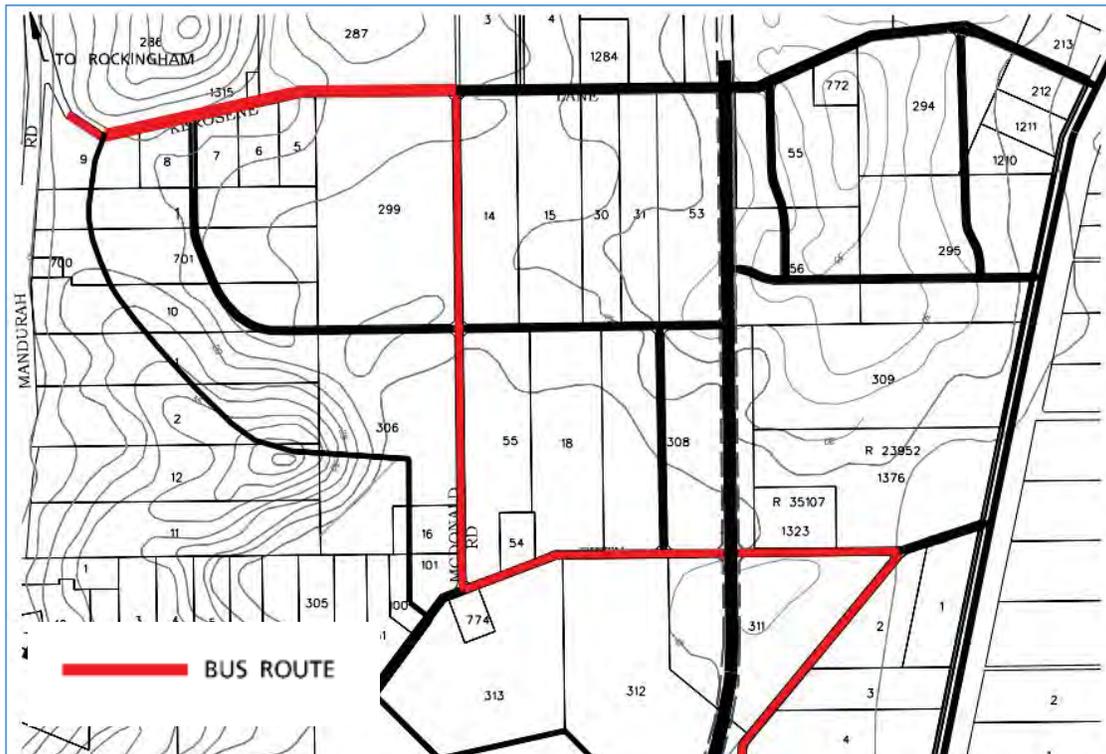


Figure 13 - Suggested Bus Route (Extract from City of Rockingham Baldavis (North) District Structure Plan

6.5. Safety issues

A review of the overall transport proposal for the site did not identify any specific issues that present unacceptable risks to the road user or that cannot be managed through appropriate design protocols.

Road hazards are typically present at intersections and may occur due inadequate sight distance, inappropriate geometry or substandard capacity that promotes undesirable and potentially hazardous movements.

For the new roads, the allocation of adequate road reservation width and truncation of corners will generally allow sight distance requirements to be accommodated in the detailed design phase of the project. Geometric standards prescribed by Austroads and Main Roads WA guidelines will ensure that no unacceptable risk is introduced into



the road environment. Assessment of the operational performance of intersections undertaken in this study prescribes appropriate geometry and lane allocation to minimise delay and optimise performance.

Detailed design undertaken as part of the Development Application process would need to define at least the following elements:

- Road cross sections including lane widths, on-road cycle lanes, path widths and provisions for people with disabilities;
- Intersection geometries; and
- Pedestrian and cycle facilities (cross sections, crossing requirements and ramps).

6.6. Noise

The proposed development is not likely to generate any traffic noise or result in any vibration issues.



7. Conclusions

Based on the assessment of traffic generation exercise it is predicted that the traffic on Kerosene Lane will increase to a level greater than the desirable capacity.

With respect to the proposed Subdivision Concept Plan area, the following is concluded;

- Under the ultimate development of the subdivision, the subdivision will yield approximately 135 dwellings.
- The predicted traffic flows are approximately 1,080 vehicles per day.
- Due to low predicted daily traffic, the intersections did not meet the warrants for analysis and are expected to operate satisfactorily.
- All roads within the subdivision area will be constructed as *Access Roads* with cross section details, line marking, intersection control and local area traffic management measures to be addressed during the detailed subdivision design stages.
- Pedestrian and cyclist facilities should be provided within the subdivision and along Kerosene Lane.
- Public Transport services should be considered for the area as it becomes increasingly urbanised.



Appendix A – Subdivision Concept Plan





Appendix B - Kerosene Lane Traffic Counts

WeeklyVehicle-919 Page 1

MetroCount Traffic Executive **Weekly Vehicle Counts**

WeeklyVehicle-919 -- English (ENA)

Datasets:

Site: [KEROSENE LANE] WEST OF SPUD SHED
Direction: 1 - North bound, A hit first. Lane: 0
Survey Duration: 14:13 Wednesday, 12 June 2013 => 7:11 Thursday, 27 June 2013
Zone:
File: KEROSENE LANE27Jun2013.EC0 (PlusB)
Identifier: N99214PS MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default (v3.21 - 15322)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 14:14 Wednesday, 12 June 2013 => 7:11 Thursday, 27 June 2013
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12
Speed range: 10 - 160 km/h.
Direction: North, East, South, West (bound)
Separation: All - (Headway)
Name: Factory Default Profile
Scheme: Vehicle classification (ARX)
Units: Metric (meter, kilometer, m/s, km/h, kg, tonne)
In profile: Vehicles = 39908 / 53024 (75.26%)



Weekly Vehicle Counts

WeeklyVehicle-919

Site: KEROSENE LANE.0.0N
Description: WEST OF SPUD SHED
Filter time: 14:14 Wednesday, 12 June 2013 => 7:11 Thursday, 27 June 2013
Scheme: Vehicle classification (ARX)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages	
	10 Jun	11 Jun	12 Jun	13 Jun	14 Jun	15 Jun	16 Jun	1 - 5	1 - 7
0000-0100	*	*	*	3	11	14	11	7.0	9.8
0100-0200	*	*	*	3	3	11	6	3.0	5.8
0200-0300	*	*	*	6	4	4	5	5.0	4.8
0300-0400	*	*	*	11	10	9	3	10.5	8.3
0400-0500	*	*	*	9	12	3	4	10.5	7.0
0500-0600	*	*	*	82	89	47	17	85.5	58.8
0600-0700	*	*	*	120	117	69	31	118.5	84.3
0700-0800	*	*	*	125	135	76	54	130.0	97.5
0800-0900	*	*	*	157	151	118	110	154.0	134.0
0900-1000	*	*	*	180	200	199	171	190.0	187.5
1000-1100	*	*	*	193	198	258	243<	195.5	223.0
1100-1200	*	*	*	210<	206<	269<	228	208.0<	228.3<
1200-1300	*	*	*	199	231	270<	294<	215.0	248.5
1300-1400	*	*	*	220	217	262	278	218.5	244.3
1400-1500	*	*	146	200	234	267	261	193.3	221.6
1500-1600	*	*	243	275	261<	232	239	259.7	250.0<
1600-1700	*	*	249	289<	259	175	222	265.7<	238.8
1700-1800	*	*	259	243	232	178	167	244.7	215.8
1800-1900	*	*	84	119	133	99	88	112.0	104.6
1900-2000	*	*	63	76	83	56	45	74.0	64.6
2000-2100	*	*	49	48	59	36	28	52.0	44.0
2100-2200	*	*	26	30	32	37	15	29.3	28.0
2200-2300	*	*	9	13	29	25	8	17.0	16.8
2300-2400	*	*	10	12	16	23	8	12.7	13.8
Totals									
0700-1900	*	*	*	2410	2457	2403	2355	2386.3	2393.8
0600-2200	*	*	*	2684	2748	2601	2474	2660.2	2614.7
0600-0000	*	*	*	2709	2793	2649	2490	2689.8	2645.3
0000-0000	*	*	*	2823	2922	2737	2536	2811.3	2739.5
AM Peak	*	*	*	1100	1100	1100	1000		
	*	*	*	210	206	269	243		
PM Peak	*	*	*	1600	1500	1200	1200		
	*	*	*	289	261	270	294		

* - No data.



Weekly Vehicle Counts

WeeklyVehicle-919

Site: KEROSENE LANE.0.0N
Description: WEST OF SPUD SHED
Filter time: 14:14 Wednesday, 12 June 2013 => 7:11 Thursday, 27 June 2013
Scheme: Vehicle classification (ARX)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages	
	17 Jun	18 Jun	19 Jun	20 Jun	21 Jun	22 Jun	23 Jun	1 - 5	1 - 7
0000-0100	8	7	5	11	11	17	14	8.4	10.4
0100-0200	2	5	4	1	9	23	8	4.2	7.4
0200-0300	4	0	2	8	2	6	2	3.2	3.4
0300-0400	8	8	9	8	7	2	7	8.0	7.0
0400-0500	15	13	12	16	17	7	7	14.6	12.4
0500-0600	76	85	84	84	84	49	18	82.6	68.6
0600-0700	140	153	167	168	145	51	24	154.6	121.1
0700-0800	172	195	180	193	203	64	42	188.6	149.9
0800-0900	155	202	195	191	145	137	96	177.6	160.1
0900-1000	174<	244	181	171	181	204	202	190.2	193.9
1000-1100	151	259<	195	214	231	233	246	210.0	218.4
1100-1200	171	232	211<	238<	231<	281<	284<	216.6<	235.4<
1200-1300	169	241	217	190	211	251	325<	205.6	229.1
1300-1400	151	205	201	181	203	267	254	188.2	208.9
1400-1500	198	226	220	207	230	268<	209	216.2	222.6
1500-1600	286<	295	292<	265	263	257	199	280.2	265.3<
1600-1700	282	302<	291	294<	290<	181	199	291.8<	262.7
1700-1800	211	266	261	249	235	172	138	244.4	218.9
1800-1900	93	121	131	175	149	90	87	133.8	120.9
1900-2000	49	44	58	85	69	67	47	61.0	59.9
2000-2100	32	31	54	62	39	30	39	43.6	41.0
2100-2200	31	23	55	42	39	38	17	38.0	35.0
2200-2300	12	17	8	24	28	16	10	17.8	16.4
2300-2400	6	9	8	6	26	23	9	11.0	12.4
Totals									
0700-1900	2213	2788	2575	2568	2572	2405	2281	2543.2	2486.0
0600-2200	2465	3039	2909	2925	2864	2591	2408	2840.4	2743.0
0600-0000	2483	3065	2925	2955	2918	2630	2427	2869.2	2771.9
0000-0000	2596	3183	3041	3083	3048	2734	2483	2990.2	2881.1
AM Peak	0900	1000	1100	1100	1100	1100	1100		
	174	259	211	238	231	281	284		
PM Peak	1500	1600	1500	1600	1600	1400	1200		
	286	302	292	294	290	268	325		

* - No data.



Weekly Vehicle Counts

WeeklyVehicle-919

Site: KEROSENE LANE.0.0N
Description: WEST OF SPUD SHED
Filter time: 14:14 Wednesday, 12 June 2013 => 7:11 Thursday, 27 June 2013
Scheme: Vehicle classification (ARX)
Filter: Cls(1 2 3 4 5 6 7 8 9 10 11 12) Dir(NESW) Sp(10,160) Headway(>0)

Hour	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Averages	
	24 Jun	25 Jun	26 Jun	27 Jun	28 Jun	29 Jun	30 Jun	1 - 5	1 - 7
0000-0100	3	6	9	0	*	*	*	4.5	4.5
0100-0200	4	3	5	0	*	*	*	3.0	3.0
0200-0300	4	1	1	0	*	*	*	1.5	1.5
0300-0400	12	7	6	0	*	*	*	6.3	6.3
0400-0500	9	10	15	0	*	*	*	8.5	8.5
0500-0600	80	106	115	0	*	*	*	75.3	75.3
0600-0700	133	141	164	0	*	*	*	109.5	109.5
0700-0800	173	182	194	0	*	*	*	137.3	137.3
0800-0900	187	179	219	*	*	*	*	195.0	195.0
0900-1000	162	268	228<	*	*	*	*	219.3	219.3
1000-1100	206<	244	194	*	*	*	*	214.7	214.7
1100-1200	194	289<	194	*	*	*	*	225.7<	225.7<
1200-1300	179	209	213<	*	*	*	*	200.3<	200.3<
1300-1400	188	198	185	*	*	*	*	190.3	190.3
1400-1500	176	234	0	*	*	*	*	136.7	136.7
1500-1600	251	260	0	*	*	*	*	170.3	170.3
1600-1700	289<	267<	0	*	*	*	*	185.3	185.3
1700-1800	243	229	0	*	*	*	*	157.3	157.3
1800-1900	107	134	0	*	*	*	*	80.3	80.3
1900-2000	49	73	0	*	*	*	*	40.7	40.7
2000-2100	24	31	0	*	*	*	*	18.3	18.3
2100-2200	34	32	0	*	*	*	*	22.0	22.0
2200-2300	12	16	0	*	*	*	*	9.3	9.3
2300-2400	3	1	0	*	*	*	*	1.3	1.3
Totals									
0700-1900	2355	2693	1427	*	*	*	*	2112.6	2112.6
0600-2200	2595	2970	1591	*	*	*	*	2303.1	2303.1
0600-0000	2610	2987	1591	*	*	*	*	2313.8	2313.8
0000-0000	2722	3120	1742	*	*	*	*	2412.8	2412.8
AM Peak	1000	1100	0900	*	*	*	*		
	206	289	228	*	*	*	*		
PM Peak	1600	1600	1200	*	*	*	*		
	289	267	213	*	*	*	*		

* - No data.



Appendix C - Road Hierarchy Criteria

Indicative volume.	Liveable Neighbourhoods Classification	MRWA equivalent classification	Indicative Reserve Width.	Indicative Carriageway Width.
50,000.	Primary Distributor.	Primary Distributor		Determined by Main Roads WA
35,000.	Primary Distributor.	Primary Distributor		Determined by Main Roads WA
15,000 to 35,000.	Integrator Arterial A (District Distributor A).	Primary Distributor/ District Distributor A	50.6 – 52.6 metres.	2 x 8.2 metre carriageways including bike lane and 2 x 5.5 metre service roads containing parking.
<25,000	Integrator Arterial A (District Distributor A).	District Distributor A	35.6 metres.	2 x 10.7 metre carriageways including combined on street parking and bike lane.
7,000 to 15,000.	Integrator Arterial B (District Distributor B).	District Distributor A/ District Distributor B	29.2 metres.	2 x 7.5 metre carriageways with on street parking and bike lane.
15,000.	Integrator Arterial B (District Distributor B).	District Distributor B	25.2 metres.	2 x 7.5 metre carriageways with on street parking.
7,000.	Neighborhood Connector A.	Local Distributor	24.4 metres	2 x 7.1 metres including parking, on street bike lane, median plus shared path on one verge.
3,000.	Neighborhood Connector B.	Local Distributor	19.4 metres	11.2 metres including parking plus shared path on one verge.
3,000.	Access Street A (Avenue).	Local Distributor/ Access Road	20 - 24 metres.	2 x 3.5 metre lanes plus indented parking.
3,000.	Access Street B (Wider street).	Local Distributor/ Access Road	16.5 - 18 metres.	9.7 metre lane.
3,000.	Access Street C (Yield or give way street).	Access Road	15.4 - 16 metres.	7.2 (7.0 – 7.5) metre lane.
1,000.	Access Street D (Narrow yield or give way street).	Access Road	14.2 metres.	5.5 – 6.0 metre lane.
150	Access Street D (Narrow yield or give way street).	Access Road	14.2 metres.	3.5 metre lane plus parking indents.
3,000.	Access Street D (Wider street).	Access Road	16.5 - 18 metres.	9.7 metre lane.

APPENDIX 7 LOCAL WATER MANAGEMENT STRATEGY

REPORT

**TERRANOVIS PTY LTD
LOTS 5, 6, 7 AND 8 KEROSENE LANE,
BALDIVIS**

LOCAL WATER MANAGEMENT STRATEGY

DECEMBER 2016



DEVELOPMENT
ENGINEERING
CONSULTANTS

Revision History:

Revision	Description	Checked	Approved	Date
0	Original Issue	SRA	SRA	27 th November 2015
1	Planset Updated to suit comments from DoW in letter dated 9 th December 2015	SRA	SRA	18 th December 2015
2	Document updated to incorporate application for Groundwater Extraction and references	SRA	SRA	15 th February 2016
3	Document updated to incorporate comments from Council received in Email dated 16 th March 2016	SRA	SRA	11 th August 2016
4	Document updated to incorporate comments from Council received in Email dated 29 th September 2016 and 18 th October 2016	SRA	SRA	12 th December 2016



Executive Summary	5
▪ Estate Scale	5
▪ Access Street Scale	5
▪ Allotment Scale	5
▪ Public Open Space Areas	5
1 Introduction	6
1.1 Drainage / Water Management Principles and Design Objectives	6
1.2 Planning Background	6
2 Proposed Development	7
2.1 Key Elements of the Local Structure Plan (LSP)	7
2.2 Previous Land Use	7
2.3 Finished Lot Levels	7
3 Design Criteria	7
4 Pre-development Environment	8
4.1 Topography and Landform	8
4.2 Soil Characteristics	8
4.3 Geotechnical	8
4.4 Groundwater Aspects	9
4.5 Surface Water Aspects	9
▪ 4.5.1 General	9
▪ 4.5.2 Predevelopment Ground Water Monitoring	9
4.6 Environmental Assets and Water-Dependent Ecosystems	10
4.7 Existing Infrastructure and Design Constraints	10
5 Water Sustainability Initiatives	10
5.1 General	10
5.2 Individual Lot Owner Initiatives	10
5.3 Estate Public Open Space (POS) Initiatives	11
▪ 5.3.1 Aims	11
▪ 5.3.2 General POS initiatives	11
▪ 5.3.3 Irrigation	11
▪ 1) Water Sources and required Allocations:	11
▪ 2) Programming and Irrigation Minimisation.	12
6 Stormwater Management Strategy	13
6.1 Pre-Development Hydrology	13
6.2 Pre- & Post- Development Hydrology	13
6.3 1 in 1 year ARI event	14
▪ 6.3.1 General	15
▪ 6.3.2 Lots:	15
▪ 6.3.3 Streets:	15
▪ 6.3.4 Detention Basins	16



▪ 6.3.5 Non structural measures	16
6.4 1 in 5 year ARI event	16
6.5 1 in 100 year ARI event	16
6.6 Finished Lot Levels (Relative to the 1 in 100 year flood levels)	16
6.7 POS Credits	17
6.8 Best Management Practices Water Quality Targets	17
7 Groundwater Management Strategy	18
7.1 Groundwater Level Management	18
7.2 Actions to Address Acid Sulphate Soils or Contamination	18
8 The next stage – Subdivisions and Urban Water management Plans	18
9 Monitoring	19
9.1 General	19
10 Implementation	19
10.1 Commitments	19
10.2 Maintenance Schedules (Incl. Roles & Responsibilities)	19
10.3 Funding	20
10.4 Review	20
11 References:	20
APPENDIX A	
L- 01 Locality Plan	
L- 02 Aerial Photo with Development Superimposed Thereon Whelans Subdivision Concept Plan	
APPENDIX B – Drainage Catchment Plans	
- L- 03 - Pre-development catchment plan	
- L- 04 - Post development catchment plan with flow directions and proposed drainage basins	
APPENDIX C – Drainage Calculations	
- End of Line Drainage Basin size calculations	
- At Lot Detention calculations to Establish Run-off	
APPENDIX D – Drainage Details	
- L- 05 – Catchment 5 – Basin details	
- L- 06 – Catchment 6 – Basin details	
- L- 07 – Catchment 7 – Basin details	
- Landscape Concept Plans	
APPENDIX E – Approval for Groundwater Extraction Licence	

LOTS 5, 6, 7 AND 8 KEROSENE LANE, BALDIVIS

LOCAL WATER MANAGEMENT STRATEGY (LWMS)

Executive Summary

Estate Scale

- Swales will be constructed in discrete areas of POS to cater for the major and minor storms. Swale areas will be designed to ensure all events up to the major storm is infiltrated on site.
- Bio retention areas sized to 2% of the connected impervious area will be installed to permit a maximum depth of storage of 0.5m. Beyond this, the stormwater up to the 10 year storm will be retained within a lower tier basin which incorporates underground storage to minimise the drainage impact on POS areas.
- The 100 year storm will be contained within POS areas additional to the lower tier and below ground storage.
- Given the depth of the groundwater beneath the site, no future groundwater monitoring is proposed, although monitoring will be carried out as part of the UWMP to ascertain the quality of groundwater for irrigation purposes.
- Information Packages will be provided to all lot purchasers to: (a) Fully inform lot owners of the requirement to install the equivalent of two by 1500mm diameter by 1200 deep soakwells prior to an outflow connection to the drainage system; (b) To encourage the use of rainwater tanks; (c) To utilise water efficient devices & appliances throughout their homes; and (d) To maximise the use Water & Nutrient-wise plants, and minimise the use of lawns.

Access Street Scale

- All piped drainage systems will be designed to accommodate the 1 in 5 year ARI event.
- Where possible piped drainage will be excluded in preference of swale drains and overland flow.

Allotment Scale

- All lot owners will be encouraged to install rainwater tanks plumbed into their homes for household use in order to assist to contain the 1 year - 1 hour ARI event on-site in lieu of soakwells.
- All lots are required to install the equivalent of 2 by 1500mm by 1200mm deep soakwells which will hold a 1 in 5 year storm without outflow.

Public Open Space Areas

- All swale basins constructed within a POS area will be designed to infiltrate all storms up to and including the 100 year ARI.

1 Introduction

This LWMS report has been prepared as a stand-alone document to support the Local Structure Plan for Lots 5-8 Kerosene Lane, Baldivis and will be used to guide the design and construction of the proposed drainage solutions for subdivision within the area.

The location of the site is shown in Appendix A, together with an aerial photograph of the existing site.

The site is located on the southern side of Kerosene Lane some 250m west of the intersection between Kerosene Lane and Mandurah Road.

1.1 Drainage / Water Management Principles and Design Objectives

The following water sensitive design criteria, principles & objectives are to be pursued &/or implemented as part of the proposed development:

- *Water Conservation & Water Efficiency*

Objective: To maximise the reuse of stormwater and minimise the use of scheme water outside of the home and to use water as efficiently as possible - both within & outside of the home.

Deliverable: All lot purchasers will be encouraged to install rain water tanks plumbed into their home; to use water efficient devices & appliances throughout their homes and to plant “Water-wise” & “Nutrient-wise” gardens.

Deliverable: All water will be infiltrated on site, mimicking the pre-development conditions.
- *Water Quantity Management and Protection of Property*

Objective: To maintain the total water cycle balance within development areas relative to the predevelopment conditions.

Deliverable: To ensure that post-development discharge is retained on site.

Objective: To protect the built environment from flooding or water logging.

Deliverable: All allotments to be a minimum of 0.3m above the 1 in 100 year flood level.

Deliverable: Retention basins to be provided to ensure that 1 in 100 year storm is disposed on sit via infiltration.
- *Water Quality Management*

Objective: To improve the overall surface & groundwater quality of the water leaving the estate and if possible improve the quality of water leaving the development.

Deliverable: Ensure that surface water is routed to swale basins and retained on site.

1.2 Planning Background

The subject land is currently zoned “Urban deferred” and is proposed to be amended to “Urban” under the Local Town Planning Scheme.

The proposed structure plan is detailed in Appendix A.

2 Proposed Development

2.1 Key Elements of the Local Structure Plan (LSP)

The site is located within the suburb of Baldvis within the City of Rockingham and covers an area of approximately 8.1ha of undeveloped land. The site is located south of Kerosene lane approximately 250m west where it intersects with Mandurah Road and west of the existing Spud Shed and “Paradiso” Development.

The development proposal consists of approximately 135 single residential allotments averaging around 350 square metres in area.

A large easement traverses the land holding to the east of the site within the “Paradiso” land. This easement contains the APA Dongara Gas pipeline and provision for a future pipeline for Alcoa. Although the easement is actually in the neighbouring land, the affected area is approximately 64m wide, which affects the eastern portion of this development and is proposed to be incorporated within POS.

2.2 Previous Land Use

The land is currently undeveloped and is generally uncleared, with existing Lots 5 and 7 having existing houses and sheds.

2.3 Finished Lot Levels

Finished Lot levels will be set using on the basis that they are a minimum of 0.5m above 100 year TWL of Drainage basins and that they are set such that major storm will flood into POS in lieu of flooding the lots.

Further criterion is that Lots are to be at least 1.2m above AAMGL, although the existing groundwater is well below surface levels.

3 Design Criteria

The drainage requirements for developments within this area are controlled by the requirements of the City of Rockingham, which are outlined below.

Item	Description	Requirement	Source / Comment
1	Water Quality	1 in 1 years 1 hour storm to be Retained on site	DoW requirements
2	ARI for pipe design	1 in 5 years	Standard Council requirement
3	ARI for compensating basin design	1 in 100 years without outflow from site	Standard Council requirement – No predevelopment flows currently exit the site.
4	Min. lot freeboard	0.5m above basin 1 in 100 year flood level 0.3m above 100 Year HGL in Road System	Standard Council requirement developments
5	Basin Criteria Side slopes – In POS	Max. 1 in 6	Standard Council requirement



Item	Description	Requirement	Source / Comment
6	Run-off coefficients	Road reserves C ₁₀₀ – 0.72 for Urban Residential Allotments C ₁₀₀ - 0.15 C ₁₀ – 0.06 0. – Developed Rural Areas/POS	Per Council requirements – Based on 80% paved area in road reserve with Run –off Coefficient of 0.9. Lots as per Calculation in Appendix C.

4 Pre-development Environment

4.1 Topography and Landform

The site moderately rises from RL8.0mAHD on the south eastern side of the site to the north western corner of the site at RL22.0mAHD on Kerosene Lane as shown in Drawing L-03 in Appendix B. The average grade of the land is around 2%.

4.2 Soil Characteristics

The Perth Environmental Geology Mapping (Gozzard JR 1983 Rockingham Part Sheets 2033 II and 2133 III)¹ indicates that part of the site area consists of two major soil types as outlined below:

- The majority of the area is “LS1”; being limestone, pale yellowish brown of eolian origin consisting of Tamala Limestone and Safety Bay sand.
- South Eastern Portion of Site - “S₇”, defined as sand derived from Tamala Limestone of residual origin. It is noted to be a good groundwater recharge area and the soils are recognized as having some ability to attenuate pollutants due to small clay content.

The various areas of the site as classified in the Environmental Geology Mapping have been superimposed on Drawing L-03 in Appendix B.

In essence the site is suitable for urbanisation, consisting of well graded sands of high permeability meaning that soakage will be effective on the site

The Western Australian Planning Commission Planning Bulletin 64 identifies the whole of the subject site as having Low to no risk of AASS and PASS occurring generally at depths of >3m no known risk of acid sulphate soils occurring.

4.3 Geotechnical

Given the homogeneous sand on the site and excavations in the peripheral areas to the site being consistent with the environmental mapping, no geotechnical investigations have been undertaken on the site to date.

It is proposed that further investigations will be undertaken as part of the Urban Water Management Plan for the area to confirm the soil profile of the area.

Development that has been carried out in adjacent land holdings has confirmed the soil profile in the area.

4.4 Groundwater Aspects

Groundwater flow directions are well documented from regional mapping data.

According to the 2004 Groundwater Atlas², which generally designates Average Annual Maximum Groundwater Levels (AAMGL) as measured from the relevant bores, the groundwater levels grade down from east to west from RL1.5 mAHD at the eastern boundary of the site to RL1.2 mAHD on the western side of the site. The measured levels on the adjoining Paradiso Development indicated that on average, the AAMGL was some 0.4m above the 2004 groundwater levels meaning that the AAMGL is likely to grade from say RL1.9m AHD on the eastern side of the site to RL1.6m AHD on the western side of the site.

The 1997 Groundwater Atlas³ indicates that the groundwater levels grade from say RL3.7m AHD on the eastern side of the site to RL3.2 mAHD on the western side of the site, although these would be representative of maximum likely groundwater levels (MGL) rather than AAMGL.

The lowest level of the site is located on the north western corner of the site and is at around RL8.0mAHD and is proposed to be filled to RL9.5mAHD to facilitate sewerage, meaning that at its shallowest; the maximum groundwater level would be at least 6.0m below the existing site levels. The 2004 Groundwater Atlas² levels are plotted in L-03 and L-04 in Appendix B.

Clearly, the groundwater levels are significantly lower than existing or proposed development levels and will have no effect on the development as such and therefore no further investigation is required for the purposes of drainage disposal and water management.

4.5 Surface Water Aspects

4.5.1 General

As shown in Appendix B, the current site is divided into three major catchments being west, central and eastern catchments, which have been split to facilitate the distribution of the drainage within the available areas of POS. The soil is very permeable and in the rare event that runoff occurs, each catchments will drain to suitable low areas and infiltrate.

4.5.2 Predevelopment Ground Water Monitoring

Given the significant depth between the site surface levels and the existing groundwater levels in addition to the low risk predevelopment land use, no predevelopment monitoring has been undertaken on the site or is required for the purposes of drainage disposal and water management.

It is noted that due to the upstream land uses of market gardening, it would be appropriate to undertake some testing to prove up groundwater quality for irrigation purposes and this will be undertaken as part of the Urban Water Management plan (UWMP).

4.6 Environmental Assets and Water-Dependent Ecosystems

There are two conservation category wetlands in the area, being Kerosene Lane Swamp to the north of the site, which is an existing Dampland some 300m north east of the site and Lake Cooloongup which is located some 300m west of the site on the Western Side of Mandurah Road.

The Kerosene Lane swamp is upstream of the hydraulic grade of the groundwater flow from the proposed development and is unlikely to be affected by the development. The depth to groundwater from the site together with the potential of the existing soils to attenuate nutrients means that provided the nutrient loading from any proposed development is managed to low levels, any development is unlikely to affect Lake Coongoolup.

There are also bush forever sites immediately north and west of the site, although they have potential environmental significance, due to the depth of groundwater and the proposal to dispose of all stormwater on this site via infiltration, there is unlikely to be any impact from this development.

4.7 Existing Infrastructure and Design Constraints

Sufficient capacity is available in the adjoining development to service the development of the subject land.

The whole of the site is proposed to be sewered into existing infrastructure to the east of the site, which will be extended through the “Paradiso” Development.

The primary constraint on the drainage of the site is the moderate terrain, which limits the use of soakage in isolated locations throughout the site, other than through the use of baseless manholes.

5 Water Sustainability Initiatives

5.1 General

The current state government requirement to increase the efficiency of water use in new developments to a target of less than 100kl per person per year is proposed to be implemented within the development.

This is proposed to be achieved by:

- Increased water efficiency in the household by encouraging the use of waterwise appliances through regulation and financial incentives.
- Encouragement of the use of rainwater tanks to supplement scheme water for irrigation.
- The use of low water requirement plants and minimizing turf areas for gardens and POS areas

5.2 Individual Lot Owner Initiatives

Water conservation will be encouraged by the developer through the promotion of native, water-wise gardens and water efficient household devices & appliances. All requirements for the purchaser will be outlined in their purchase contract and associated information handouts.

The information will also outline the case for all lot owners to use rainwater tanks plumbed into their homes to assist with the retention of the 1 in 1 year ARI event.

5.3 Estate Public Open Space (POS) Initiatives

5.3.1 Aims

The drainage impacts of the POS will be managed to ensure that:

- The maximum depth of water within drainage basins during a 100 year storm is limited to 1.2m.
- Inlets to basins will be directed to bio retention basins as requested by the City of Rockingham, which will facilitate infiltration and treatment of the low ARI storms prior to overflow to below ground storage, which will maximise the useability of POS.
- Flush kerbs may be constructed abutting POS areas with either direct run-off for infiltration in lower areas or with swales for infiltration/conveyance to drainage basin areas.

Any proposed landscaping development of the POS areas will address the following objectives:

- Minimising irrigation & fertiliser demands via appropriate species selection
- Managing fertiliser application to minimise impacts on water quality.
- Weed Management
- Fauna Protection

5.3.2 General POS initiatives

The treatment of the POS areas will typically consist of grassed areas with designated areas of native planting and mulching. All areas will be designed to minimise irrigation requirements with predominantly native plantings incorporated into the landscape design and the use of low water requirement grasses such as kikuyu.

Full landscape plans will be prepared at the time of subdivision in accordance with agreed requirements with the City of Rockingham which will address the objectives outlines in Section 5.3.1.

5.3.3 Irrigation

1) Water Sources and required Allocations:

For the POS irrigation the overall water use is limited to a maximum of 7500kl per hectare per annum in accord with the Department of Water requirements. The total area to be irrigated over the total development is approximately 0.711ha which will require an annual bore yield of some 5330kL per annum. An application for this allocation has been made and approved and a copy of the approval is included in Appendix E.

Standard conditions require irrigation usage to be metered monthly and submitted annually in accord with DoW requirements.

It is noted that arrangements have been made with the adjoining Paradiso Estate to make up the shortfall of POS, some 0.153ha, but this area will be irrigated from the Paradiso Estate groundwater allocation.

Although street trees are typically not included in the allocation, these will be irrigated using hand watering or from an individual's internal irrigation system.

2) Programming and Irrigation Minimisation.

Establishment irrigation for trees and native POS planting areas is expected to be used for a period of between 2 and 3 years after planting then disconnected.

Typically, watering will start with 10mm three times / day for initial establishment over a period of around 1 month, depending on the weather and the time of the year. This should then be reduced to 10mm once/day for a period of around 2 months - dependent on the time of year. The watering is then reduced to 10mm applied 2 to 3 times a week.

Irrigation should be programmed and maintained to minimise the water used across the site, with the following mechanisms to minimise water use.

- The system should be checked regularly to detect faults and ensure water is being used effectively and efficiently.
- In general the system should be checked at a frequency of
 - November to April - Once per fortnight.
 - May to October - Once a month.
- All sprinklers should be checked to fully pop-up and retract, bubblers and that nozzles are free of blockages and sprinklers are providing adequate coverage. Particular attention should be paid to irrigation of transplanted mature trees and street trees to ensure they are receiving adequate water.
- The watering regime for planted areas should reflect the plants needs in accordance with the plant type and natural rainfall, in accordance with the Water Corporation's "Water-wise" guidelines. Watering should be monitored throughout the year and adjusted accordingly to ensure appropriate watering. Watering should only take place within the hours stipulated by the Water Corporation (Currently 6.00pm to 9.00am).

The Irrigation Schedule is expected to be as follows (based on landscape hydrozones):

- Turf should be separated from shrubbery and turf and shrubbery should be supplied by different stations of irrigation and scheduled separately.
- Areas of turf subject to lower wear in sheltered environments &/or are not in visually prominent positions should be scheduled to receive a lesser amount of irrigation than areas of turf that are subject to high levels of wear, in exposed environments &/or in visually prominent locations;
- Low Water use plants should be scheduled to receive a lesser amount of water than areas of higher water use; and,
- Irrigation should be progressively withdrawn from areas of native shrubbery.

As part of the landscape works, the topsoil in the landscaped areas will be improved to ensure free drainage and nutrient retention properties prior to planting.

6 Stormwater Management Strategy

6.1 Pre-Development Hydrology

As outlined in Section 4, the site consists of sand with excellent soakage characteristics and is moderately steep with most portions of the site grading at around 5%.

Based on the fact that little or no run-off occurs from the site and all rainfall is infiltrated, it has been assumed that there is no predevelopment flow from the site. A plan detailing the predevelopment catchment boundaries is shown in L-03 in Appendix B.

The majority of the area, being the western two thirds of the land grade to a low point to the south of the site in the southern land holding at around RL6.0mAHD.

The remaining eastern third of the land grades to a low point in the “Paradiso land”, which in turn grades north of Kerosene lane to the Kerosene Lane at around RL3.0mAHD.

As outlined above, despite the topography indicating these flow paths, the permeability of the surface means that infiltration occurs at a greater rate than run-off meaning that little or no runoff leaves the site. In the unlikely event that runoff reached the isolated low points, the water infiltrates in that area.

6.2 Pre- & Post- Development Hydrology

The drainage strategy is proposed to infiltrate all stormwater on site as close to the source as possible. The underlying soils, consisting of a deep limestone layer are deemed to be appropriate for uptake of nutrients meaning that the soakage of the water will provide sufficient opportunities for nutrient uptake.

The site is proposed to be divided into three major catchments to suit the distribution of Public Open Space. A plan detailing the catchment boundaries and proposed drainage basins is shown in Appendix B.

Due to the moderately steep slopes on the site, the benefit and logistics of installing small retention basins across the site are marginal and difficult. Soakage at source will be employed for all allotments without outflow for all storms up to the 5 year storm. Beyond that, water will surcharge and run overland to the street drainage system and be conveyed to the drainage basins.

Planning of the site has utilised lineal open space, particularly abutting the service easement and in various other locations on the site which lends itself to use of flush kerbing which allows road water to run off and infiltrate. This can be either used in conjunction with swales or simply allowing run-off into POS areas where they are lower than roadways and lots, but this will be resolved as part of the approval process in detailed design.

Infiltration has been conservatively calculated on the assumption that the permeability of the insitu soils is 1.1m/day and this will need to be reaffirmed at the time of the UWMP.

Basins will generally be constructed as swales within POS areas. The basin arrangements are generally constructed as a two or three tiered arrangement as follows:

- Where bio-retention areas are provided, water will drain into a bio-retention area surrounded by a retaining wall around 0.5m high.
- For areas where a bio-retention area is not provided water will flow direct into below ground storage, which in conjunction with some additional depth in the basin will contain the 10 year storm. For those areas for which the bio-retention area has been provided, the water will surcharge to the below ground storage after the 1 year 1 hour storm.
- Beyond the 10 year, the water will further surcharge into a grassed swale which will contain the 100 year ARI storm.

GPT's will be constructed at entry to the POS soakage areas to ensure that all litter and sediment is contained for easy cleaning.

The areas required to contain flows from the post development catchments areas are summarised in Table 6.1 - Refer also to Appendices B and C for the catchment plan and detailed calculations:

Table 6.1 – Drainage Basin Areas/Catchments and Areas affected by Drainage

Basin Description	Catchment 5(Eastern)	Effective Volume in the Paradise Site – Catchment 5 ²	Catchment 6/7(Central)	Catchment 8 (Western)	TOTAL
Impervious Catchment (Ha) (C₁₀₀)	0.54	0.83	1.58	0.96	3.91
Storage provided (100Yr)	229	463	645	615	2012
Storage provided (5Yr)¹	229	0	389	338	956
Storage provided (1Yr)	229	0	343	180	752
Site Area Required (100Yr)(m²)	120	726	533	650	2,330
Site Area Required (5Yr) (m²)	120	0	176	0	296
Site Area Required (1Yr) (m²)	120	0	0	0	120
TWL₁₀₀ (mAHD)	8.5	8.7	9.8	13.36	
Critical Tc (1 Year ARI) (hours)	32	16	16	16	
Critical Tc (5 Year ARI) (hours)	32	32	16	16	
Critical Tc (100 Year ARI) (hours)	32	32	32	32	

Notes:

1. After the 1 in 1 year 1 hour storm has been exceeded and the water overflows the bio retention areas, the stormwater flows into below ground storage which then provides capacity for up to the 5 year storm for Catchment 5 and the 10 year storm for Basin 8.

Water flows directly into the below ground storage for Catchments 6/7 and 8.

2. Excess water for the 100 year storm from the combined catchments has been allocated within the lineal POS for the neighboring Paradiso Development – the impacted area inclusive of the Paradiso Development is included. Refer Calculation Catchment D Paradiso in Appendix C.

6.3 1 in 1 year ARI event

6.3.1 General

The 1 in 1 year event is typically seen as the storm where most nutrients and particulate matter is generated from.

The separation distance between all of the development and the groundwater is greater than 5.0m and generally no groundwater control measures are required. The greater separation distance between the surface and groundwater levels together with the greater distance of potentially affected receiving environments means that this area does not require bio-retention in higher areas of the catchment.

It is proposed that the 1 in 1 year ARI 1 hour storm will be retained on site without outflow in accordance with DoW requirements. This is proposed to be undertaken at the various levels as outlined in the following sections.

6.3.2 Lots:

Lots will either retain water on site in rainwater tanks in conjunction with soakwells or install soakwells to infiltrate water to ensure no outflow into the street drainage system. All Lots are required be fitted with the equivalent 2 by 1500 diameter by 1.2m deep soakwells to achieve full retention of all storms up to the 1 in 5 year storm without outflow.

Beyond this storm, stormwater will surcharge from the soakwells and run overland to the street drainage system and some infiltration will occur, particularly in back yards.

6.3.3 Streets:

The 1 in 1 year 1 hour storm for roadways, will be contained within swales in POS and in the end of line swales/soakage basins and below ground storage.

Drainage pits will be laid with open bases to permit soakage for small rainfall events thereby encouraging further soakage “at source”. The baseless pits will cater for around 1.5-2.0mm of rainfall.

Overland flow will be employed in lieu of piped drains where possible. Where roads are constructed adjacent to open space and opportunities for soakage are available, flush kerbs may be used in conjunction with swale drainage in lieu of a piped drainage system. This is subject to final landscape design details and agreement from the Local Authority at detailed design stage.

The remainder of the 1 in 1 year 1 hour event will be contained within the soakage basin without overflow to any surrounding POS areas.

Where required, the 1 in 1 year bio-retention area will be defined using retaining walls, thereby ensuring that stormwater will be constricted to cause minimal inundation for lower ARI rainfall events, thereby maximizing the usability of the POS area and associated swales. Bio-retention areas will be installed in accordance with the *Adoption Guidelines for Stormwater Biofiltration Systems (CRCWSC, 2015)*.

A GPT will be installed prior to any inflow from the piped drainage system into the drainage basin to limit the siltation of the basin.

6.3.4 Detention Basins

Beyond the measures employed in baseless pits and lineal swales, the remainder of the 1 in 1 year 1 hour storm will be retained within the retention basin areas. The drainage basins will retain the water until it infiltrates.

Details of the proposed retention basins are included in Appendix D.

6.3.5 Non structural measures

Non structural measures will also be employed to reduce the sources of nutrients. These measures involve providing advice to lot purchasers and stakeholders to reduce nutrient sources from the application of garden fertilisers and eroded particulate matter particularly from the new urban areas during the housing construction phase and in establishment of gardens.

Minimisation of nutrient loading can obviously be achieved through:

- Education of local residents and Council maintenance personnel; and
- By implementing frequent street and storm water maintenance programs – particularly during housing construction.
- By planting and using appropriate native species.

6.4 1 in 5 year ARI event

All piped drainage systems will be designed to accommodate the 1 in 5 year ARI event, without any inundation of roadways.

6.5 1 in 100 year ARI event

For the major event, lot drainage flows in excess of the 5 year storm will surcharge and run overland. All roads within the estate will be designed to accommodate and direct extreme event flows towards each POS and compensating basin. The land will be divided into the same catchment areas as detailed in the post development plan as Appendix B.

6.6 Finished Lot Levels (Relative to the 1 in 100 year flood levels)

As outlined in Section 2.3, the land is proposed to be filled a minimum of 500mm above the top water level of drainage basins. In all cases, lots will be set to ensure conveyance for major storms will be along the roadways without flooding homes.

6.7 POS Credits

As outlined in the LSP document all POS credit calculations have been based upon current “Liveable Neighbourhood” policy guidelines - where 100% of the area covered by the 1 in 1 year event of each compensating basin is typically not included as a “usable” POS area. The 1 in 5 Year event is designated as a restricted area normally attracting a 100% credit for the area between the 1 Year and the 5 year ARI levels provided this comprises less than 20% of the total POS allocation.

The affected areas of the drainage basins are detailed in Table 6.1.

6.8 Best Management Practices Water Quality Targets

The DoW’s Stormwater Manual provides guidelines and information on best management practices that may be applied at land development and construction sites to improve stormwater management and environmental performance.

Poorly managed land development sites can often be a major source of stormwater pollution. Certain construction activities can allow pollutants to be transported (via existing stormwater systems or over-land flow) to adjoining receiving water bodies.

The major source of pollutants from construction activities in this instance will potentially be from:

- Eroded materials in the interim period between opening up the surface of the site and implementing the drainage management measures.
- Litter & waste storage areas- that allow materials to be blown by wind or washed away by rainfall into existing stormwater systems.
- Wash-down areas– poor practices can allow materials to enter stormwater systems.
- Placement & storage of delivered products- particularly sand and soil stockpiles where such materials may be tracked by vehicles onto roads, or blown, or washed on to roads which then get into existing stormwater systems.
- Dewatering activities– which can cause sedimentation of downstream water bodies.

Consequently no construction activities will commence on the site until an appropriate approved Environmental Management Plan (EMP) is prepared that fully addresses:

- litter and waste management practices (non-hazardous & hazardous materials);
- vehicle & equipment washing-down practices;
- water conservation practices;
- product placement & storage practices;
- dewatering activities (if applicable); and
- Any other practices that may adversely impact upon receiving water bodies.

This will be prepared by the contractor undertaking the civil works on the subdivision together with the engineering consultant.

The Best Management measures proposed for this area are proposed to be:

- Non Structural Measures to be implemented reduce applied nutrient loading.

- On Site Retention of 1 in 1 year 1 hour ARI Storm.

Research has indicated that this approach will achieve reductions of at least 80% of total suspended solids; 60% of total phosphorus; 45% of total nitrogen & 70% of gross pollutants compared to a conventional drainage system.

7 Groundwater Management Strategy

7.1 Groundwater Level Management

Groundwater levels for the site location are plotted on the site plan in Appendix B. In general the levels are many metres below the site levels with the exception of the eastern side of the site. Development levels in that location are set at around RL9.50 minimum which is well above the maximum likely groundwater level of around RL3.0mAHD.

There is no further need for controls of groundwater levels and all drainage pipework will be laid well above the controlled groundwater levels.

7.2 Actions to Address Acid Sulphate Soils or Contamination

The ASS mapping for the area indicates that there is no known of ASS soils occurring within 3.0m of natural soil surface (or deeper).

Therefore there is little or no risk of the development proposal encountering any ASS soils.

8 The next stage – Subdivisions and Urban Water management Plans

The structure plan area is under the ownership of four separate land owners which are not professional developers, which depending on the ultimate agreements forged in regard to a development strategy, may mean that the full drainage strategy as proposed cannot be implemented immediately. As a result, the staging of the development and any temporary facilities as required will be addressed in the Urban Water Management Plan (UWMP) which will be required for the subdivision proposal. It is anticipated that the ultimate drainage strategy will generally fit within the framework of this Local Water Management Strategy.

The UWMP will build on the concepts of this report providing ongoing monitoring results and addressing the following major points:

- Further detail in the design of the detention basins.
- Detailed geotechnical investigations including testing of the PRI and permeability of the existing soils both at the surface and at the depth of drainage cells.
- Further detail in landscape proposals.
- Testing of groundwater quality for irrigation purposes.

Once this data is received, the approach outlined herein will be reviewed with detailed work required to:

- Finalise the design of the swales in the POS.
- Detail the Drainage basins including the various inlet configurations and edge treatments to ensure the overall functional and aesthetic outcomes are satisfactory.
- Review the drainage calculations relative to final planning proposals for the site to ensure that the land use assumptions within the drainage calculations herein are consistent.

9 Monitoring

9.1 General

Given the height of the site above the water table, empirical information indicating the benefits of infiltration of stormwater through Safety Bay sand to ameliorate nutrient levels and the significant distance of the site from any environmental assets of any note it is not proposed to undertake further monitoring.

10 Implementation

10.1 Commitments

The developers are committed to

- 1) Physical Outcomes – To be undertaken at the time of construction.
 - Ensuring that all storm water drainage from the estate is infiltrated on site.
- 2) Non Structural – To be undertaken as part of sales documentation, by providing Information Packages to all lot purchasers to:
 - Fully inform lot owners of the requirement to install the equivalent of two 1500mm diameter by 1200mm deep soakwell prior to outflow into the drainage system in the event a rainwater tank is not installed or reduced storage equivalent to the storage of a rainwater tank in the event that one is used.
 - To encourage the use of rainwater tanks (plumbed into their homes); and
 - To utilise water efficient devices & appliances throughout their homes, and to encourage all purchasers to install Water & Nutrient-wise plants.
- 3) Further investigation and reporting:
 - Prepare Urban Water Management plans to support further detailed subdivision planning.
 - Undertake geotechnical investigations.

10.2 Maintenance Schedules (Incl. Roles & Responsibilities)

Maintenance schedules and arrangements will be resolved as part of the Urban Water Management planning and will be dependent on the detailed design and operation of the mechanisms required. As a brief summary, Table 10.1 has been included to provide guidelines for likely maintenance responsibilities.

Table 10.1 – Proposed Maintenance Programme for the development

#	Drainage Element:	Possible Maintenance and Inspection Frequency:	Responsibility:
---	-------------------	--	-----------------



#	Drainage Element:	Possible Maintenance and Inspection Frequency:	Responsibility:
1	Rainwater tank(s); trapped underground soakage / connection pit(s)	Annually inspection & clean-out (as necessary) – just prior to winter rains	Lot Owner
2	Swale Areas, table drains and detention basins	<u>During developer maintenance period</u> (2 year in conjunction with Landscaping) Inspect, clean-out & maintain plants ~fortnightly intervals (depending on loading) – as part of POS maintenance works <u>After developer maintenance period:</u> Inspect, clean-out & maintain plants (as required) as part of standard Council POS maintenance program	Developer Council
3	Drainage culverts, standard table drains, pipes and pits	<u>During developer maintenance period:</u> (12 month Defects liability period) Inspect, clean-out & maintain structures annually – just prior to winter (& then again in Aug / Sept if necessary) <u>After developer maintenance period:</u> Inspect, clean-out & maintain structures at least annually – just prior to winter – but inspection frequency will need to be higher during home construction phase	Developer Council
4	Trapped Pits, Underground Storage and GPT's	<u>During developer maintenance period:</u> (12 month Defects liability period) Inspect, clean-out & maintain pits tri-annually – just prior to winter & then around June / July & again in Oct / Nov for the first two years <u>After developer maintenance period:</u> Inspect, clean-out & maintain pits tri-annually – just prior to winter & then around June / Aug – but inspection frequency will need to be higher during home construction phase.	Developer
5	Base of compensating basins	Initial formal inspection & assessment of performance of bases (say) at around year 3 & then every 5 – 10 years.	Council

10.3 Funding

The cost for the implementation of the capital water management measures will be borne by the developers. Maintenance and monitoring costs will be borne by the developers for the periods as outlined in the maintenance schedule table in section 10.2 above.

10.4 Review

Following the approval of this document, it is not expected that the LWMS for this development will need to be reviewed as this forms the broad structure of the approach for the drainage in the area.

In general minor amendments can be made, provided they meet the outcomes sought within this report. In the event that the management measures used within the state have significantly changed or the first subdivision application following the expiration of 4 years from the first subdivision approval whichever is the later, the measures used for management of stormwater should be reviewed.

11 References:

1. Environmental Geology Mapping - Part Sheets 2033 II and 2133 III, Gozzard JR 1983
2. Australian Rainfall and Run-off A Guide to Flood Estimation Volume 1, Institute of Engineers, 1987



3. Perth Groundwater Atlas, Waters and Rivers Commission, October 1997.
4. Perth Groundwater Atlas (Edition 4), Department of Environment, 2004



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APPENDIX A –

- L- 01 Locality Plan**
- L- 02 Aerial Photo with Development Superimposed
Thereon**
- Whelans Subdivision/Structure Plan Concept Plan**

**SUBDIVISION CONCEPT PLAN
LOTS 5 - 8 KEROSENE LANE
BALDIVIS**

DATE DRAWN: 21/02/2015
DRAWN BY: DMH
CHECKED BY: JPF
FILE: 18064 - 1st concept plan 2.dwg
V: 01 (DRAFT)
P: 01 (SUBMIT)



- LEGEND**
- - - - Solid Wall
 - ← Dwelling Orientator
 - - - - Structure Plan Boundary
 - - - - Pipeline
 - - - - Existing parent lot boundary
 - - - - Pipeline 32m setback

Plan No. : 20864-3
Revision : REV/8
Scale : 1:200 @ A3 1:1000 @ A1
Scale 1 First Floor - 40 Haver Road Osborne Park WA 6017 www.whelans.com.au



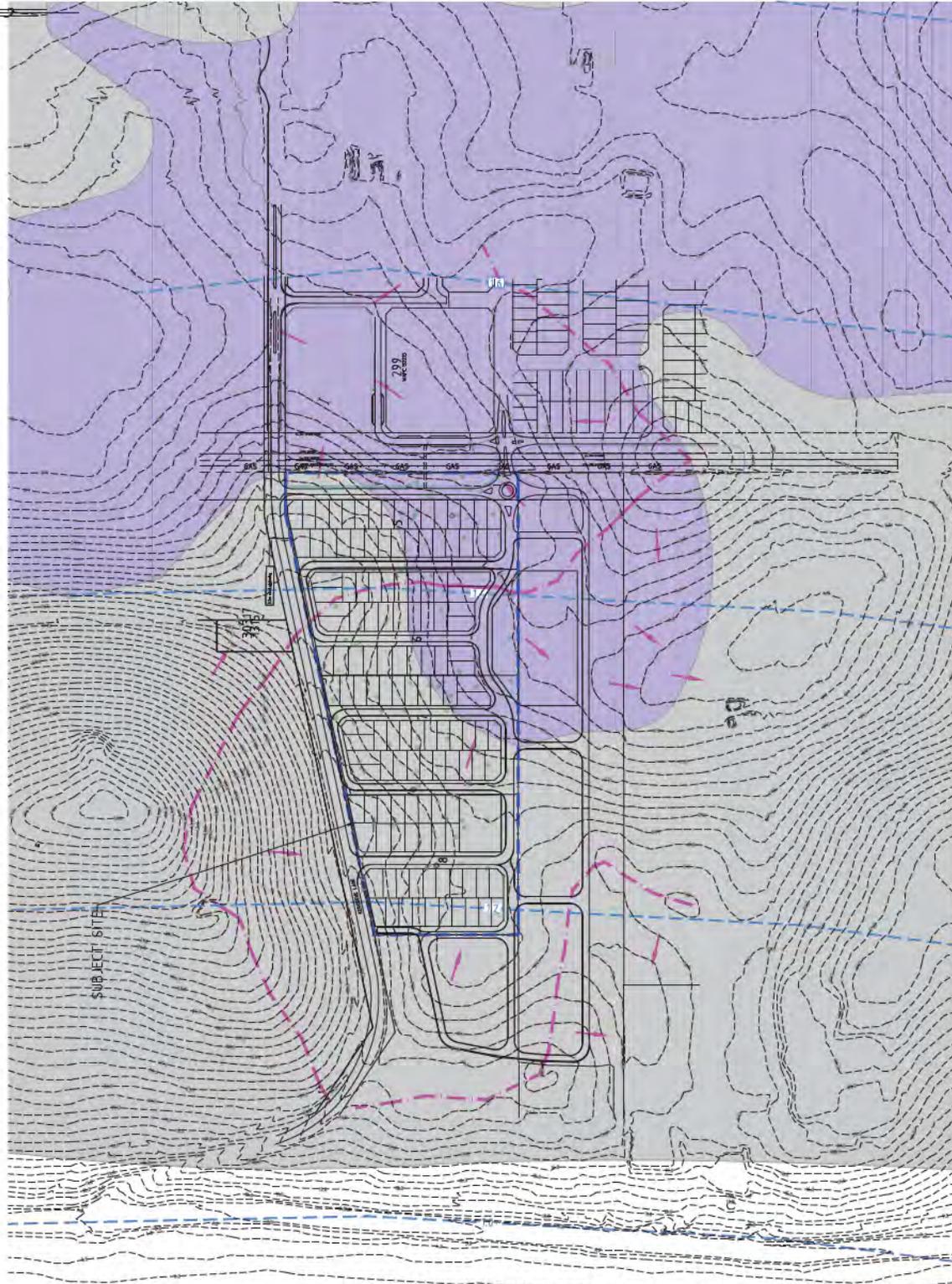
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APPENDIX B – DRAINAGE CATCHMENT PLANS

- L- 03 - Pre-development catchment plan**
- L- 04 - Post development catchment plan with flow directions and proposed drainage basins**

LEGEND

- SITE BOUNDARY
- EXISTING SURFACE
- CONTOURS
- WATER CONTOURS - 10% PERCENT
- WATER CONTOURS - 2% PERCENT
- WATER CONTOURS - 0.5% PERCENT
- GRADEWATER TABLE
- PROPOSED NATURAL RIGOLE
- FLOW ARROW
- MONITORING BORE
- SOIL TYPES - LST LIMESTONE
- SOIL TYPES - ST SAND



1:20000

<p>TERRANOVIS PTY LTD</p>	<p>DEVELOPMENT ENGINEERING CONSULTANTS</p>	<p>DATE: 3, 2014 WEST PERTH, WA WESTERN AUSTRALIA PH: (08) 9441 8800 FAX: (08) 9441 1100</p>	<p>PROJECT: LOTS 5, 6, 7 & 8 KEROSENE LANE BALDIVIS W.A.P.C. No. -</p>	<p>DRAWING: LOCAL WATER MANAGEMENT STRATEGY PRE-DEVELOPMENT CATCHMENT PLAN</p>	<p>SCALE: 1:2000</p>	<p>DATE: 10/10/14</p>	<p>PROJECT NUMBER: 14000000000000000000</p>	<p>DATE: 10/10/14</p>	<p>SCALE: 1:2000</p>	<p>DATE: 10/10/14</p>
					<p>CLIENT:</p>	<p>DATE: 10/10/14</p>	<p>SCALE: 1:2000</p>	<p>DATE: 10/10/14</p>		

BDVTER30 L03

LOCAL WATER MANAGEMENT STRATEGY
PRE-DEVELOPMENT
CATCHMENT PLAN

LOTS 5, 6, 7 & 8
KEROSENE LANE
BALDIVIS

DEVELOPMENT ENGINEERING CONSULTANTS

TERRANOVIS PTY LTD

CLIENT: [Blank]

DATE: 10/10/14

SCALE: 1:2000

DATE: 10/10/14



DEVELOPMENT
ENGINEERING
CONSULTANTS

APPENDIX C – DRAINAGE CALCULATIONS

- End of Line Drainage Basin size calculations**
- At Lot calculation to Establish Run-off**

Development Engineering Consultants - Drainage Basin Spreadsheet



Project: Lots 5, 6, 7 and 8 Kerosene Lane Baldwinis

LWMS Calcs

Location: Catchment 5

Data to be Input

Rainfall ARI (Years)	100
1 in 1 Year Impervious Catchment(Ha)	0.45
Required BioRetention Area (2%) (m ²)	100
Required Storage(1 in 1Yr 1 Hr)(m ³)	69
Available Storage(m ³)	229
Soakage Outflow(l/s/m ²)	0.013

Catchment Details	Roads	Lots (Connected)	Lots (Unconnected)	POS*	Basin Area	Sub Total Catchment Area	Add Effective Area from Catchment 6/7	Deduct Effective Area to Paradiso	Total
Gross Catchment Area	0.52	0	0.5582	0.1769	0.0800	1.3321			1.33
Run-Off Co-efficient(C ₁₀)	0.80	0.45	0.06	0	1.00				
ARI Multiplier	0.90	1.22	2.50	1.41	1.00				
Run-Off Co-efficient(C _y)	0.72	0.55	0.15	0.00	1.00				
Impervious Area(Ha)	0.37	0.00	0.08	0.00	0.08	0.54	0.58	-0.83	0.29

0.40 Effective C

Data From A, R & R Volume 2

Location	Baldwis WA	Road Catchment Area:	RR Width(m)	Length(m)	Area (Total)
Map 1	20.6		20	0	-
Map 2	4.5		18	0	-
Map 3	1.3		40	0	-
Map 4	35.5		16	0	-
Map 5	7		15	0	-
Map 6	2.1		14	0	-
Map 7	0.68		13	0	-
Map 8	4.82		6	0	-
Map 9	17				5,170

Tc(mins)	Tc(hrs)	I(mm/hr)	Q(l/s)	Total V in	Preliminary Height(m)	Q out (Soakage)(l/s)	V out (Soakage)	Net Storage (After Soakage)	Time of Water in Basin(hrs)	V out (Req'd)	Q out(l/s)
20	0.33	98.74	78	94	0.25	3.03	3,63168	90	8.6	0	0.0
30	0.50	75.22	60	108	0.25	3.03	5,44752	102	9.9	0	0.0
45	0.75	56.30	45	121	0.25	3.03	8,17128	113	11.1	0	0.0
60	1.00	45.44	36	130	0.25	3.03	10,89504	119	11.9	0	0.0
120	2.00	28.82	23	165	0.25	3.03	21,79008	143	15.1	0	0.0
240	4.00	18.07	14	207	0.25	3.03	43,58016	163	19.0	0	0.0
480	8.00	11.32	9	259	0.25	3.03	87,16032	172	23.8	0	0.0
960	16.00	7.21	6	330	0.25	3.03	174,32064	156	30.3	0	0.0

Development Engineering Consultants - Drainage Basin Spreadsheet



Project: Lots 5, 6, 7 and 8 Kerosene Lane Baldivis

LWMS Calcs

Location:	Catchment 5								
2880	48.00	3.53	3	484	0.25	3.03	522.96192	-39	0
4320	72.00	2.62	2	540	0.25	3.03	784.44288	-244	0
									44.4
									49.6
									0.0
									0.0

Calculation of Storage in Above Ground Basin

Lower Tier Drainage Basin Dimensions:

Side Slopes 1: Length(m) Breadth(m)
 0 30 4

RL(Base) 8

TWL(mAHD)	Height(m)	A(TWL)	Total Wetted		Average Area	Vol(m ³)	Treatment	
			Area	Area			Storage above LWL	Storage above The Designated Height allows Storage for
8	0	120	120	480	0	0	Static Water Level	
8.5	0.5	120	120	480	60	60	1 in 1 year 1 hour	

TOTAL STORAGE TO TOP OF LOWER TIER 60 m³

Volume and Dimensions of below Ground Storage Based on Humes Storm Trap

Width (Inside)	2350 mm	2.35 m	
Height	1500 mm	1.5 m	
Storage Required	143.00 m ³	Width Provided	4.70 m
Length Required	40.57 m	Length Provided	20.28 m
		Length provided (4.0m Increments)	24.00 m
Area of Storage	95.33	Storage Provided	169.20 m ³
TOTAL STORAGE LOWER TIER AND STORMTRAP	229 m³	100 Year Storage	

Development Engineering Consultants - Drainage Basin Spreadsheet



Project: Lots 5, 6, 7 and 8 Kerosene Lane Baldvivi

LWMS Calcs

Location: Catchment 6 and 7

Data to be Input

Rainfall ARI (Years)	100
1 in 1 Year Impervious Catchment(Ha)	1.16
Required BioRetention Area (2%) (m ²)	300
Required Storage(1 in 1Yr 1 Hr)(m ³)	179
Available Storage(m ³)	645
Soakage Outflow(l/s/m ²)	0.013

Catchment Details	Roads	Lots (Connected)	Lots (Unconnected)	POS*	Basin Area	Sub Total Catchment Area	Deduct effective Area to Catchment 5/Paradiso	Total
Gross Catchment Area	1.51	0	2.784	0.1549	0.0800	4.5239		4.52
Run-Off Co-efficient(C ₁₀)	0.80	0.45	0.06	0	1.00			
ARI Multiplier	0.90	1.22	2.50	1.41	1.00			
Run-Off Co-efficient(C _v)	0.72	0.55	0.15	0.00	1.00			
Impervious Area(Ha)	1.08	0.00	0.42	0.00	0.08	1.58	-0.58	1.00

Effective C 0.35

Data From A,R & R Volume 2

Location	Baldvivi WA	RR Width(m)	Length(m)	Area (Total)
Map 1	20.6	20	0	-
Map 2	4.5	18	0	-
Map 3	1.3	40	0	-
Map 4	35.5	16	0	-
Map 5	7	15	0	-
Map 6	2.1	14	0	-
Map 7	0.68	13	0	-
Map 8	4.82	6	0	-
Map 9	17			15,050

Tc(mins)	Tc(hrs)	I(mm/hr)	Q(l/s)	Total V in	Preliminary Height(m)	Q out (Soakage)(l/s)	V out (Soakage)	Net Storage (After Soakage)	Time of Water in Basin(hrs)	V out (Req'd)	Q out(l/s)
20	0.33	98.74	275	330	1.00	10.01	12,014,854,63	318	9.1	0	0.0
30	0.50	75.22	209	377	1.00	10.01	18,022,281,95	359	10.4	0	0.0
45	0.75	56.30	157	423	1.00	10.01	27,033,422,92	396	11.7	0	0.0
60	1.00	45.44	126	455	1.00	10.01	36,044,563,9	419	12.6	0	0.0
120	2.00	28.82	80	577	1.00	10.01	72,089,127,8	505	16.0	0	0.0
240	4.00	18.07	50	724	1.00	10.01	144,178,255,6	579	20.1	0	0.0
480	8.00	11.32	31	907	1.00	10.01	288,356,511,2	619	25.2	0	0.0
960	16.00	7.21	20	1155	1.00	10.01	576,713,022,4	578	32.0	0	0.0
2880	48.00	3.53	10	1695	1.00	10.01	1730,139,067	-35	47.0	0	0.0
4320	72.00	2.62	7	1892	1.00	10.01	2595,208,601	-703	52.5	0	0.0

Calculation of Storage in Above Ground Basin



Project: Lots 5, 6, 7 and 8 Kerosene Lane Baldivis
LWMS Calcs

Location: Catchment 6 and 7

Volume and Dimensions of below Ground Storage Based on Humes Storm Trap

Width (Inside)	2350 mm	2.35 m	
Height	1500 mm	1.5 m	
Storage Required	340.00 m ³	Width Provided	7.05 m
Length Required	96.45 m	Length Provided	32.15 m
		Length provided (4.0m Increments)	36.00 m
Area of Storage	226.67	Storage Provided	380.70 m ³

5 Year Storage

TOTAL STORAGE LOWER TIER AND STORMTRAP 381 m³

RL(Base)	TWL(mAHD)	Height(m)	A(TWL)	Vol(m ³)	Storage for
7	0	254	0	0	Static Water Level
7.44	0.44	254	112	112	1 in 1 year 1 Hour
8.35	1.35	254	343	343	1 in 1 year
8.5	1.50	254	381	381	Top of Underground Storage

Upper Tier Drainage Basin Dimensions:

Side Slopes 1: Length(m) Breadth(m)

6 22.5 7.00

9

RL(Base)	TWL(mAHD)	Height(m)	A(TWL)	Total Wetted Area	Average Area	Vol(m ³)	Volume in Dip	Total Storage above LWL	The Designated Height allows Storage for
9	0	158	158	158	630	0	0	381	Bottom of Soakage Area
9.05	0.05	176	176	176	666	8	0	389	1 in 5 year
9.54	0.54	391	391	391	1054	144	0	525	1 in 10 year
9.8	0.8	533	533	533	1289	264	0	645	1 in 100 year

TOTAL STORAGE TO TOP OF UPPER TIER 645 m³

Development Engineering Consultants - Drainage Basin Spreadsheet



Project: Lots 5, 6, 7 and 8 Kerosene Lane Baldvis

LWMS Calcs

Location: Catchment 8

Data to be Input

Rainfall ARI (Years)	100
1 in 1 Year Impervious Catchment(Ha)	0.73
Required BioRetention Area (2%) (m ²)	200
Required Storage(1 in 1Yr 1 Hr)(m ³)	112
Available Storage(m ³)	615
Soakage Outflow(l/s/m ²)	0.013

Catchment Details	Roads	Lots (Connected)	Lots (Unconnected)	POS*	Basin Area	Sub Total Catchment Area	Total
Gross Catchment Area	0.90	0	1.5758	0.1390	0.0800	2.6928	2.69
Run-Off Co-efficient(C ₁₀)	0.80	0.45	0.06	0	1.00		
ARI Multiplier	0.90	1.22	2.50	1.41	1.00		
Run-Off Co-efficient(C _y)	0.72	0.55	0.15	0.00	1.00		
Impervious Area(Ha)	0.65	0.00	0.24	0.00	0.08	0.96	0.96

0.36 Effective C

Data From A, R & R Volume 2

Location	Baldvis WA	RR Width(m)	Length(m)	Area (Total)
Map 1	20.6	20	0	-
Map 2	4.5	18	0	-
Map 3	1.3	40	0	-
Map 4	35.5	16	0	-
Map 5	7	15	0	-
Map 6	2.1	14	0	-
Map 7	0.68	13	0	-
Map 8	4.82	6	0	-
Map 9	17			8,980

Tc(mins)	Tc(hrs)	I(mm/hr)	Q(l/s)	Total V In	Preliminary Height(m)	Q out (Soakage)(l/s)	V out (Soakage)	Time of Water in Basin(hrs)	V out (Reqd)	Q out(l/s)
20	0.33	98.74	264	317	0.25	9.00	10.79451259	9.8	0	0.0
30	0.50	75.22	201	362	0.25	9.00	16.19176889	11.2	0	0.0
45	0.75	56.30	151	407	0.25	9.00	24.28765334	12.6	0	0.0
60	1.00	45.44	122	438	0.25	9.00	32.38353778	13.5	0	0.0
120	2.00	28.82	77	555	0.25	9.00	64.76707557	17.1	0	0.0
240	4.00	18.07	48	696	0.25	9.00	129.5341511	21.5	0	0.0
480	8.00	11.32	30	872	0.25	9.00	259.0683023	26.9	0	0.0
960	16.00	7.21	19	1111	0.25	9.00	518.1366046	34.3	0	0.0
2880	48.00	3.53	9	1630	0.25	9.00	1554.409814	50.3	0	0.0
4320	72.00	2.62	7	1819	0.25	9.00	2331.61472	56.2	0	0.0



Project: Lots 5, 6, 7 and 8 Kerosene Lane Baldvris
LWMS Calcs
Location: Catchment 8

Volume and Dimensions of below Ground Storage Based on Humes Storm Trap

Width (Inside)	2350 mm	2.35 m
Height	1500 mm	1.5 m
Storage Required	300.00 m ³	Width Provided 7.05 m
Length Required	85.11 m	Length Provided 28.37 m
		Length provided (4.0m Increments) 32.00 m
Area of Storage	200.00	Storage Provided 338.40 m ³

TOTAL STORAGE LOWER TIER AND STORMTRAP 338 m³ 10 Year Storage

RL(Base)	TWL(mAHD)	Height(m)	A(TWL)	Vol(m ³)	Storage for
10.3	0	226	0	0	Static Water Level
10.75	0.45	226	102	102	1 in 1 year 1 Hour
11.1	0.8	226	180	180	1 in 1 year
11.8	1.5	226	338	338	1 in 5 year
11.8	1.50	226	338	338	Top of Underground Storage

Upper Tier Drainage Basin Dimensions:

Side Slopes 1: Length(m)	6	17.6
Breadth(m)	12.8	20.00

TWL(mAHD)	Height(m)	A(TWL)	Area	Average Area	Vol(m ³)	Volume in Dip	Total Storage above LWL	The Designated Height allows Storage for
12.8	0	352	352	1408	0	0	338	Bottom of Upper Tier
12.81	0.01	357	357	1417	4	0	342	1 in 10 year
13.36	0.56	650	650	1959	276	0	615	1 in 100 year

TOTAL STORAGE TO TOP OF UPPER TIER 615 m³

Development Engineering Consultants - Drainage Basin Spreadsheet

Project: Lots 5, 6, 7 and 8 Kerosene Lane, Baldivis

Location: At Lot Detention Calculations to Establish Run-off Coefficient

Lots Unconnected > 300m² in Area - 350m² Ave



Data to be Input

Rainfall ARI (Years)	100
1 in 1 Year Impervious Catchment(Ha)	0.022
Required Storage(1 in 1Yr 1 Hr)(m ³)	3.396

Catchment Details	Paved Area	Upaved area	Total
Lot Area (SQM)			350.00
Proportion Paved	70%	30%	100%
Area Paved (Ha)	0.025	0.011	0.035
Run-Off Co-efficient(C10)	0.90	0.00	
ARI Multiplier	1.00	1.20	
Run-Off Co-efficient(Cy)	0.90	0.00	
Impervious Area(Ha)	0.022	0.000	0.022

Volume and Dimensions of Available Storage

Area above Ground inundated to 0.03m Deep (Back Yard and Front Yard)	30.00	0.02
Storage provided manholes and pipe		
Number of Soakwells	2.00	
Diameter of Soakwells	1.50	
Depth of Each Soakwell	1.20	
Storage Provided Soakwells	4.24	
Total Storage Provided	4.84	
Soakage Rate (l/s/m ²)		0.02

0.63 Effective C

ARI	Effective C	Multiplier
1	0	0.00
2	0	0.00
5	0	0.00
10	0.06	1.00
20	0.06	1.00
50	0.09	1.50
100	0.15	2.50

NOTE: All water is retained in Soakwells to 5 ARI without surcharge. For Greater ARI storms water will surcharge and soak over an area of 30 Square metres to a maximum depth of 20mm

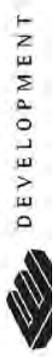
Development Engineering Consultants - Drainage Basin Spreadsheet

Project: Lots 5, 6, 7 and 8 Kerosene Lane, Baldivis

Location: At Lot Detention Calculations to Establish Run-off Coefficient

Data From A,R & R Volume 2

Location	Perth WA
Map 1	22.6
Map 2	4.9
Map 3	1.5
Map 4	37.5
Map 5	7.8
Map 6	2.5
Map 7	0.68
Map 8	4.85
Map 9	17



Tc(mins)	Tc(hrs)	I(mm/hr)	Q(l/s)	Total V in	Q out (Soakage)(l/s)	V out	Net Storage Required	Vout (Required)	Q out(l/s)	Effective Run-off C
10	0.167	152.26	9.33	5.595553704	0.90	0.538128303	5.0574254	0.22	0.36	0.02
20	0.333	101.28	6.20	7.443743327	0.90	1.076256607	6.36748672	1.53	1.27	0.13
30	0.500	77.57	4.75	8.551792527	0.90	1.61438491	6.937407617	2.10	1.16	0.15
60	1.000	47.33	2.90	10.43611421	0.90	3.228769821	7.207344391	2.37	0.66	0.14
120	2.000	30.65	1.88	13.51710928	0.90	6.457539642	7.059569636	2.22	0.31	0.10
240	4.000	19.63	1.20	17.31523396	0.90	12.91507928	4.400154674	-	0.00	0.00
480	8.000	12.57	0.77	22.17335383	0.90	25.83015857	-3.65680474	-	0.00	0.00
960	16.000	8.19	0.50	28.88956675	0.90	51.66031713	-22.77075038	-	0.00	0.00
1440	24.000	6.44	0.39	34.06399351	0.90	77.4904757	-43.42648219	-	0.00	0.00
2880	48.000	4.18	0.26	44.19550366	0.90	154.9809514	-110.7854477	-	0.00	0.00
4320	72.000	3.16	0.19	50.17568102	0.90	232.4714271	-182.2957461	-	0.00	0.00

Development Engineering Consultants - Drainage Basin Spreadsheet



Project: Lots 14, 9010, 299 Kerosene Lane, Baldvivi
Paradiso Estate Development
Location: Western Catchment - Catchment D

Data to be Input

Rainfall ARI (Years)	100
1 in 1 Year Impervious Catchment(Ha)	0.41
Required Storage(1 in 1Yr 1 Hr)(m ³)	63
Available Storage(m ³)	721
Soakage Outflow(l/s/m ²)	0.013
Allowable Outflow (l/s) (10 year)	-

Catchment Details	Roads	Lots (Connected)	Lots (Unconnected)	Commercial Lots (Unconnected)	POS/School*	Basin Area	Add Extra Area Lots 5-8	Total
Gross Catchment Area	0.54	0	0.45	0	0.21	0.03		1.23
Run-Off Co-efficient(C ₁₀)	0.78	0.32	0.05	0.01	0	1.00		
ARI Multiplier	0.90	1.20	2.40	29.00	1.41	1.00		
Run-Off Co-efficient(C _y)	0.70	0.38	0.12	0.29	0.00	1.00		
Impervious Area(Ha)	0.38	0.00	0.05	0.00	0.00	0.03	0.83	1.29

1.05 **Effective C**

* Includes School Sites

Data From A,R & R Volume 2

Location	Perth WA	Road Catchment Area: RR Width(m)	Length(m)	Area (Total)
Map 1	20.6	20	0	-
Map 2	4.5	18	0	-
Map 3	1.3	16	0	-
Map 4	35.5	15	0	-
Map 5	7	14	0	-
Map 6	2.1	12.5	0	-
Map 7	0.68	10	0	-
Map 8	4.82	6	0	-
Map 9	17			5,400

Tc(mins)	Tc(hrs)	I(mm/hr)	Q(l/s)	Total V in	Preliminary Height(m)	Q out (Soakage)(l/s)	V out (Soakage)	Time of Water in Basin(hrs)	Q out(l/s)
20	0.33	98.74	354.66	426	0.60	18.77	22.52093466	6.3	0
							403		0
									0

Development Engineering Consultants - Drainage Basin Spreadsheet



Project: Lots 14, 9010, 299 Kerosene Lane, Baldivis
Paradiso Estate Development

Location: Western Catchment - Catchment D

30	0.50	75.22	270.17	486	0.60	18.77	33.78140199	453	7.2	0	0
45	0.75	56.30	202.21	546	0.60	18.77	50.67210298	495	8.1	0	0
60	1.00	45.44	163.21	588	0.60	18.77	67.56280397	520	8.7	0	0
120	2.00	31.59	113.47	817	0.60	18.77	135.1256079	682	12.1	0	0
240	4.00	19.11	68.66	989	0.60	18.77	270.2512159	718	14.6	0	0
480	8.00	11.56	41.53	1196	0.60	18.77	540.5024318	656	17.7	0	0
960	16.00	8.08	29.01	1671	0.60	18.77	1081.004864	590	24.7	0	0
2880	48.00	3.65	13.10	2263	0.60	18.77	3243.014591	-980	33.5	0	0
4320	72.00	2.62	9.43	2443	0.60	18.77	4864.521886	-2421	36.2	0	0

Lower Tier Drainage Basin Dimensions:

Side Slopes 1: Length(m) Breadth(m)
 6 33 3.6

RL(Base) 7.7

TWL(mAHD)	Height(m)	A(TWL)	Fenced Site		Average Area	Vol(m ³)	The Designated Height allows Storage for
			Area	Equiv			
7.7	0	119	196	475	0	Static Water Level	
7.88	0.18	203	288	638	29	1 in 1 year 1 Hour	
8.15	0.45	346	444	900	102	1 in 1 year	
8.4	0.7	497	608	1161	207	5 Year Storage	
8.5	0.8	562	678	1270	260	10 Year Storage	

TOTAL STORAGE TO TOP OF LOWER TIER

Upper Tier Drainage Basin Dimensions:

Side Slopes 1: Length(m) Breadth(m)
 6 60 24

RL(Base) 8.5

TWL(mAHD)	Height(m)	A(TWL)	Fenced Site		Average Area	Vol(m ³)	Total Volume(m ³)	The Designated Height allows Storage for
			Area	Equiv				
8.79	0.29	1744	1930	6357	461	721	100 Year Storage	
Allocation to Lots 6-8						463		



DEVELOPMENT
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APPENDIX D – DETAILS OF DRAINAGE BASINS

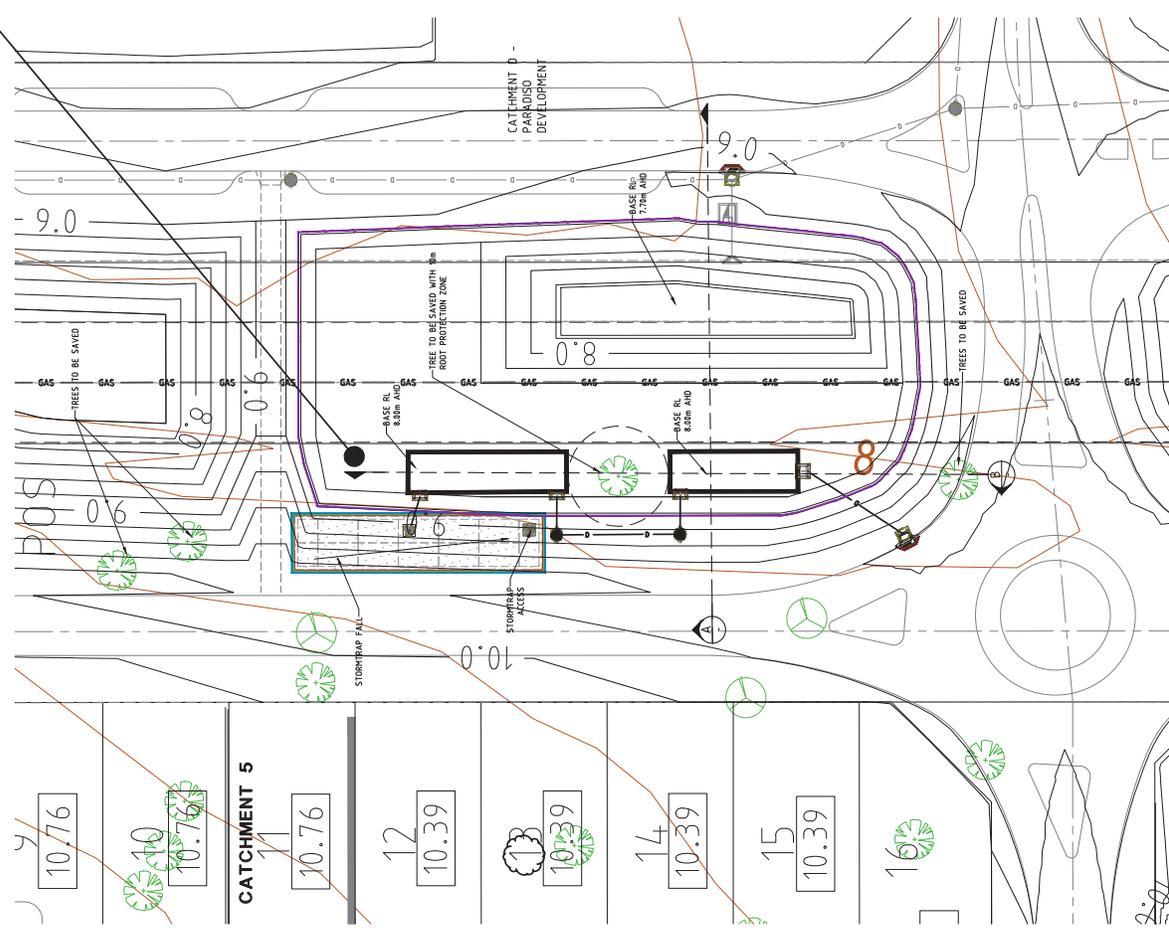
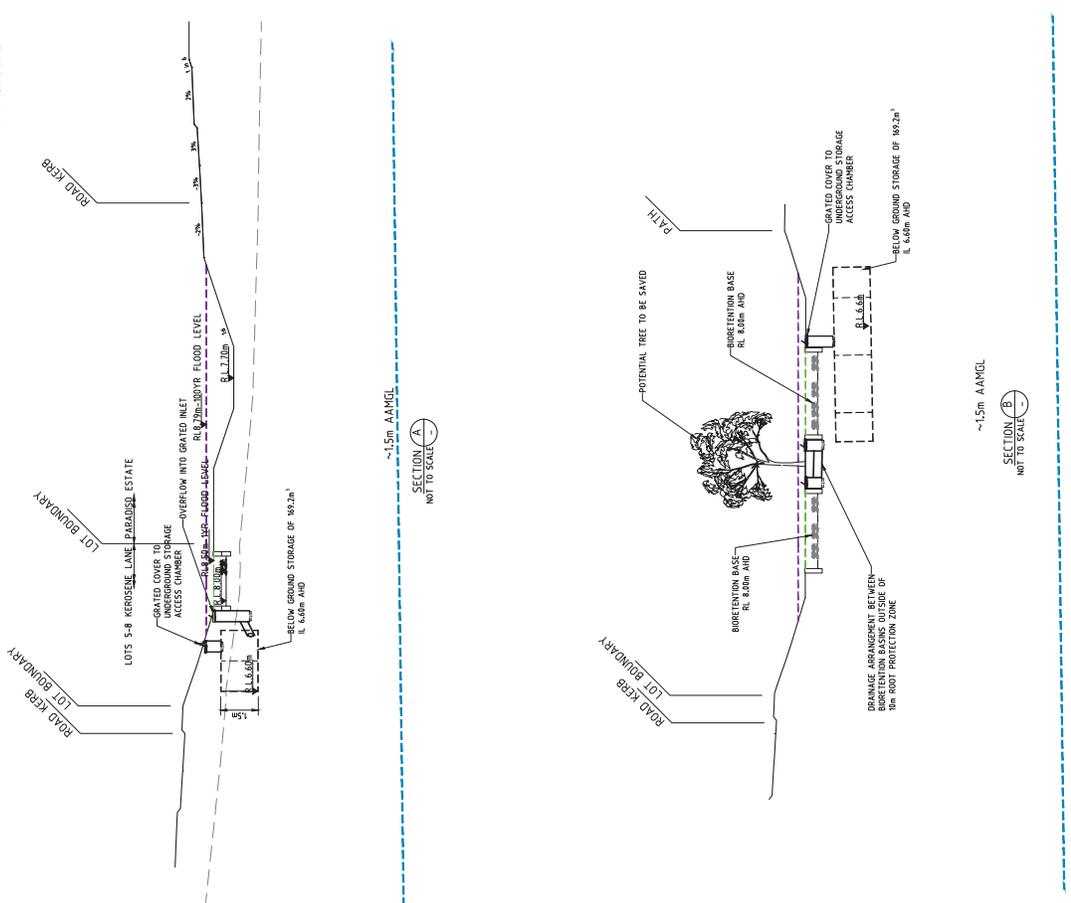
- L- 05 – Catchment 5 – Basin details**
- L- 06 – Catchment 6 – Basin details**
- L- 07 – Catchment 7 – Basin details**
- Landscape Concept Plans**

LEGEND

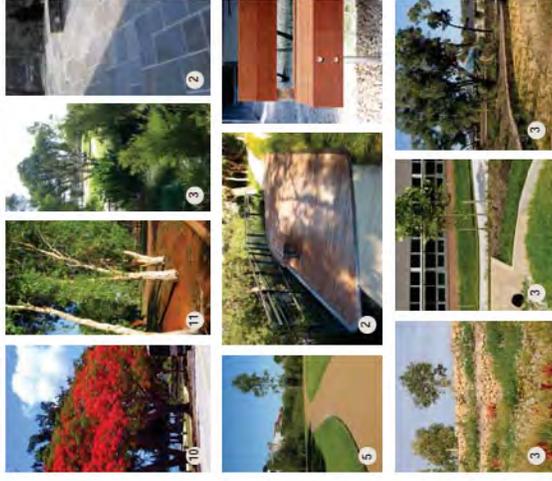
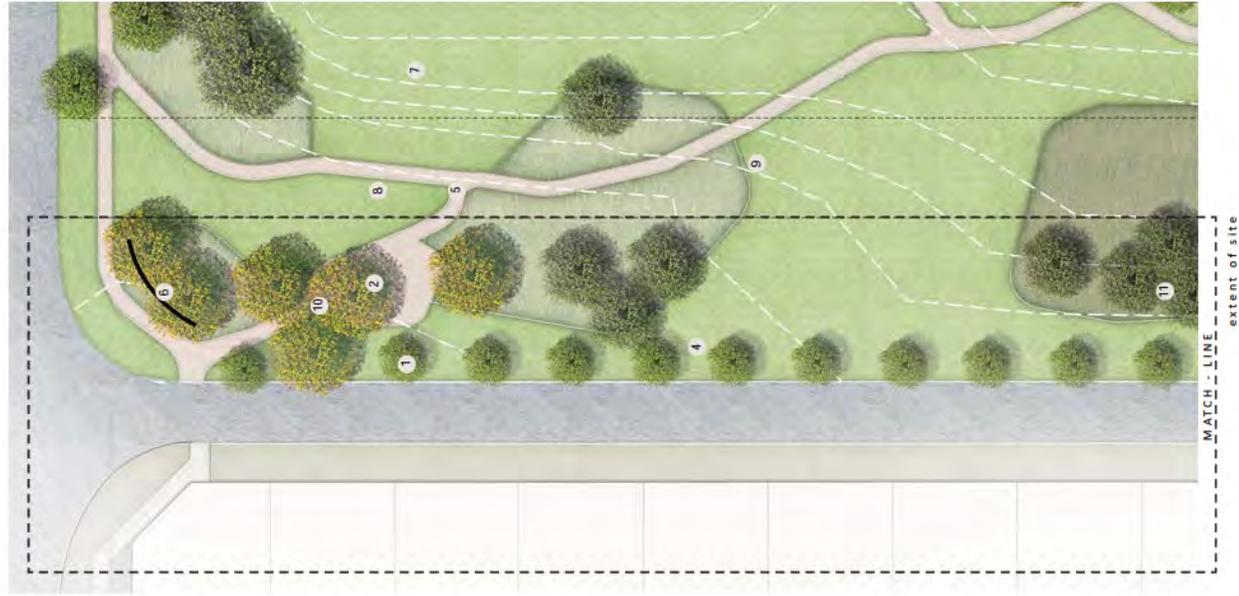
- LMWS CATCHMENT AREA
- NATURAL SURFACE
- LANDSCAPING SURFACE
- GROUND WATER CONTOURS
- OVERLAND FLOW ARROW
- MONITORING BORE
- BORE LEVEL
- BORE DIAMETER
- 1 IN 1 YEAR STORAGE
- 1 IN 5 YEAR STORAGE
- 1 IN 100 YEAR STORAGE

BASIN DETAILS - CATCHMENT 5

TOTAL IMPERVIOUS AREA (100yr)	8.27m ²
100yr STORAGE (PARADISO)	227m ³
AREA AT T.M. (100yr)	463m ²
AREA AT T.M. (100yr) (PARADISO)	100m ²
AREA AT T.M. (100yr) (LOTS 5-8)	363m ²
AREA AT T.M. (100yr) (PARADISO)	726m ²
RL (T.M.) (100yr)	8.77m AHD
5yr STORAGE REQUIRED	18m ³
AREA AT T.M. (5yr)	95m ²
1yr STORAGE REQUIRED	8.55m ³
AREA AT T.M. (1yr)	95m ²
100m ³ STORAGE REQUIRED	8.55m ² AHD
PEAK FLOW (100yr)	8.77



<p>CLIENT:</p> <p>TERRANOVIS PTY LTD</p>	<p>DEVELOPMENT:</p> <p>ENGINEERING CONSULTANTS</p>	<p>PROJECT:</p> <p>LOTS 5, 6, 7 & 8 KEROSENE LANE BALDIS</p>	<p>DRAWING:</p> <p>LOCAL WATER MANAGEMENT STRATEGY CATCHMENT 5 BASIN DETAILS</p>	<p>SCALE: 1:250</p>	<p>DATE: 11/10/15</p>	<p>DESIGNED BY: JAS</p>	<p>DRAWN BY: JEG</p>	<p>CHECKED BY: SFA</p>	<p>APPROVED BY: G</p>
				<p>PROJECT NO: 1000</p>	<p>PROJECT NAME: KEROSENE LANE BALDIS</p>	<p>PROJECT NUMBER: 1000</p>	<p>DRAWING NUMBER: BDVTER30 L05</p>		



LEGEND

- 1 *Ulmus parvifolia* street trees to mainroad.
 - 2 Feature paved seating area overlooking basin / POS.
 - 3 Native reeds & sedges tubestock planting to drainage basin.
 - 4 Turf grassing to verge with evergreen street trees.
 - 5 Path connections to the adjacent POS network.
 - 6 Estate Entry sign
 - 7 1:100 year event overflow to open turf area.
 - 8 Make good to existing lawn / garden bed areas
 - 9 Existing high pressure gas line
 - 10 Feature deciduous shade trees to entry. E.g. *Erythrina indica*
 - 11 POS planted with groups of local, native trees.
E.g. *Eucalyptus gomphocephala*
 - 12 Stormtrap underground storage.
 - e Significant existing trees to be retained & protected.
Araucaria (*Eucalyptus marginata*) / Tuart (*Eucalyptus gomphocephala*)
 - p POS will provide attractive areas hillside areas to walk, ride, sit and relax.
- Existing significant trees may be retained in verges and POS depending upon cut and fill requirements. These will be identified following finalised civil design works.

Final drawings to be completed as part of subdivision stage.





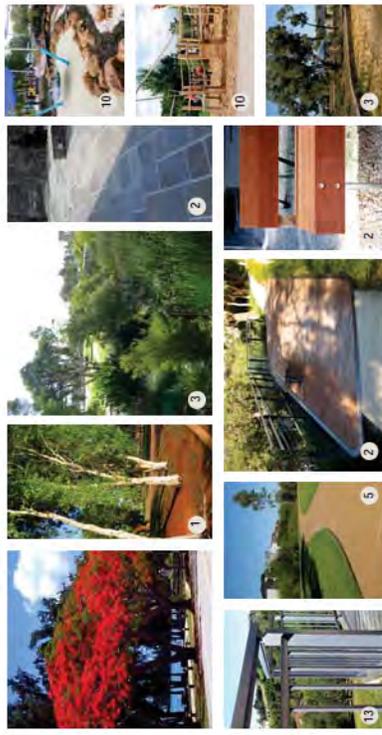
LEGEND

- 1 Avenue of large native trees
E.g. Eucalyptus rudis or Melaleuca leucadendra
- 2 Feature paved seating area overlooking basin with balustrade.
- 3 Native reeds & sedges tubestock planting to drainage basin.
- 4 Turf grassing to batter (max 1:6 slope)
- 5 2m Wide in situ concrete path.
- 6 Ulmus parvifolia street trees to main road.
- 7 Underground storage tanks.
- 8 RL 9.80-100yr Flood level.
- 9 Feature paved picnic seating area with shade trees & feature garden bed planting.
- 10 Feature deciduous shade trees E.g. Erythrina indica
- 11 Drainage basin planted with native tree species.
E.g. Eucalyptus rudis & Melaleuca preissiana.
- 12 Balustrade to retaining wall surrounding picnic area.
- 13 Low native shrub & groundcover planting.
- 14 Open lawn recreation area.
- e Significant existing trees to be retained & protected.
Jarrah (Eucalyptus marginata) / Tuart (Eucalyptus gomphocephala)
- p POS will provide attractive areas hillside areas to walk, ride, sit and relax.

Existing significant trees may be retained in verges and POS depending upon cut and fill requirements. These will be identified following finalised civil design works.

Final drawings to be completed as part of subdivision stage.





LEGEND

- 1 Avenue of native trees
E.g. Melaleuca leucadendra
 - 2 Feature paved seating area overlooking basin.
 - 3 Native reeds & sedges tubestock planting to drainage basin.
 - 4 Turf grassing to verge with Ulmus parvifolia street trees.
 - 5 2m Wide Insitu concrete dual-use path.
 - 6 1:100 year flood level
 - 7 1:21 sloped walkway.
 - 8 Latentite block seating height retaining wall (TW 15.8)
 - 9 Feature paved picnic seating area with bin, overlooking playground.
 - 10 Mulched nature play playground area with climbing logs and boulders.
 - 11 Feature deciduous shade trees E.g. Erythrina indica
 - 12 Drainage basin planted with native tree species.
E.g. Eucalyptus rudis or Melaleuca preissiana.
 - 13 Balustrade to top of wall.
 - 14 Underground storage tanks.
 - Ø Significant existing trees to be retained & protected.
Jarrah (Eucalyptus marginata) / Tuart (Eucalyptus gomphocephala)
 - P POS will provide attractive areas hillside areas to walk, ride, sit and relax.
- Existing significant trees may be retained in verges and POS depending upon cut and fill requirements. These will be identified following finalised civil design works.
- Final drawings to be completed as part of subdivision stage.





DEVELOPMENT
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APPENDIX E – Approved Groundwater Licence for POS Irrigation



Bortolo Morzenti
C/- Terranovis
PO Box 1320
CANNINGBRIDGE APPLECROSS WA 6153

Dear Licensee

**Re: Issue of a licence under the *Rights in Water and Irrigation Act 1914*
Property: Lot 8 Keroscene Lane Baldivis**

Please find enclosed the following:

- Your licence to take water (*GWL182358*)
- Brochure *Your licence to take water*
- Brochure *Metering your water use*
- Meter Water Use Card & example card can be downloaded from the department's website: <http://www.water.wa.gov.au/licensing/water-licensing/metering> or refer to Water Online information below
- Your licence to construct or alter a well (*CAW182356*)
- Form 2 "Information to be provided on completion of a non-artesian well"
- Brochure *Your licence to construct a well*

Please take time to read these documents as they contain important information about your rights and responsibilities.

You may apply to the State Administrative Tribunal (SAT) for a review of our decision. You will need to contact the SAT office directly, within 28 days.

In person State Administrative Tribunal
 Level 6, 565 Hay Street PERTH WA 6000

In writing: State Administrative Tribunal
 GPO Box U1991
 PERTH WA 6845

By telephone: Metro: (08) 9219 3111

Regional: 1300 306 017 (for the cost of a local call)

By fax: (08) 9325 5099

For more information about the SAT please visit their website
www.sat.justice.wa.gov.au.

You can now use online services to manage all of your licensing and metering needs. Water Online provides the easiest, fastest and most efficient way to:

- Apply for a new licence or permit
- Apply to amend, renew or transfer an existing licence
- Submit meter readings in accordance with a licence; and
- Manage your account details.

Register for Water Online at www.water.wa.gov.au by clicking on the Water Online Login icon.

The instructions for registering, checking your details and updating them where required can be found by selecting the Quick Reference Guides link on the water online home page.

Please check your details to ensure that they are correct. If they are not correct please contact the department's online business support unit on 1800 508 885 (select option 2).

If you have any queries about this or any other water licensing matter please contact Alana Patterson on telephone 95504236.

Yours sincerely



Alana Patterson
A/ Snr Natural Resource Management Officer
Peel Region

30 May 2016



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

Licensee(s)	Morzenti, Bortolo Nicola		
Description of Water Resource	Stakehill Perth - Superficial Swan	Annual Water Entitlement	5330 kL
Location of Water Source	Lot 8 On Diagram 31197 - Volume/Folio 1907/259 - Lot 8 Kerosene Lane Baldivis		
Authorised Activities	Taking of water for	Location of Activity	
	Irrigation of up to 0.711 ha of public open space	Lot 8 On Diagram 31197 - Volume/Folio 1907/259 - Lot 8 Kerosene Lane Baldivis	
Duration of Licence	From 24 May 2016 to 24 May 2026		

This Licence is subject to the following terms, conditions and restrictions:

- 1 The licensee shall not use water for public open space between 9 am and 6 pm except for the establishment of newly planted areas. For newly planted areas water may be used within these hours for a period of up to 28 consecutive days, commencing from the date of planting.
- 2 Between 1 June and 31 August in any year, the licence-holder must not water a lawn, garden, or grass-covered area ("turf") by reticulation, provided always that this restriction shall not apply to watering with a hand held hose; or watering, by way of reticulation: newly planted areas for a period of up to 28 days from the date of planting; for renovating turf; or for maintenance of reticulation systems.
- 3 The licensee must install an approved meter to each water draw-point through which water is taken under this licence.
- 4 The annual water year for water taken under this licence is defined as 1 July to 30 June.
- 5 The licensee must not, in any water year, take more water than the annual water entitlement specified in this licence.
- 6 The licensee must take and record the reading from each meter required under this licence at the beginning and another at the end of the water year defined on this licence.
- 7 The licensee must take and record the reading from each meter required under this licence, at the end of each month.
- 8 Unless otherwise approved, all meter readings must be recorded on the 'Meter Water Use Card' available from the Department of Water.
- 9 The completed Meter Water Use Card must be submitted to the Department of Water every 12 month(s) commencing 14/07/2017.
- 10 The licensee must ensure the installed meter(s) accuracy is maintained to within plus or minus 5% of the volume metered, in field conditions.
- 11 The licensee must notify the Department of Water in writing of any water meter malfunction within seven days of the malfunction being noticed.

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000



LICENCE TO TAKE WATER

Granted by the Minister under section 5C of the Rights in Water and Irrigation Act 1914

This Licence is subject to the following terms, conditions and restrictions:

- 12 The licensee must obtain authorisation from the Department of Water before removing, replacing or interfering with any meter required under this licence.

End of terms, conditions and restrictions



LICENCE TO CONSTRUCT OR ALTER WELL

Granted by the Minister under section 26D of the Rights in Water and Irrigation Act 1914

Licensee(s)	Morzenti, Bortolo Nicola	
Description of Water Resource	Stakehill Perth - Superficial Swan	
Location of Well(s)	Lot 8 On Diagram 31197 - Volume/Folio 1907/259 - Lot 8 Kerosene Lane Baldivis	
Authorised Activities	Activity	Location of Activity
	Construct 1 non-artesian well(s).	Lot 8 On Diagram 31197 - Volume/Folio 1907/259 - Lot 8 Kerosene Lane Baldivis
Duration of Licence	From 24 May 2016 to 24 May 2017	

This Licence is subject to the following terms, limitations and conditions:

- 1 The well must be constructed by a driller having a current class 1 water well drillers certificate issued by the Western Australian branch of the Australian Drilling Industry Association or equivalent certification recognised nationally by the Australian Drilling Industry Association.
- 2 The licensee must install an approved meter to each well, and provide evidence of the installation to the Department of Water within 30 days of completion of the well.
- 3 The licensee shall provide to the Department of Water within 30 days of drilling, the results of down-hole lithological logging of the bore hole drill cuttings. The results must contain a strata description and their corresponding depth intervals.
- 4 The licensee shall construct the well using materials and methods for single aquifer systems described in "Minimum construction requirements for water bores in Australia, 3rd edition, National Uniform Drillers Licensing Committee (2012)".

End of terms, limitations and conditions

APPENDIX 8

ENGINEERING SERVICING REPORT



DEVELOPMENT
ENGINEERING
CONSULTANTS

Telephone: (08) 9481 1900

Facsimile: (08) 9481 1700

Ground Floor "The Atrium"

Suite 3/123A Colin Street

West Perth WA 6005

Our Ref:

Servicing Report 5- 8 Kerosene
lane Oct 2015

October 8, 2015

TERRANOVIS PTY LTD

LOTS 5 – 8 KEROSENE LANE, BALDIVIS

ENGINEERING SERVICES REPORT.

1. General.

The above land is to be developed into an urban subdivision containing some 135 residential lots plus POS. This report covers existing and proposed services plus proposals for earthworks, retaining walls, roads, drainage, groundwater, water supply, power supply, gas, telecommunications and sewerage as required for current urban development standards.

2. Executive Summary.

The land the subject of this report is located on the south side of Kerosene Lane in the northern area of Baldivis, within the City of Rockingham. The land is between 300m and 700 metres east of Mandurah Rd and between 2km and 2.4km west of Baldivis Rd. The APA high pressure ethane gas pipeline is located just east of lot 5 in the adjacent land being developed as "Paradiso Estate". This pipeline runs north – south.

The land is uncleared, with houses and sheds located on lots 5 and 7, both of which have power and telephone services. Kerosene Lane is a sealed rural road in fair condition with centerline marking. It lacks kerbing and formal drainage. A high (22kVa) and low voltage aerial power line is located on the south verge of Kerosene Lane abutting the site.

The basic land form is free draining sand over limestone. The Environmental Geology map of the Geological Survey of Western Australia classifies this site as generally "S7" Sand derived from Tamala Limestone on the eastern half and "LS1" Tamala Limestone on the western half. The current process is listed as "ground water recharge".

The land can be connected to all services, either by extension and upgrading from existing infrastructure, or by provision of new infrastructure as set out below. Power and telephone services already pass along the site frontage. A LWMS for the area is being prepared. All storm water generated from the development for storms up to the 1 in 100 year storm will be contained on site in swale drainage basins located at low points within local catchments. Houses will discharge roof storm water to on site soakwells. According to the 1997 Ground Water Atlas, the land is a minimum of 4.5 metres above the water table at its lowest point on the south west corner of the site.

The site is undulating, sloping to the south off Kerosene Lane, which will necessitate construction of medium height retaining walls to provide level building blocks.

3. Site

Lots 5 – 8 are located on the south side of Kerosene Lane, some 500 metres east of Mandurah Rd at its mid-point, and some 2.4km west of Baldivis Rd. The land is currently uncleared, with lots 5 and 7 having residences and sheds.

Kerosene Lane abutting the site on the north is a rural road, generally with an 8 metre wide seal, no kerbing nor formal drainage. This is the only access to the site at present.

Generally the land is undulating, falling steeply to the south off Kerosene Lane from a high point of RL 22m AHD at the north-west corner to a low area at RL 8m AHD at the south east corner.

The geology of the land is described by the Environmental Geology Map of the Geological Survey of WA, as “S7 being sand derived from Tamala Limestone, and “LS1” Tamala Limestone, both of which are described as being suitable for urbanization.

The site is adjacent, on its eastern side, to a new subdivision (Paradiso Estate) which will extend to the eastern boundary of the site in the near future. This development will extend all services through to the site. To the west and south is another development site which is undergoing design (lots 9 and 302).

The existing buildings on lots 5 and 7 are serviced with septic tanks for site waste water disposal and roof tanks and groundwater bores for water supply. Power and telephone services are located in Kerosene Lane and are connected to each site.

Just east of the eastern boundary of the site is the APA Gas Pipeline, which is a high pressure ethane gas trunk pipeline placed within an easement within the Paradiso Estate. This pipeline has a mandatory buffer to any residential house of 32 metres. Provision has been made in the planning to allow for this, with POS and a road reserve located alongside the pipeline.

4. Development Proposal

It is proposed to develop the land as a 135 lot residential subdivision. The development will be provided with all normal services, with links to the abutting development on the east of the site for sewer, water, power, roads, gas and telephone services, with all drainage to be retained on site using best management practices. The development will have one road connection to the eastern development (Paradiso Estate) and two to Kerosene Lane.

Water Corporation sewer and water services exist in the abutting new development on the eastern boundary of the site, and connection will be made to them in Maranca St where convenient and as approved by the Water Corporation. Water Corporation policy requires developers to extend sewer and water services to the boundary when further extension is planned. Fill will be required to provide cover to the sewer extension across the southern portion of lots 5 and 6. This sewer will also connect to the adjacent new development on lots 302 and lot 9 south and west of the site.

The development will entail earthworks to provide level, free draining building blocks with extensive low height retaining walls, given the undulating site. Lots abutting

Kerosene lane will be constructed to the same level as Kerosene lane to provide proper amenity and outlook.

Drainage will be managed by on-site drainage swales to be located at the lowest points of the site as detailed by the drainage catchments and LWMS. All residential storm runoff will be directed to individual lot on-site soakage.

The development will allow provision for the implementation of the NBN network.

5. Earthworks & Retaining Walls.

Because of the undulating nature of the site, overall earthworks will be required to provide level building blocks, thus necessitating extensive low to medium height retaining walls. No retaining wall is envisaged to be higher than three metres in height.

All retaining walls will be subject to Council building approval.

Earthworks on site will entail removal of topsoil, cut and fill, and stabilization of finished land surfaces. Some importation of fill is required to fill the low southern areas on lots 5 and 6 for sewer cover, and to lift lots abutting Kerosene Lane to the level of the road.

It is envisaged that the total site will be earthworked in one contract so as to provide efficiencies in cut to fill and imported fill operations. There is an earthworks embargo for this site during the months of November to March.

6. Roads

All roads will be constructed to City of Rockingham standards and approval, including kerbing and piped drainage plus provision of footpaths as required.

The existing Kerosene Lane is a rural road in good condition, with no kerbing or formal drainage. It will need to be upgraded with such as part of the development along the frontage of the land.

7. Drainage

The site will be self-contained as far as storm water drainage is concerned. The soil characteristics of the site will allow site soakage, based on the geology and the depth to groundwater. The whole site is contained within one drainage catchment, with low point being in the south east corner of the site. Some allowance for Kerosene Lane drainage will be made.

Storm Water design will be done to the standards of the City of Rockingham, with a storage facility to contain the 1 in 100 year storm runoff from roads located in the proposed POS in the south east corner of the site. The LWMS will detail drainage storm runoff basins.

8. Groundwater

According to the 1997 Ground Water Atlas, the groundwater level at the site is approximately RL3.5m AHD across the middle of the site, some 4.5 metres below the lowest site ground level of RL 8m AHD at the south east corner of the site. This low

area will be filled in order to provide cover for the sewer extension to a minimum of RL 10m AHD, thus providing a minimum of 6.5 metres to the groundwater level.

9. Power

It appears that sufficient power supply exists in the area to supply the development. A high and low voltage aerial power line is located along the southern verge of Kerosene Lane. It is likely this line will be relocated underground along the frontage of the site as part of the development. Underground power reticulation will also be extended from the adjacent Paradiso Estate into the development.

Lines and poles inside the lots will be removed as part of the development. Maintenance of power to occupied homes and the business occupying the next property west of the site will not be required as these residences are being removed as part of the development.

All subdivision underground power reticulation lines and transformer installations will be constructed at the cost of the developer. Transformer and switch station sites will be determined at the detailed subdivision design stage.

10. Water Supply

At present there is no public water supply to the site. The adjacent Paradiso Estate development is fully reticulated with Water Corporation mains, and these will be extended into this development, both from the internal road connection and also along Kerosene Lane. There is no high level water supply requirement in this development.

11. Sewer

The site is not currently connected to sewer.

The site can be served from the Water Corporation's Baldivis North Pump Station (WWPS) "McDonald Rd" south of the site. Connection to the existing 225mm gravity sewer in the adjacent "Paridiso Estate" subdivision along the future Maranca St will allow the site to be served by this pump station, with the proviso that fill is placed to provide cover to the sewer.

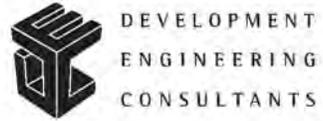
Water Corporation planning shows that the site is contained within the catchment of this WWPS.

12. Telephone & NBN

Telstra services exist in the area along Kerosene Lane and in the adjacent Paradiso Estate subdivision. These are most likely to be able to be extended to service this proposed development. Some upgrading may be required.

If Telstra is to be the servicing authority, Telstra normally requires twelve months' notice of development starting to ascertain any upgrading requirements.

In accordance with recent requirements, the developer is required to install NBN "pipe and pit" to allow for future installation of cables for the NBN. The design of the "pipe & pit" is the responsibility of the developer, and will be designed in conjunction with the underground power network, and installed during the construction phase of the development.



13. Gas

Gas mains are installed in this area in the abutting subdivision. Gas will be extended to this development by ATCO in the normal way, with trenching done by the developer.

DEVELOPMENT ENGINEERING CONSULTANTS PTY LTD

THIS REPORT IS DATED 7TH OCTOBER 2015.

APPENDIX 9 PRE-LODGEMENT CONSULTATION

PRE-LODGEMENT CONSULTATION

AGENCY	DATE OF CONSULTATION	METHOD OF CONSULTATION	SUMMARY OF OUTCOME
City of Rockingham	Circa 05/2015 – 09/2015	Meetings/Telephone/Emails	<p>Preparation of SP required prior to subdivision approval. SP lodgement post new Plannign Regulations operational date so SP to follow new format.</p> <p>An east-west collector road to be provided as extension of 17.9m NC road from Paradiso Estate connecting with Kerosene Lane.</p> <p>The proposed road layout in the SCP was generally supported 'in-principle', however City officers indicated design should try and retain as many significant trees as possible.</p>
Western Power	During 2015	Email/telephone discussion	SP development area can be connected to reticulated power supply.
Water Corporation	During 2015	Email/telephone discussion	SP development area can be connected to reticulated water and sewer.
Landowner Lot 9 & 302	During 2015	Meetings/telephone/emails	Agreement as to SCP interface with Lots 9 & 302 allowing for future road connections, location of POS and provision of servicing and infrastructure for urban development of Lots 9 & 302.