CHALLENGER PRECINCT STRUCTURE PLAN

PART 1: STATUTORY SECTION

LOT E26 GILMORE AVENUE & LOTS 303 & 9036 WELLARD ROAD KWINANA TOWN CENTRE

CITY OF KWINANA

Version 5 - MARCH 2014

PREPARED BY:

burgess design group
TOWN PLANNING + URBAN DESIGN

ENDORSEMENT PAGE

This structure plan is prepared under the provisions of the City of Kwinana Town Planning Scheme No. 2

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

2013

In accordance with Schedule 2, Part 4, Clause 28 (2) and refer to Part 1, 2. (b) of the *Planning and Development (Local Planning Schemes) Regulations 2015.*

Date of Expiry: **19 OCTOBER 2030**

Lot E26 Gilmore Avenue and Lots 303 & 9036 Wellard Road, Kwinana Town Centre

City of Kwinana

PART 1 – STATUTORY SECTION

CHALLENGER PRECINCT (E26) LOCAL STRUCTURE PLAN

Issue 5: March 2014

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City of Kwinana

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3	22/02/2013	JB	JD
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Table 1 :
Record Of Modifications To Part One And Structure Plan Map

Modification No.	Description Of Modification	Date of Council Approval	Date Endorsed by WAPC

EXECUTIVE SUMMARY

This Local Structure Plan report and accompanying map relates to that portion of land identified as the Kwinana Town Centre 'Ancillary Use Policy Area Precinct', under the City of Kwinana's Town Planning Scheme No. 2. The structure plan has been prepared to satisfy the City of Kwinana's Scheme requirements and the development objectives of the Kwinana Town Centre Master Plan and Design Guidelines, with respect to local structure plans being in place prior to substantive subdivision and development. In addition, this report confirms that the LSP reflects the policy and statutory planning requirements of the Western Australian Planning Commission.

The plan has been based on sustainable and contemporary planning principles with emphasis on promoting community health and physical activity through a permeable, legible and logical road network and assists in the activation of the Kwinana Town Centre by supporting bus routes and providing direct access to the nearby Wellard train station. The plan promotes walking and cycling within and to key destinations, as well as via the well-placed and sizeable open spaces that form the heart of the site and offer a great asset for future residents. The over provision of public open space and the allocation of extra width road reserves has also been a key feature of the planning process in an attempt to retain existing vegetation, both for landscape amenity and for environmental conservation purposes.

The interface treatments with adjoining land holdings, as proposed by the plan, are consistent with the Kwinana Master Plan and reinforce existing facilities in the Town Centre such as the shopping centre, high school and playing fields to the north. Overall, the Structure Plan ensures a coordinated and integrated approach to planning in Kwinana that will result in the introduction of a great range of new housing products that cater to ever diversifying household structures and living arrangements. The Structure Plan also recognises the site's key strategic identity in the broader metropolitan region as also emphasised in Directions 2031.

Furthermore, it is important to acknowledge the highly collaborative approach taken to the preparation of this Local Structure Plan. The ongoing and active inputs of City of Kwinana officers and elected members have contributed considerably to the submission of a comprehensive and highly scrutinised Structure Plan that will complement and enhance the ongoing developments of the Kwinana Town Centre.

Table 2 : Structure Plan Summary Table		
Item	**Data**	**Section Number referenced in Part 2**
Total area covered by the Structure Plan:	36.85 ha	1.2.2
Net Subdivisible Area	36.1906 ha	FIGURE 9
Area of each land use proposed: - Residential (inc roads) - Mixed Use (excl Strategic Precinct) - Strategic Site - Unrestricted POS - Restricted POS - Dedicated Drainage Reserves	 21.5808 ha 0.5032 ha 3.4065 ha 6.6762 ha (18.4%) 1.2387 ha 0.6594 ha	 3.3 3.4 3.5 3.2 / Figure 9 3.2 / Figure 9
Estimated Lot Yield:	482	3.3.1
Estimated Number of Dwellings:	916	3.3.1
Estimated Residential Site Density:	32 dwellings /gross ha	3.3.1
Estimated Population:	1941 people	3.3.1
Number of High Schools:	Nil	2.6.2 / 3.9
Number of Primary Schools:	Nil	2.6.2 / 3.9
Estimated Commercial Floor Space:	Commercial uses only permitted within Mixed Use zone: - Up to 4032m² NLA 'Shop' use permitted. - No m² NLA cap for non 'shop' commercial uses, except that must be contained on ground floor and/or first floor of mixed use development.	3.10
Estimate number and area of Local Parks	6 Local Parks and 5 landscape strips totalling 7.9140 ha (21.5%) creditable POS.	3.2 / Figure 9 /Appendix 5

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LIST OF PLANS

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1. STRUCTURE PLAN APPLICATION AREA

This Structure Plan shall apply to:

- Lot E26 on Deposited Plan 214425 Vol: 2157 Fol: 159
- Lot 303 on Deposited Plan 47729 Vol: LR3137 Fol: 321
- Lot 9036 (Balance Title) on Deposited Plan 75365 Vol: 2806 Fol: 173; and
- A portion of the old Wellard Road alignment, which is to be closed.

The Structure Plan area (subject land) comprises a total area of approximately 36.85 hectares and is bound by Challenger Avenue to the north, Meares Avenue to the east, Wellard Avenue to the south and Gilmore Avenue to the west, being the land contained within the inner edge of the line denoting the structure plan boundary as shown on the Structure Plan Map (Figure 1).

The subject land is located approximately 34 kilometres south of the Perth Central Business Area and immediately south of the existing Kwinana Town Centre Market Place (See Figures 1 and 2).

2. STRUCTURE PLAN CONTENT

This Structure Plan comprises:

a) Part One – Statutory Section
This section contains the structure plan map and statutory planning provisions and requirements.

b) Part Two – Non-Statutory (Explanatory) Information
This section is to be used as a reference guide to interpret and justify the implementation of Part One.

c) Appendices – technical reports, plans, maps and supporting documents.

3. INTERPRETATION AND RELATIONSHIP TO THE SCHEME

Unless otherwise specified in this part, the words and expressions used in this Structure Plan shall have the respective meanings given to them in the City of Kwinana's Town Planning Scheme No.2 (TPS 2) (the Scheme) including any amendments gazetted thereto.

The Local Structure Plan Map (Figure 1) outlines land use, zones and reserves applicable within the structure plan area. The zones and reserves designated under this Local Structure Plan apply to the land as if the zones and reserves were incorporated into the Scheme.

Pursuant to clause 6.17.7.3 of the Scheme:

a) The provisions, standards and requirements specified under Part One of this Structure Plan shall have the same force and effect as if it were a provision, standard or requirement of the Scheme. In the event of there being any variations or conflict between the provisions, standards or requirements of the Scheme and the provisions, standards or requirements of this Structure Plan, then the provisions, standards or requirements of the scheme shall prevail to the extent of any inconsistencies.

Any other provision, standard or requirement of Part One of the Structure Plan that is not otherwise contained in the Scheme, shall apply to the structure plan area as though it is incorporated into the Scheme, and shall be binding and enforceable to the same extent as if part of the Scheme; and

Part Two of this Structure Plan and all appendices are to be used as a reference only to clarify and guide interpretation and implementation of Part One.

4. OPERATION

In accordance with clause 6.3 'Policies' and 6.5 'Division 2 – Kwinana Town Centre' of TPS2, the land subject to this Structure Plan falls within the 'Kwinana Town Centre - Ancillary Use Precinct' of Policy Area 20 and requires an overall use and development control plan to be prepared and approved by Council prior to subdivision and development. This Structure Plan has therefore been prepared in response to this requirement of the Scheme and will enable development to commence in accordance with the current provisions of TPS2.

This Structure Plan shall come into operation upon gazettal of Scheme Amendment 140 to Town Planning Scheme No.2 which will enable the operation of a Structure Plan within the Kwinana Town Centre Zone. Until such time as Amendment 140 is gazetted, this Structure Plan will enable subdivision and development to commence in accordance with the existing provisions of Town Planning Scheme No.2.

This Local Structure Plan has been prepared in accordance with the WAPC *Structure Plan Guidelines (August 2012)* which enables broad residential density ranges to apply to specific areas within the Structure Plan.

As a normal progression of subdivision, the Lot-specific residential densities within the defined residential density ranges are to be subsequently assigned in accordance with a Residential Code Plan. The R-Code Plan will be required to be approved by the WAPC at time of subdivision and shall indicate the R-Code applicable to each lot within the subdivision. This will be required for all subdivision applications within the subject site.

5. LAND USE AND SUBDIVISION

The Structure Plan Map outlines land use, zones and reserves applicable within the Structure Plan area. The zones and reserves designated under this Structure Plan apply to the land within it as if the zones and reserves were incorporated into the Scheme.

5.1 Land Use Permissibility

Land use permissibility within the Structure Plan area shall be in accordance with the corresponding zone or reserve under the Scheme.

5.2 Land Use Zones that are not prescribed by the Scheme

The following land use zone(s) are not prescribed by the Scheme but are to be enforced through the Structure Plan as if those zone(s) were incorporated into the Scheme:

5.2.1 'Mixed Use' Zone

The objectives of the Mixed Use zone are:

a) To provide for a wide variety of active uses at street level which contribute towards a vibrant and active street and which are compatible with residential and other non-active uses on upper levels.

b) To ensure an appropriate transition of commercial to residential land uses and provide an acceptable interface with existing development.

c) To facilitate the creation of local employment, so as to reduce the demand for travel and enhance the level of self-sufficiency.

d) To ensure a high standard of design that mitigates issues such as noise, smell and vibration that may arise in mixed use developments.

Land within the Mixed Use zone may be used for the purposes specified below in Table 3 of this LSP, as if the table was incorporated into Table 1 of the Scheme:

Table 3 – Mixed Use Zone Land Use Permissibility	
USE CLASSES	**MIXED USE ZONE**
Ancillary Accommodation	X
Aged and/or dependant persons dwelling	P(3)(4)
Aged and/or Dependent Persons Accommodation	X
Amenity Building	AA(2)
Amusement Centre	AA(2)
Aquaculture	X
Boatel	X
Boat Sales	X
Bus Station	X
Caravan Park	X
Caretaker's House/Flat	IP (3)(4)
Car Park	SA(2)(3)
Chicken Farm	X
Child Care Centre	P(2)
Civic Building	P(2)
Club	P(2)
Commercial Hall	P(2)
Consulting Rooms	P(2)
Dog Kennel	X
Drive-In Take Away Food Shop	X
Drive-In Theatre	X
Dry Cleaning Premises	SA(2)
Eating House	P(2)
Educational Establishment	AA(2)
Equestrian Uses	X
Extractive Industry	X
Factory Units	X
Family Day Care Centre	AA(3)
Fish Shop	AA(2)
Forestry (Selective)	X
Fuel Depot	X
Funeral Parlour	AA(2)
General Industry	X
Grouped Dwelling	X
Hazardous Industry	X
Health Studio	P(2)
Holiday Accommodation	AA (4)
Home Occupation	AA
Hospital	P(2)
Hotel	SA (4)
Intensive Agriculture	X
Laundry (Laundrette)	P(2)
Licenced Restaurant	P(2)

Table 3 – Mixed Use Zone Land Use Permissibility	
USE CLASSES	**MIXED USE ZONE**
Light Industry	X
Liquor Store	AA(2)
Local Shop	P(2)
Lodging House	SA(3)(4)
Marina	X
Medical Clinic	AA(2)
Motel	SA (4)
Motor Racing Track	X
Motor Repair Station	X
Multiple Dwelling	P(3)(4)
Museum	P(2)
Non-Residential Health Centre	AA
Noxious Industry	X
Office	P(2)
Open Air Display	X
Open Air Storage Yard	X
Petrol Filling Station	X
Piggery	X
Private Hotel	AA(4)
Private Recreation	AA
Private Utility	AA
Professional Office	P(2)
Public Amusement	AA(2)
Public Assembly – Place of Worship	SA(2)
Public Recreation	P(2)
Public Utility	P(2)
Public Worship	SA(2)
Recreational Facilities	P(2)
Residential Building	P(3)(4)
Restricted Premises	SA(2)
Retail Plant Nurseries	X
Rural Industry	X
Rural Produce Stall	X
Service Industry	AA(2)
Service Station	X
Shop	P(2)(5)
Showroom	P(2)
Single House	X
Stables	X
Tailing Pond	X
Tavern	AA(2)
Telecommunications Infrastructure	SA
Trade Display	P(2)
Transport Depot	X

Table 3 – Mixed Use Zone Land Use Permissibility	
USE CLASSES	**MIXED USE ZONE**
Vehicle Sales	X
Vehicle Wreckers	X
Veterinary Clinic	SA(2)
Veterinary Hospital	X
Warehouse	IP(2)

(2) Use only permitted below ground level, on the ground floor, and/or on the first floor.

(3) Use not permitted on the ground floor fronting a street.

(4) Maximum density of residential and short stay accommodation to correspond with the R-Code depicted on the on the Scheme Map or Structure Plan.

(5) The NLA of 'Shop' uses on any given lot shall not exceed a plot ratio of 0.3 in the Mixed Use Zone.

5.3 Residential

5.3.1 Density

The Structure Plan is comprised of a range of residential densities from medium density (R25, R30 and R60) single residential allotments through to higher density (R60 and R80) grouped housing sites. The Structure Plan Map defines the broad residential density ranges that apply to specific areas within the Structure Plan. Lot specific residential densities within the defined residential density ranges are to be subsequently assigned in accordance with a Residential Code Plan approved by the WAPC.

A Residential Code Plan (R-Code Plan) is to be submitted at the time of subdivision to the WAPC and shall indicate the R-Code applicable to each lot within the subdivision.

The WAPC may approve a variation to an R-Code Plan when the variation is consistent with the Locational and Density Criteria detailed herein. Any revised R-Code Plan will, at the time of approval, replace wholly or partially the previously approved Residential Density Code Plan, and shall then form part of the Structure Plan as outlined above.

R-Code Plans are not required if the WAPC considers that the subdivision is for one or more of the following:

a) The amalgamation of lots;

b) Consolidation of land for "superlot" purposes to facilitate land assembly for future development;

c) The purposes of facilitating the provision of access, services or infrastructure; or

d) Land which by virtue of its zoning or reservation under the Structure Plan cannot be developed for residential purposes.

All R-Code Plans must:

a) Be consistent with the Residential Density Ranges identified on the Structure Plan Map;

b) Be consistent with the Locational Criteria detailed below.

c) Demonstrate that the proposal complies with a maximum average per lot density of 500m^2; and,

d) Include a summary of the proposed dwelling yield of the subdivision.

5.3.2 Locational Criteria

Lots overall have been orientated such that they would provide effective surveillance of (and achieve an effective relationship with) public/community areas such as the streets, existing bus stops and local parks both within and abutting the subject area. The allocation of residential densities on the Residential Code Plan shall however, be in accordance with the following criteria:

Low Density Residential (R25)

a) A base residential density code of R25 applies to all low density single residential lots.

b) Low density single residential corner lots may be developed to a residential density code of R30.

Medium Density Residential (R30-R60 Range)

a) A base residential density code of R30 applies to all medium density single residential lots.

b) Medium density single residential lots with access to a public laneway may be developed to a residential density code of up to R60.

Medium-High Density Residential (R60-R80)

a) A base residential density code of R60 applies to all medium-high density grouped dwelling or multiple housing residential lots.

b) Medium-High density residential lots within the 'Strategic Precinct' may be developed to a residential density code of up to R80.

Mixed Use (R80)

a) A base residential density code of R-80 applies to all residential land uses within Mixed Use lots.

5.3.3 Dwelling Target

A key objective of the Structure Plan is to encourage a diversity of housing products. This will be achieved by ensuring a minimum number of dwellings are provided within the Structure Plan area.

The LSP intends to provide the opportunity for family sized homes, generally at R25 and R30 densities and possibly also R60 when constructed at two storey, which are either traditional design (garages on primary streets) or rear lane accessed dwellings. The inclusion of R30 and R60 densities provides the opportunity for smaller built form products suitable for smaller family structures or singles or couples. The R60 and R80 grouped housing sites provide the opportunity for either grouped or multiple dwellings.

The following tables 4A & 4B provide a summary of the residential yield, both lot yield and likely anticipated dwelling yield. For the purpose of calculating dwelling yields for the Multiple Dwelling sites, an average dwelling area of 100sqm has been applied at a Plot Ratio of 1.0.

Table 4(A) – Lot Yield Summary			
Lot Type	**Total Area (m2)**	**Average Lot / Dwelling* Size (m2)**	**Dwelling Yield**
Low Density Single Residential (R25)	8,240	350	23
Medium Density Single Residential (R30)	47,959	350	159
Medium to High Density Single Residential (R60)	76,796	180	282
Medium Density Grouped Dwellings (R60)	37,098	180 (12 lots)	136
Mixed Use site (R80)	5,036	100* (1 lot)	50
DWELLING YIELD			**650**
Strategic Site (R80)	26,658	100* (5 lots)	266
TOTAL YIELD			**916**

Table 4(B) – Dwelling Target	
Dwelling Type	**Minimum number of Dwelling**
Single Residential	464 Dwellings
Grouped Residential	136 Dwellings
Multiple Residential inc. Mixed Use	316 Dwellings
TOTAL	**916 Dwellings**

5.4 Commercial

The following provisions relate to commercial development:

a) Commercial floor space may be provided below natural ground level, on the ground floor, and/or on the first floor of Mixed Use zoned land only when residential and/or short term residential land uses are provided on the first floor and above.

b) For the purposes of 5.4 a) above, residential and short term accommodation include the following land uses: Aged and/or Dependant Persons Dwelling; Caretakers House/Flat; Holliday Accommodation; Hotel; Lodging House; Motel; Multiple Dwelling; Private Hotel; and, Residential Building.

c) All land uses not listed in 5.4 b) above, and designated as P, AA, SA and/or IP in Table 3 (land use permissibility table) are classified as 'Commercial' land uses.

d) The maximum NLA for 'Shop' uses within the Mixed Use zone may be exceeded through a Local Development Plan for the entire centre where the requirements of State Planning Policy 4.2 Activity Centres for Perth and Peel are met to the satisfaction of the WAPC and the City of Kwinana.

5.5 Public Open Space

Public open space is to be provided generally in accordance with the Structure Plan Map and/or with an updated public open space schedule to be provided at the time of subdivision for determination by the WAPC, upon the advice of the City of Kwinana.

The Structure Plan provides a minimum of 15% Public Open Space in accordance with the Kwinana Town Centre Master Plan and in excess of the 10% minimum creditable Public Open Space required by Liveable Neighbourhoods.

A total of 21% of POS is being provided for within the Structure Plan.

A Landscape Strategy and Master Plan has been provided as an appendix to this Structure Plan to guide the development of Public Open Space and Streetscape areas, with a key objective being to retain significant trees where possible. Tree retention will occur in the POS areas and road reserves wherever possible.

5.6 Reports/Strategies Required Prior to Subdivision

There are no reports/strategies, other than those already provided for in this Structure Plan, required prior to the lodgement of subdivision applications to the WAPC.

5.7 Conditions of Subdivision Approval

At the time of subdivision the City of Kwinana may recommend conditions to the WAPC as applicable, requiring the preparation and/or implementation of the following:

a) Urban Water Management Plan(s);

b) Fire Management Plan(s);

c) Local Development Plans (where appropriate) and Design Guidelines;

d) Remnant Vegetation Maintenance and Management Plan;

e) Fauna Management Plan (if appropriate);

f) Public Open Space and Road Verges – Design, Maintenance and Management Plan;

g) Acid Sulphate Soil Investigations and Management Plan (if applicable);

h) Stakeholder and Construction Management Plan;

i) Other detailed engineering designs (as required by the City of Kwinana); and,

j) Maintenance periods are to be as negotiated with the City of Kwinana.

6. DEVELOPMENT REQUIREMENTS

6.1 Local Development Plans (referred to as Detailed Area Plans in the Scheme)

Local Development Plans must to be prepared in accordance with clause 6.17.6 of the Scheme prior to any subdivision and/or development of:

a) Grouped/multiple housing sites;

b) Lots that abut a public laneway;

c) Lots that abut public open space;

d) Lots within the Mixed Use Zone; and/or

e) Lots with an area less than 260m².

Design Guidelines are to be prepared to guide development with regard to built form, materials, colours, landscaping, amenity, orientation and the appropriate placement of infrastructure.

6.2 Residential Design Code Variations

Variations to the Acceptable Development Criteria of the R-Codes may be detailed at the Local Development Plan or subdivision stages of the development approval process.

6.3 Development Requirements for Mixed Use Development

When developing a Mixed Use zoned site, the requirements set out under Table 5 must be met in addition to any other general planning matters specified in the Scheme, under this Structure Plan, or on in any subsequent Local Development Plan.

Table 5 Minimum Development Requirements for Mixed Use Development	
Heights	The maximum height shall be as follows: • Top of External Wall 16 metres; • Top of External Wall (Concealed Roof) 17.5m; • Top of Pitched Roof 19m; • The wall height is determined by the maximum height specified by the R-Code applicable to that land plus additional height for any commercial land uses on the ground floor.
Street Setbacks	• All buildings must be setback a minimum 2m, to a maximum of 3m, from primary and secondary streets.
Side and rear setbacks	• A minimum 0m side and rear setback applies. • All development must have nil setbacks to the side boundary on the ground and first floor for a depth of at least 20m as measured from the street boundary. • The side and rear setbacks for residential and short term accommodation components of any mixed use development must comply with the setback requirements as specified in the R-Codes.
Car parking	• Car parking must not be visible from the primary street.
Façades	• A minimum 75% of the ground floor street frontage must be glazed. • The façade of development above the first floor must be articulated to break up the bulk of the building.
Balconies	• Balconies may have a nil setback to the primary or secondary street. • Balcony balustrades must be at least 50% visually permeable.
Development within the Setback Area	• Minor projections are permitted within the street setback area. • The ground floor setback area must be paved and/or landscaped between the building line and the road reserve to the satisfaction of the City. • Awnings, canopies and/or pedestrian shelters, of a minimum width of 2.0m, must be provided along the whole length of the ground floor frontage (ie, from side boundary to side boundary along the street frontage). • Fencing within the street setback area is not permitted.
Plot ratio	The following plot ratios shall not be exceeded; **Use** **Plot Ratio** Shop * 0.3 Office 2.0 Showroom 1.5 Service Industry 1.5 *Up to 4032m^2 NLA of 'Shop' uses permitted on any given lot Residential uses in accordance with Residential Design Codes of WA. Other uses as determined by Council.

7. OTHER REQUIREMENTS

7.1 Bush Fire Prone Area

The subject land comprises land which is abutting, or adjacent to existing and proposed areas of Public Open Space and local reserves. As such, the subject land is hereby declared as a Bush Fire Prone Area and is subject, or likely to be subject, to bush fires.

Those lots abutting or adjacent to areas of Public Open Space and Reserves which contain retained bushland must not be approved by the City until a fire management plan for the land has been prepared and approved. Development on lots within 100m of land identified as being of a Moderate or Extreme risk under the Bush Fire Hazard Assessment carried out as part of this Structure Plan or at future planning stages (subdivision and development stages), will be subject to comply with the current Australian Standard (AS) for development within Bush Fire Prone Areas, being AS3959.

A notification is further required on the Title to all those lots within 100m of a classified hazard and within the Structure Plan area, as determined by the approved Fire Management Plan, and which shall state:

a) This land is subject, or likely to be subject to bush fires.

b) A Bushfire Management Plan applies to this land.

c) All construction is to comply with the Australian Standard relevant to bush fire attack levels and minimum constructions standards (Currently AS 3959 -2009).

7.2 Development Requirements for land within the 'Strategic Precinct'

The Strategic Precinct shall not be developed for any purpose until such time as 5 years has elapsed from the commencement of development within the Structure Plan area in accordance with the Structure Plan Map.

7.3 Significant Tree Retention

Prior to any earthworks commencing or City approval of detailed Landscaping Designs, on-site investigations into the retention of significant trees will be carried out in consultation with City Officers. These investigations will be required to identify those trees worthy and capable of being retained on-site, within road reserves and within areas of Public Open Space. The retention of trees will be in accordance with current AS4970 'Retention of Trees on Development Sites', or subject to an Arborist assessment.

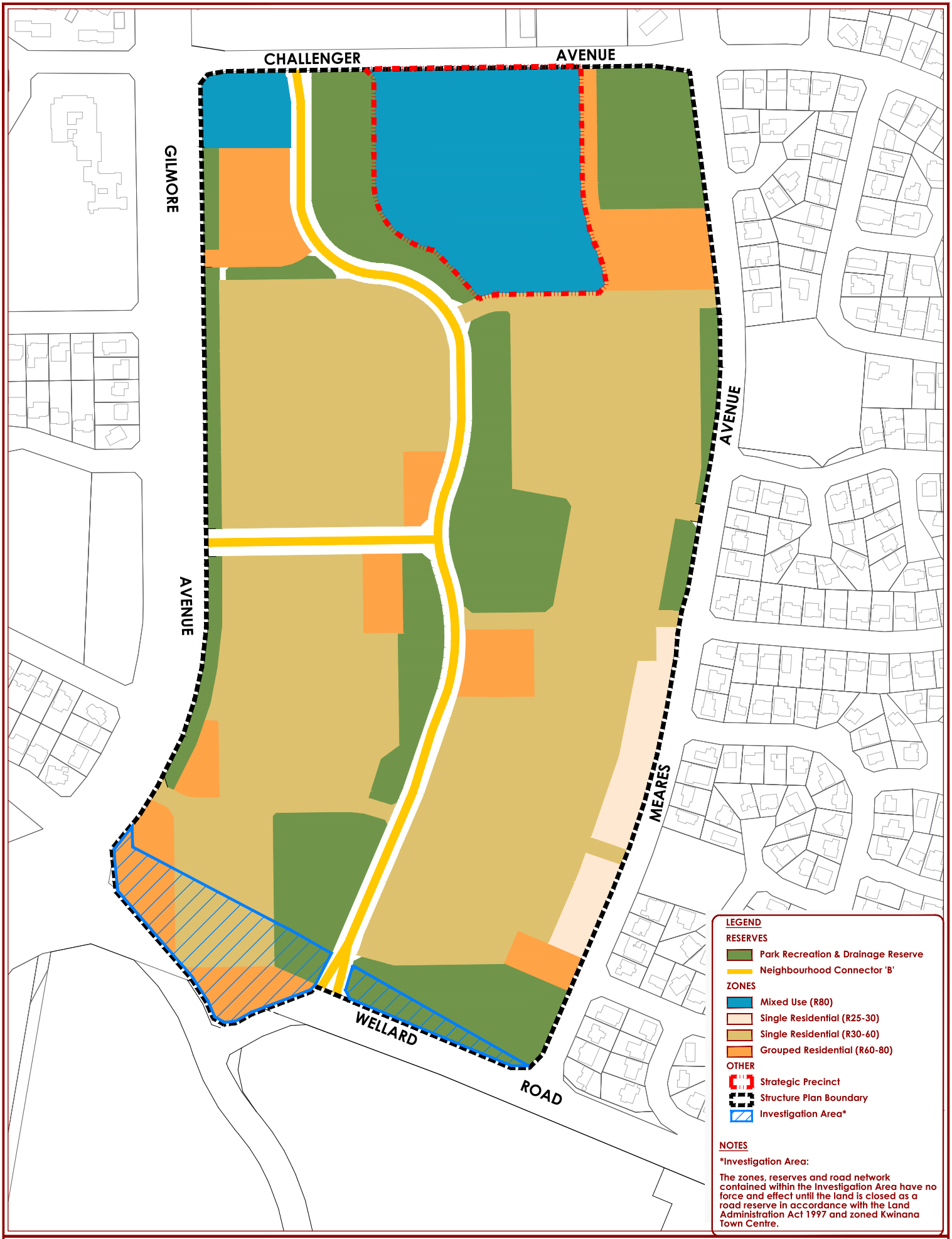
7.4 Development Contributions

The structure plan area falls within the Development Contribution Special Control Area No. 15 "Townsite". As such contributions towards infrastructure shall be in accordance with the relevant Development Contribution Plan as set out under Schedule V of the City's TPS No.2

Further contributions towards the City of Kwinana Mosquito Monitoring Program may also be required as a result of the potential "off-site" mosquito problem in accordance with the requirements of the Environmental Protection Authority Guidance Statement No.40 Management of Mosquitoes by Land Developers.

Figure 1

Structure Plan Map



STATUTORY STRUCTURE PLAN MAP

LOTS E26, 303 & 9036 GILMORE RD & PT CLOSED WELLARD RD

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CITY OF KWINANA

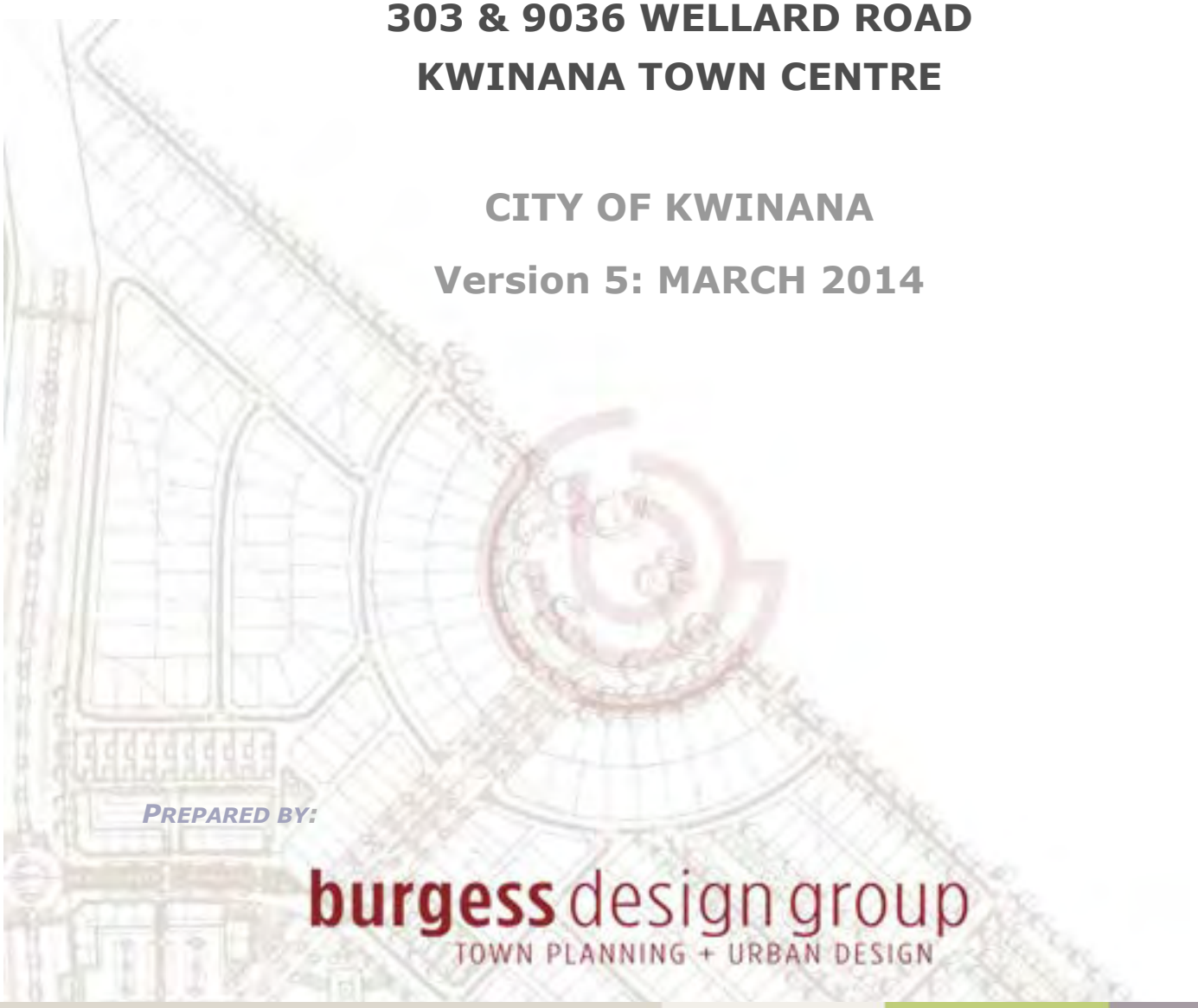
CHALLENGER PRECINCT STRUCTURE PLAN

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LOT E26 GILMORE AVENUE & LOTS 303 & 9036 WELLARD ROAD KWINANA TOWN CENTRE

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City of Kwinana

PART 2 – EXPLANATORY SECTION

CHALLENGER PRECINCT
LOCAL STRUCTURE PLAN

Issue 5: March 2014

Prepared for: **Satterley Property Group**
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1 PLANNING BACKGROUND

1.1 Introduction and Purpose

Burgess Design Group has been engaged by Satterley Property Group, as Project Manager on behalf of the Department of Housing, to prepare a Local Structure Plan (LSP) over Lot E26 Gilmore Avenue and Lots 303 & 9026 Wellard Road, Kwinana Town Centre, as well as a portion of closed road at the southern extent of the site, being the old Wellard Road alignment (Subject Land).

The LSP has been prepared in conjunction with the City of Kwinana through a collaborative design process over the past several years.

An endorsed LSP will satisfy the City of Kwinana's requirement for an overall use and development control plan being approved for the site as set out under its' Town Planning Scheme No. 2. The Scheme sets out the matters to be addressed in local structure plans and this LSP report and accompanying plan have been prepared in a manner that fully and sufficiently responds to these matters.

Further, this report confirms that the LSP reflects the policy and statutory planning requirements of both Council and the Western Australian Planning Commission. The plan is based on contemporary planning principles facilitating the creation of a sustainable, active and engaging community environment in the context of the broader development of Kwinana as a secondary centre.

1.2 Land Description

1.2.1 Location

The subject land is bounded by Challenger Avenue to the north, Meares Avenue to the east, Wellard Avenue to the south and Gilmore Avenue to the west. It is located approximately 34 kilometres south of the Perth Central Business Area and immediately south of the existing Kwinana Market Place. A Location Plan is provided at Figure 2.

1.2.2 Area and Land Use

The subject land comprises a total area of approximately 36.85 hectares. It is zoned for urban land uses under the Metropolitan Region Scheme and for Town Centre ancillary uses under the subsequent Town Planning Scheme.

The majority of the subject land is comprised of uncleared bushland. A small portion of the site on the eastern boundary has been cleared and fenced for Water Corporation sewerage infrastructure.

An aerial photograph is provided at Figure 3 which depicts the extent of bushland coverage across the site and an indication of pre-development contours.

1.2.3 Legal Description and Ownership

The subject land comprises three allotments that can be legally described as:

- Lot E26 on Deposited Plan 214425 Vol: 2157 Fol: 159
- Lot 303 on Deposited Plan 47729 Vol: LR3137 Fol: 321
- Lot 9036 on Deposited Plan 5862 Vol: 2695 Fol: 882

A copy of the Certificate of Title's for the lots within the Structure Plan area are attached at Appendix 1.

In addition to the abovementioned lots, a portion of closed road at the southern extent of the site, being the old Wellard Road alignment, also falls within the subject area.

Lots E26 and 9036 are owned by the State Housing Commission and Lot 303 is reserved for the purposes of recreation under the management order of the City of Kwinana. The subject land also incorporates a small portion of Road Reserve for Wellard Road. It is proposed that a separate application be made under the Land Administration Act 1997 to facilitate the necessary partial road closure.

1.2.4 Site History

As a result of a review of historical aerial photographs, title information and various discussions with local government officers, the main findings of the site history are:

- The subject land has not been significantly cleared since 1953;
- The subject land has remained in the ownership of the State Housing Commission since the Crown granted it the parcel of land know as Kwinana Lot E26 in 1979;
- A portion of the land on the eastern boundary was transferred to the former Water Authority of Western Australia for sewerage infrastructure purposes in 1987;
- The subject land appears to be used as an area for road drainage and nearby shopping centre car park drainage;
- The subject land has been used for illegal dumping and experiences frequent fires and significant weed invasion; and,
- The informal pathways through the site are currently used by school children (walking and on bikes) and other members of the general public.

1.3 Planning Framework

1.3.1 Zoning and Reservations

The subject land is currently zoned 'Urban' under the Metropolitan Region Scheme and 'Kwinana Town Centre' under the City of Kwinana's Town Planning Scheme No.2 (TPS 2). The subject land is also identified as 'Policy Area 20' and directly abuts an 'Other Regional Road' reservation (Gilmore Avenue). The most south western strip of the subject land is not included within a zone, being old road reserve, and as such is identified as 'No Zone' under TPS 2 (see Figures 4 & 5).

As per Table 1 of TPS 2, a range of different land uses are permissible within the Kwinana Town Centre zone, including Single Houses, Grouped Dwellings, Multiple Dwellings, Shops and Offices as may be envisaged within the land use categories shown on the proposed Structure Plan.

Clause 6.5 of TPS 2 provide further guidance on statutory matters within the Kwinana Town Centre zone, including broad objectives, plot ratios, car parking and site coverage provisions. Clauses 6.4.3 and 6.5.3 of TPS 2 currently limits residential development to a density of R40 and does not contemplate mixed use development.

In addition to the above, Clause 4.3 of TPS 2 includes the subject land and adjoining town centre land parcels within "Policy Area 20" which is further divided into precincts. The subject land is located in the "Town Centre Ancillary Use Precinct" within which uses ancillary and complementary to district centre functions are to be promoted. Further, an overall use and development control plan approved by Council is required prior to subdivision and development.

The Structure Plan responds to Policy Area 20 by providing an overall Development Concept as the basis to enable development to commence. The intention is that the Structure Plan will guide the initial development of the site and provide the basis for amending TPS 2 which would then allow residential densities above R40 and mixed use development to proceed.

1.3.2 Strategic Planning

1.3.2.1 Directions 2031 and Beyond:

This strategic plan recognises the benefits of a more consolidated city and sets realistic goals to promote housing affordability and sustainable urban growth. The aims and objectives of Directions 2031 and Beyond which have been addressed in the Structure Plan include:

a) Promoting higher densities;

b) Increasing catchment populations close to activity centres;

c) Improving public transport patronage;

d) Promoting community connectivity and health particularly through paths and walk trails;

e) Protecting biodiversity and environmental significance;

f) Expanding and enhance open space networks through continued identification and management; and

g) Maximising urban infrastructure to improve efficiency of existing services; and

h) Promoting opportunities to living and work in the same community.

1.3.2.2 Outer Metropolitan Perth and Peel Sub-Regional Strategy (Draft):

The Draft Outer Metropolitan Perth and Peel Sub-Regional Strategy forms part of the implementation programme for Directions 2031 and Beyond.

The subject land is identified in the draft strategy as 'Challenger', and is an "Urban Zoned Undeveloped" site. The site is expected to provide a target dwelling yield of 500 if the development was to be fully utilised through medium to high density housing, as opposed to the 'business as usual' approach, being low density housing which will only provide an estimated dwelling yield of 300. The Structure Plan as submitted responds to this density target of 500 dwelling units by nominating a range of R Codes intended to facilitate medium to higher density houses ranging from single dwelling homes to smaller town houses, villas and 'maisonette' style homes as well as the opportunity for multiple dwelling or mixed use dwelling scenarios in the form of apartment style living.

The Structure Plan is consistent with the strategic framework and will seek to go beyond this minimum target, aiming for the provision of 650+ dwellings. The draft Strategy also re-enforces the Kwinana Town Centre as a viable Secondary Centre.

1.3.2.3 City of Kwinana's Revised Town Centre Master Plan and Design Guidelines:

The Kwinana Town Centre Master Plan and Design Guidelines ('The Master Plan') was prepared in response to the changing market conditions in and around Kwinana and the demand for new housing which is putting pressure on the Department of Housing to release land in the Challenger neighbourhood. Following the Town Centre Master Plan Workshop in 2005 a set of 11 key design principles were established to guide the development of a more detailed Conceptual Plan. This Concept Plan has been endorsed by Council as an overall framework for development of the Town Centre and is the basis for the design guideline.

The Master Plan Concept Plan is provided at Figure 6.

The key objectives of the Master Plan Challenger Neighbourhood Precinct are:

- To expand the range of in-town housing choices in Kwinana and increase the number of residents within the trade area of the central retail and entertainment uses of the town centre;
- To develop the area in an environmentally sensitive manner that integrates development into the natural bushland quality of the site;
- To tie the development into the fabric of existing neighbourhoods; and
- To reserve a site of approximately 4 hectares for strategic development opportunities of various kinds.

In preparing the Local Structure Plan, the Master Plan' objectives, aims and principles were all considered and provided the framework for allocating land uses, residential densities, road connections and references to public open spaces.

Elements such as land use (particularly allowing for mixed use and encouraging home-based business), residential density variety, road layout (including design widths) and the interface with existing development have all been carefully considered and the overall objectives of the Master Plan incorporated into the Structure Plan in this regard. Key design elements which have been retained in the Structure Plan include:

a) A strong north to south spine running through the centre of the site;

b) The provision of at least 15% public open space and the retention of key vegetation;

c) A large strategic precinct to provide for a variety of future land uses;

d) Various housing types, including single, grouped and multiple dwellings;

e) Mixed use development along Challenger Avenue and within the strategic precinct; and,

f) Lower density development along Meares avenue.

Importantly, it was also accepted through the extensive and highly collaborative design process, that various elements identified in the Master Plan Design Guidelines would be refined through the detailed structure plan preparation process.

1.3.3 State Planning Policies

1.3.3.1 State Planning Policy 1 – State Planning Framework Policy (SPP 1)

SPP 1 sets out the key principles relating to environment, community, economy, infrastructure and regional development which guide the way in

which planning decisions are made for sustainable land use and development. In relation to the planning and development of the subject land, the following key principles of SPP 1 have been considered:

a) Environment –by promoting the conservation of ecological systems and the biodiversity they support through the provision of appropriately sited public open space to enable the conservation of existing remnant vegetation on site.

b) Community – by accommodating future population growth and providing housing choice and diversity to suit the needs of different households. This will be achieved through the provision of a range of housing densities and lot types. The structure plan also provides for higher density development closer to the Kwinana Market Place and Bus Station, which will reduce the need for private transport, promote the use of public transport and reduce the dependence on private cars.

c) Economy – by promoting local employment opportunities in order to reduce the time and cost of travel to work, the site's location in close proximity to Kwinana Hub Shopping Centre and to access to key public transport nodes (such as the Kwinana Bus Station and the Kwinana and Wellard Train Stations) ensures future residents are afforded adequate access to a variety of employment opportunities. Furthermore, the inclusion of Mixed Use zones will enable local employment opportunities within the development; and,

d) Infrastructure – by facilitating the efficient use of existing urban infrastructure and human services and preventing development in areas which are not well serviced, where services and facilities are difficult to provide economically and which creates unnecessary demands for infrastructure and human services. The subject land is ideally situated in a location that is readily serviced by water, sewer, gas, electricity and telecommunications infrastructure.

1.3.3.2 State Planning Policy 3 – Urban Growth and Settlement Policy (SPP 3)

The overall aim of SPP 3 is to facilitate sustainable patterns of urban growth and settlement to facilitate growth and change throughout the state.

The Structure Plan addresses these aims by:

a) providing a variety and choice in the size, type and affordability of housing to support a range of household sizes, ages and incomes;

b) providing affordable land for housing;

c) directing urban expansion into areas which are well serviced by employment and public transport;

d) supporting higher residential densities in the most accessible locations, such as, close to the Kwinana Hub and adjacent to high amenity areas such as public open space;

e) retaining 15%+ of POS while retaining a large component of existing vegetation throughout the site.

1.3.3.3 State Planning Policy 4.2 - Activity Centres for Perth and Peel (SPP 4.2)

SPP 4.2 has been prepared to better guide the planning and development of new activity centres and the redevelopment and renewal of existing centres. It is mainly concerned with the distribution and function of centres, and with coordinating their land use and infrastructure planning however the policy also reflects the State's intention to encourage residential development in activity centres and includes housing density targets to be incorporated into local planning schemes.

The LSP area is located adjacent to and within the walkable catchment of the Kwinana Marketplace which, is identified as a Secondary Centre under the Directions 2031 strategic plan.

Fundamentally, the LSP aims to increase the density and diversity of housing around the Centres to improve land efficiency, housing variety and support centre facilities, and to maximize access to the centre by walking, cycling and public transport while reducing private car trips.

1.3.3.4 Liveable Neighbourhoods

The Local Structure Plan has been designed around the principles of Liveable Neighbourhoods and has been developed to meet the objectives and requirements of each of the Liveable Neighbourhoods design elements. In particular, the Structure Plan provides a site responsive approach in its design and provides a reliable framework to coordinate the more detailed planning process that is to follow.

The Structure Plan is considered to:

a) effectively integrate future development with the adjacent existing land uses and minimise land use conflict;

b) achieve a balanced outcome to urban and environmental sustainability;

c) appropriately locate non-residential uses;

d) successfully meet density targets and housing diversity;

e) provide a highly interconnected and permeable network of local streets and paths that supports alternative modes of transportation;

f) ensure lots and streetscapes have a suitable level of amenity;

g) enhance the local amenity through the overprovision of Public Open Space;

h) provide an integrated approach to urban water management;

i) accommodate the efficient location and delivery of utilities;

j) respond appropriately to and support local economic needs; and

k) facilitate a mixed use development that provides the flexibility to change and adapt over time.

1.3.4 Other

1.3.4.1 Local Scheme Amendment

In order to appropriately implement this Local Structure Plan, a local Town Planning Scheme amendment will be required to rezone that portion of the subject land currently zoned as 'No Zone' to 'Town Centre', and to facilitate the adoption of this Structure Plan over the Kwinana Town Centre Zone.

This will enable greater flexibility in the way in which development can occur and better facilitate the implementation of the State Government's Directions 2031 and Beyond strategic plan and State Planning Policy for Activity Centres (4.2). Currently, the presiding zoning will inhibit contemporary planning practices as there is currently no provision to allow for Mixed Use development or residential densities above the R40 coding, both of which are integral components of this Structure Plan.

1.3.4.2 Environmental Protection and Biodiversity Conservation (EPBC) Act

The Environmental Protection and Biodiversity Conservation (EPBC) Act is the Australian Government's key piece of environmental legislation. The objectives of the EPBC Act are to:

- provide for the protection of the environment, especially matters of national environmental significance;
- conserve Australian biodiversity;
- provide a streamlined national environmental assessment and approvals process;
- enhance the protection and management of important natural and cultural places;
- control the international movement of plants and animals (wildlife); and promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources.

Under the EPBC Act, approval from the Australian Government Environment Minister is required for any proposed action, including projects, developments and activities, or alteration of these things, likely to have a significant impact on a matter protected by the EPBC Act.

It is the responsibility of the person proposing to take the action, (in this case the landowner) that makes a referral under the EPBC Act.

The Environment Minister is the decision making authority and will determine whether a proposed action is likely to have a significant impact on one or more matters protected by the EPBC Act. If a significant impact is likely the action will need to be assessed and approved under the EPBC Act before it can proceed.

With regards to the subject land, matters of national environmental significance that could be affected and are protected by the Act include threatened species and ecological communities, and migratory species.

2 SITE CONDITIONS AND CONSTRAINTS

A Context Plan and Site Plan (Figures 2 & 7) have been prepared to illustrate the main issues discussed in this section.

2.1 Biodiversity and Natural Area Asset

360 Environmental Consultants were engaged to undertake an Environmental Assessment of the subject land (refer Appendix 2), including a Level 2 (L2) Flora Survey, Level 1 (L1) Fauna Survey, Black Cockatoo survey and Fauna and Vegetation Management Plan, and which confirms the suitability of the site for the type and scale of development proposed. An Aborists Report and Tree Survey were also conducted on site in addition to the Environmental Assessment Report.

2.1.1 Flora and Vegetation

The vegetation assessment includes an onsite flora and vegetation survey, desktop searches and an Arborist Report. Desktop assessments included searches of the Department of Environment and Conservation's (DEC) Threatened (Declared Rare) and Priority Flora database, the Western Australian Herbarium Database, the Environment Protection and Biodiversity Conservation (EPBC)Act 1999 Protected Matters Search Tool and DEC's Threatened Ecological Community (TEC) database.

The following is a summary of the key environmental features and findings as they relate to Flora:

a) Results of the desktop searches indicate that no Declared Rare Flora (DRF) or Priority Taxa species have previously been recorded within the site and that there were no Threatened Ecological Communities (TEC) known to occur within 2.5 km of the site. However, there is potential for some significant species of flora that may occur within the area.

b) The onsite Flora Survey concluded that there were no TECs, DRFs or Priority Taxa vegetation types found during the survey and that the subject land was found to contain a modest diversity of vegetation units and could therefore be considered as having moderate values for diversity.

c) The results of these vegetation surveys suggest that the subject land appears to be covered in good condition remnant bushland, predominantly being Jarrah-Banksia Woodland, several smaller pockets of Marri Woodlands and only a very small coverage of Tuart Woodlands predominantly in the very south of the site, as classified in Figure 4 of the attached Environmental Assessment report.

d) Other Environmentally Sensitive Areas, including Bush Forever sites, are located in the vicinity of the subject land, though none adjoining. Figure 3 of the Environmental Assessment Report illustrates the location and extent of such sites.

e) The assessment further advises that any clearing of the subject land would require a vegetation clearing permit from the Department of Environment

and Conservation under the Environmental Protection (Clearing of Native Vegetation) Regulation 2004.

f) An Arborist Report was prepared, and is included at Appendix 2. The Survey was undertaken in order to determine the health and condition of the existing trees on the subject land, and made recommendations relating to root protection zones required to ensure the specimens survival within an urban environment. The recommendations of which were considered in the preparation of the Structure Plan.

2.1.2 Fauna

The fauna assessment included desktop searches using the DEC's Threatened and Priority Fauna Database and the Environmental Protection and Biodiversity Conservation (EPBC) Act Protected Matters Search Tool, the Level 1 Vertebrate Baseline Fauna Survey and Black Cockatoo Survey.

The following is a summary of the key environmental features and findings as they relate to Fauna:

a) The DEC desktop assessment revealed that there are several fauna species recorded within a 5km radius of the subject land. As these listed species are predominantly associated with wetland habitats the report concludes that it is unlikely that any would be found on the subject site and should any such native fauna be found, there is potential to relocate to nearby bushland or wetland. The two most likely species to be located within the subject site are the Black-Striped Snake and the Lined Skink - Priority 3 classification snake and skink.

b) The EPBC Act desktop search of Protected Matters identified five vulnerable, three endangered and five migratory species listed as potentially occurring within 3km of the site. It is considered unlikely that many of these species rely on the site for habitat or feeding due to the type, extent and modified nature of vegetation on site.

c) The Level 1 fauna survey established ten survey sites to assess fauna habitat types recorded within the site. Three fauna species of Conservation Significance were recorded during the survey, being Carnaby's Black Cockatoo, the Red-tailed Black Cockatoo and Quenda. Whilst no direct observations of the Quenda species were made (only diggings), it is listed as a Priority 5 species by the DEC and appears to be present at the site.

d) In addition to the generic fauna study, a targeted Black Cockatoo Survey was carried out, indicating that the site is used for feeding and potentially nesting by black cockatoos, though not to the extent that might be expected. The Structure Plan was subsequently amended to maintain cockatoo nesting sites.

e) A Graceful Sun Moths survey was also carried out and none were recorded at the site.

2.2 Landform and Soils

The Servicing and Engineering Report prepared by Cossill and Webley Pty Ltd is provided at Appendix 3 and provides details on Landform and Soil types across the subject land.

The subject land features an undulating surface with existing contours varying on the site from a high point of RL16.0m AHD at the central western area of site to low points of RL 4.0m AHD to the south and RL 5.0m AHD in the north-east corner. This represents a 10m difference in elevation across the site, which is significant for development purposes. As the site levels are consistently between approximately 10m and 11m around its perimeter, it is often perceived to be flat however, the site falls away from the adjacent road reserve into the site prior to rising near its centre.

The majority of the subject land is comprised of undeveloped bushland. On the western boundary there are several road drains that enter the subject land and flow into several sump areas. On the northern boundary a large drainage sump is present which appears to take stormwater runoff from the adjacent shopping centre car park.

Regional geological mapping identifies the site as comprised of sands with high-to-medium permeability and contribute to groundwater infiltration. Site observations confirm the sandy nature of the site soils. The soils have been assessed as having low to no risk of salinity, waterlogging, water erosion, phosphorus loss and wind erosion and therefore considered well suited to infiltration drainage.

Preliminary earthworks designs have been undertaken on the proposed LSP. The basis of the design is to keep landform where possible by way of:

a) Minimising batters within areas of POS to facilitate retention of existing vegetation;

b) Propose levels to match existing road reserves,

c) Level pads to Lots to minimise site works to potential purchasers,

d) Limit the extent of imported fill and

e) Facilitate drainage disposal into proposed POS areas thus eliminating the requirement for drainage sumps.

The preliminary earthworks design does however indicate the need to import material to obtain the required levels.

The site has 'no to low' known risk of Actual Acid Sulphate Soils (AASS) and Potential Acid Sulphate Soils (PASS) occurring generally at depths less than 3 metres. As the site is within 500m of an area mapped as high risk for the presence of AASS or PASS, an Acid Sulfate Soils investigation is required.

2.3 Groundwater and Surface Water

Hydrogeological information obtained from the Perth Groundwater Atlas (2012) indicates groundwater is located at approximately 3m AHD and ranges between approximately 4m - 10.5m below the natural ground surface.

There are no natural surface water features on the site although there are a number of artificial surface water drains that enter the site from surrounding uses. There are no waterways occurring adjacent to the site and the site is not within the mapped 100 year floodway and flood fringe areas.

Ground and surface water generally flows towards the south west of the subject land.

2.4 Bush Fire Hazard

The subject land is considered to have a moderate to extreme fire risk due to the relatively dense vegetation currently on the site (pre-development) and within surrounding local reserves.

As some native remnant tress and shrubs are proposed to be retained within proposed public open space areas (refer Appendix 5 Landscape Strategy), those lots which are abutting, or adjacent to Public Open Space and Drainage Reserves posing a moderate or extreme risk are considered to be subject to, or likely to be subject to bush Fires.

A notification will be required on all lots within 100m of classified vegetation posing a moderate or extreme risk and which shall state:

a) This land is subject, or likely to be subject to Bush Fires.

b) A Bush Fire Management Plan applies to this land.

c) All construction is to comply with the Australian Standard relevant to bush Fire attack levels and minimum constructions standards (Currently AS 3959 -2009).

A Fire Management Plan, including a Bush Fire Hazard Assessment and recommended Bush Fire Attack Level rating for construction standards is included in this LSP (See Appendix 7).

2.5 Heritage

A search of the Aboriginal Heritage database indicates that there are no sites of significance reported for the Kwinana Town Centre or the subject land.

A search of the Heritage Council database found that there are no culturally significant heritage sites reported on the subject land, however, sites such as Leda Nature Reserve and the Fire Station are located nearby.

2.6 Context and Other Land Use Opportunities/Constraints

The subject land forms a key component of what is a strategic development and redevelopment project within the Kwinana Town Centre (Master Plan area), which stretches generally from Christmas Avenue in the north, along Gilmore Avenue to Wellard Road in the south. A Location and Context Plan is provided at Figure 2.

The following is a summary of the key services and facilities in the surrounding area.

2.6.1 Existing Access and Public Transport

The subject land can be accessed via all the existing constructed roads around the perimeter of the site, with Gilmore Avenue being a main integrator road. The subject land is located approximately 3.2km from the Mortimer Road Freeway entry (to the east) and 6km from the Thomas Road Freeway entry (to the north east). The subject land is afforded unrestricted access and egress onto the existing road network and is within close proximity of the Kwinana Freeway enabling access north to Perth and south to Rockingham and Mandurah

A Transport and Access Report was prepared by SKM and is provided at Appendix 4. The report elaborates upon the existing road network and access arrangements around the site. The report confirms that the subject land is well serviced by established pedestrian and bike paths throughout the Kwinana Town Centre locality and surrounding suburbs with an existing shared use path network located around the perimeter of the subject land.

The Structure Plan area has easy access to an established public transport network that includes both local bus services and access to the Perth to Mandurah passenger rail line. There are currently several Transperth bus services that service the subject land. Bus Numbers 542 (Wellard Road and Gilmore Avenue), 541 (Wellard Road), 920 (Gilmore Avenue) and 543 (Challenger Avenue) enable direct access to public transport services with bus stops along Gilmore and Meares Avenue.

The Kwinana Bus Station, associated with the shopping centre to the north, is located on Gilmore Avenue within 400m of the subject land. The subject land is also in close proximity to the Wellard and Kwinana Train Station, which are easily accessed via the public bus transport system.

Wellard Road to the immediate south and Thomas Road (via Gilmore Avenue) also provide direct road connections to the regional industrial employment node of Kwinana Beach to the west.

As such, the site is highly accessible on both a micro and macro level and via a variety of existing transport methods with additional bus services possible in the future.

2.6.2 Schools

The subject land is located in an area that has access to several public and private primary and high schools. Peter Carnley Anglican Community School (private primary and secondary school) and Calista Primary School (public) are both located within 500 metres of the subject land. Gilmore College (previously known as the Kwinana Senior High School) is located approximately 900 metres north of the subject land and caters for secondary students in the area. The existing public schools in the area have capacity to cater for the additional students anticipated to emanate from the subject development site. No School Sites are proposed within the Structure Plan area.

2.6.3 Existing Public Open Space and Reserves

There are several local and neighbourhood parks located in close proximity to the subject land with key Public Open Space linkages existing to the east and west of the subject land. There are also several ovals in the vicinity to enable active recreation opportunities and no further sporting ovals are required within the subject land.

The surrounding area is also characterised by various regional reserves, such as Sloans Reserve to the east, Bollard Bulrush Swamp to the east and Beeliar Regional Park to the north.

2.6.4 Amenities

Given the strategic location of the Challenger site within the Kwinana Town Centre, there are several community facilities and district level amenities located in the surrounding area. These include the Kwinana Recquatic Centre, Town Park, Knowledge & Resource Centre, Kwinana Golf Course, tennis and lawn bowls facilities, and an array of local and neighbourhood centres such as the Orelia and Wellard Village centres. Importantly, the Kwinana Marketplace shopping centre ius located directly opposite the subject site.

Calista Oval located to the west of the site on Gilmore Avenue has also been highlighted in the City of Kwinana's draft Community Facilities Plan as having the potential to become a sub-regional level Destination Park.

2.6.5 Servicing Infrastructure

The Cossill and Webley servicing report is included at Appendix 3. In summary, access to all key infrastructure services is currently available to the site, or in close proximity, and extensions to all are readily available.

These existing available services include 150mm and 300mm water mains running along both Meares and Challenger Avenue, there is an existing sewer pump station located in the south-east of the site along Meares Avenue with the majority of sewer in the immediate local area gravitating towards it, and there are existing overhead powerlines along Meares and the eastern end of Challenger Avenue and underground power along Wellard Road. The existing high voltage powerlines along Gilmore Avenue are not available for connection and instead shall remain in their current form and easement.

Preliminary investigations in this regard confirm that there are no significant constraints or unfeasible servicing infrastructure that hinders the development to full urban standards.

3 LAND USE AND SUBDIVISION REQUIREMENTS

The Local Structure Plan seeks to create an urban environment where a strong sense of community is forged and where the physical, social and mental health of that community can be encouraged and sustained. The Vision is to create a site offering a wide range of housing diversity, ultimately assisting in improving the vibrancy and economic viability of The Kwinana Secondary Centre to the north. Balancing the retention of natural vegetation and other aspects of the site was of key importance and is reflected in the fabric of the structure plan design (refer Figure 8 - Density Code and Land Use Plan and Figure 11 - Aerial with LSP overlay).

3.1 Land Use

The 36.85ha of land contained within the Local Structure Plan is intended primarily for residential development, with mixed uses permitted along Challenger Avenue, and 6 relatively large Public Open Space areas spread throughout the site.

The LSP is based on a logical and permeable network of streets that will combine to create a pleasant walking/cycling environment. Higher residential densities are envisaged in those areas with higher amenity, especially to the north of the site, where mixed use and medium-high density development is proposed to support the existing and future commercial uses, and to take advantage of the Kwinana bus station.

A strong emphasis has been placed on the central north-south neighbourhood connector road, linking Challenger Avenue in the north and Wellard Road in the south. The road is bound by POS on at least one side for its full length, providing a pleasant green thoroughfare for drivers, pedestrians and bike riders alike.

Emphasis was also placed on ensuring that future development integrates with the existing residential areas and road network, recognising that a Kwinana community and identity already exists. It is envisaged that the development will reinforce and expand upon the existing community.

The allocation of land uses as reflected on the LSP Map is described in more detail in Table 2 of Part One (Statutory Section) of this LSP report, being the Structure Plan summary table.

3.2 Public Open Space

A POS schedule, in accordance with Liveable Neighbourhoods requirements, is provided at Figure 9 and should be read in conjunction with the Landscape Strategy and Master Plan (Appendix 5). The Landscape Master Plan is an indicative plan to illustrate the general principles and intent of the Public Open Space areas.

3.2.1 Objective

The objective of the POS provision was never simply to meet the statutory requirements, but rather to create a unique estate which helped retain the treed character of the Kwinana town centre and Gilmore Avenue boulevard theme based upon the following aims:

- Integration of internal and external living in a legitimate attempt to encourage healthy outdoor recreation;

- Increasing passive interaction opportunities with other residents as a means to address social isolation and improve mental health;
- Provide safe and attractive movement networks that are not reliant upon car ownership and within the context of anticipated destinations;
- Accommodate drainage in a usable landscaped manner to create an amenity for residents as well as allowing for natural nutrient stripping and infiltration processes to occur;
- Maximise natural vegetation retention for conservation purposes and in recognition of the habitat value of some vegetation;
- Encourage maximum surveillance of POS and bushland areas to discourage opportunities for criminal activities;
- Reduce the opportunity for illegal rubbish disposal and fires within vegetated areas;
- Recognition of existing land uses and POS locations and types external to the subject area;
- Achievement of the original master plan objectives relating to POS including a minimum 15% POS allocation;
- Protection of viewscapes towards existing trees and natural vegetation so as to retain the existing character of the suburb; and,
- Provision of a variety of POS types and sizes in acknowledgement of the likely diversity of family types and needs resulting from the proposed density and cell structure.

In addressing these objectives, the Structure Plan evolved to create approximately 21% of the site for public open space, above the Master Plan target of 15%. This includes setting aside land for landscaped drainage and for dedicated landscape strips along Meares Avenue and Gilmore Avenue. The provision of POS has been designed with the intent of maximising opportunities for existing tree retention; both for landscape amenity reasons and for conservation reasons.

3.2.2 Distribution and Function

The Public Open Space Schedule located at Figure 9 and associated Landscape Master Plan best portrays POS functionality across the site. Public Open Space is distributed across the site through six areas of POS roughly in an elongated fashion through the centre of the site. This is to create a green spine running alongside the primary north-south vehicle and cyclist road with each strip of a size and dimension to offer both an active and passive recreation function and create a green heart, then linking residents to the district centre to the north or towards Wellard Train Station in the south.

The POS distribution has been design so as to:

a) ensure vegetation retention and protection;

b) create a lineal POS linkage for walking and cycling through the site;

c) enable drainage to be accommodated in a sustainable and usable recreational manner;

d) maximises viewscapes from residents and down streets to green landscaping; and

e) provide recreational opportunities within a 200m walk for all residents.

The Landscape Strategy and Master Plan contained at Appendix 5, as prepared by consulting landscape architects Emerge, best explains the variations in POS function. Generally, there are 3 different categories of open space described within the Structure Plan area which include:

- Formal Town Centre Open Space;
- Central Linear Public Open Spaces;
- Multiple Use / Drainage Public Open Spaces.

A 1.14ha formal Town Centre open space area (POS 1) is proposed as an entry focal point into the development area from Challenger Avenue and to smooth the transition of character from the Commercial sub-area of Kwinana into the development. A system of central linear parklands (identified as POS 3, 4, & 5 (being approximately 1.63ha, 0.68ha and 1.08ha in size respectively) will be developed as the defining point of the project running in a north south direction for the entire length of the Development area.

Two Public Open Spaces areas (POS 2 & 6) will be designated to accept major stormwater drainage events. These areas will be constructed to provide a multiple use, drainage and landscaped response, which will be critical to establishing an immediate informal active and passive recreation opportunity. In addition to local parks, a series of smaller landscape strips are proposed for the purpose of providing informal, multiple use drainage and landscape buffer areas.

The intention is to landscape each POS area generally in accordance with the vision of the Landscape Master Plan.

3.2.3 Management

Landscape maintenance is further outlined in the Landscape Strategy. Every public open space landscape and irrigation design will be submitted to and approved by City of Kwinana for Landscape Approval prior to construction commencing. Maintenance and Management plans for areas of Public Open Space, including streetscapes and road verges, will be entered into as Conditions of Subdivision as per Clause 5.7 of Part One of this Structure Plan Report.

3.3 Residential

3.3.1 Density

The Structure Plan (Figure 1 – Structure Plan Map) is comprised of a range of residential densities, providing for approximately 917 dwellings in total. This is made up of:

- 23 Low density (R25) front loaded single residential dwellings fronting Meares Avenue;
- 159 Medium density (R30) single residential dwellings fronting new internal roads;
- 282 Medium density (R60) rear loaded single residential dwellings fronting internal roads;
- 136 Medium density (R60) grouped dwellings, spread across 12 grouped housing sites;
- 50 High density (R80) multiple dwellings to be constructed within the Mixed Use site at the corner of Gilmore and Challenger Avenue;
- 266 multiple dwelling units spread across 5 sites within the strategic precinct.

It should be noted that estimated dwelling yields have been based on the following assumptions:

- The potential for the strategic site to be developed after 5 years;
- High density (R80) zones have dwelling yields based on an average dwelling size of 100m^2 and plot ratio of 1 (as per the WAPC Multi -Unit Housing Code Q & A's)
- Yields are based on the latest ABS data for household size which indicates an average of 1.76 people per 2 bedroom dwelling and an average of 2.47 people per 3 bedroom dwelling.

The structure plan should therefore accommodate approximately 1941 residents if fully developed. This is on the assumption that all single residential dwellings will have 3 bedrooms and all grouped and multiple dwellings will have an average of 2 bedrooms.

The above yields indicates a good range of housing products will be made available, and that the target housing yield of *Directions 2031* at 500 dwellings is exceeded, even if neither the Strategic Site nor the Mixed use site contain any residential component. On this basis, the yield equates to an average housing density of 32 dwelling units per gross hectare, assuming the Strategic Site is not developed for residential use and as such is deducted from the calculable area. This equates to about an R30 net average across the site – being of a medium density equivalent.

If the Strategic site is subsequently developed for residential purposes, potentially at an R80 density, the average density and targets shall be increased further.

3.3.2 Lot Pattern

The lot pattern is generally based on a traditional grid to maximise the number of east/west lots for best attempts at climate responsive design, whilst also facilitating a highly permeable and legible street layout which protects views through the site and towards the central open space corridor. A range of route alternatives are therefore presented to residents as a result of the lot pattern and street network. The final evolution of the Structure Plan was a focus refreshment to lot orientation to specifically respond to changing housing standards.

For the single residential lots (the R25, R30 and R60 coded sites) emphasis was placed on narrower lot dimensions to allow opportunities for cross ventilation in the built form with rear laneways offered to some of these lot types so as to reduce the impact of garages dominating the streetscape, particularly along key entry roads and boulevards and opposite public open space.

The higher density group housing sites have been placed to attempt to 'bookend' the development site and create a well-balanced built form. The balance of the medium and higher density sites have also been strategically placed overlooking public open space and in close proximity areas considered to have a high amenity value.

The highest density sites are provided in the 'Strategic Precinct' and the Mixed Use zone fronting Challenger Avenue, due to the proximity of these sites to major attractors such as the Kwinana Secondary Centre and associated Bus Station.

Importantly, the 'Residential' and 'Mixed Use' zoning of the strategic precinct does not detract from the option of this site to be developed for civic or educational purposes, which are either permitted or discretionary in the respective zones.

3.3.3 Built Form

The LSP intends to provide the opportunity for family sized homes generally at R25 and R30 densities, possibly also R60 when constructed at two storeys, which are either traditional design (garages on primary streets) or rear lane accessed dwellings often referred to as cottage homes, townhouses or terrace homes.

In addition, the inclusion of R30 and R60 densities provides the opportunity for smaller built form products such as two and three bedroom homes suitable for smaller family structures or singles or couples. The R60 coded single residential areas are likely to comprise housing products such as the 7.5m x 30m cottage homes with rear garages which equate to more of an R40 equivalent however, the use of the R60 coding allows for greater flexibility should a slightly shallower lot depth (for example) be sought at the more detailed subdivision stage.

The R60 to R80 grouped housing sites provide the opportunity for either grouped or multiple dwellings, such as a town house, unit or apartment style homes which may be attractive to those future residents seeking a lower maintenance or more

affordable housing product and within which onsite shared facilities such as swimming pools may be offered. The 'maisonette' style units are also intended to introduce yet another style of housing product increasingly attractive in new urban estates and offering an additional housing choice. The concept is for medium density apartment or townhouse style housing, though grouped into small packages so as visually, the dwelling appears as one. This form of housing encourages neighbour interaction, variety in amenity and streetscape and yet still allows residents their own privacy.

A plan is included at Figure 10 to assist in illustrating the diversity of housing product to be encouraged within the LSP. Design Guidelines are also being prepared to assist in ensuring a quality built form outcome results across the estate.

3.4 Mixed Use

3.4.1 Objective

The Structure Plan proposes the introduction of a 'Mixed Use' zone, which is not prescribed by the Scheme, but is proposed to be enforced through the Structure Plan as though the zone was incorporated into the scheme. The land use permissibility, setbacks, plot ratios, car parking, landscaping and alike are all to be guided by the basic development requirements as set out under Part One of the Structure Plan report.

Notwithstanding this, the intention of offering the opportunity for a residential/mixed use component within the structure plan area is to encourage home based businesses, for example beauty therapists and accountants, and also small scale commercial or office uses (likely non-retail) compatible with the residential area that are not necessarily suitable for inclusion in the Kwinana Marketplace shopping centre to the north.

The concept of mixing uses on the one site, potentially with business opportunities at the ground level and residential above, assists in catering for the 'work from home' lifestyle and offers the opportunity for a varied customer base, with possible customers literally living above or within close proximity to them to support the business.

3.4.2 Location

The mixed use development site is located at the corner of Gilmore Avenue and Challenger Avenue and is designed to maximise exposure for viability purposes. This location will also help to reinforce the shopping centre on the north side of Challenger Avenue as the urban and commercial heart of Kwinana, rather than decentralising its function.

A high level of access is provided to this Mixed Use site, both for the visual exposure but also for pedestrian/cyclist access and access from the nearby Kwinana bus station to the immediate north along Gilmore Avenue. Its location alongside multiple roads also helps improve the servicing capability by any delivery vehicles.

3.4.3 Design and Development

Being a corner site also enables the opportunity to create an identifiable cornerstone development addressing both key adjoining roads as well as the new internal subdivision roads. Some height in the built form on this site shall also help to create that statement.

Any future built form design within this site shall comply with the objectives of the existing Kwinana Town Centre zone and applicable provisions set out under Part One of this LSP. Any future development shall adequately address all adjoining streets and land uses with their primary frontage along Challenger Avenue so as to help create a mainstreet style development along that street front, encouraging a pedestrian scale interface at street level. Emphasis shall also be placed on creating a 'corner stone' development at the Challenger and Gilmore Avenue intersection, utilising a height differential, limited street setback, articulation and interest in the architectural style and use of shopfront windows, balconies and shading devices to encourage activation and surveillance of the street and an attractive and identifiable entry to the subject land.

Importantly, the Mixed Use zoning provisions proposed under Part One of the LSP will not place any caps on the floor area of ground or first floor commercial uses, except to limit 'Shop' uses to a maximum plot ratio of 0.3. This will permit a maximum 4032m² NLA of 'Shop' uses which is compliant with SPP 4.2. Under SPP4.2 development of up to 6000m² NLA of 'Shop-Retail' floor space is permitted without requiring a Retail Needs Assessment or referral to the WAPC for development approval.

3.4.4 Potential Yields

As noted in Table 4A of Part One, the 'Town Centre – Mixed Use' site has the potential to yield up to 50 dwellings at the applicable R Code and plot ratio, depending upon whether built in a grouped or multiple dwelling scenario. This yield however is very approximate with the number significantly reducing as commercial development increases. The number and mix of business and commercial floor space and residential yield shall be dependent upon the more detailed design.

3.5 Strategic Precinct

A 3.4065ha 'Mixed Use - Strategic Site' has been designated on the LSP. The 'Strategic Precinct' overlays both the residential zone and a portion of the mixed use zone, and is located in the very central north of the subject land, opposite the existing Kwinana Marketplace Shopping Centre on the northern boundary of the site and abutting Challenger Avenue.

3.5.1 Objective

The intent is that this site shall remain undeveloped until the final stage of the Structure Plan is realised, upon which the site is to be made available for medium to high density residential uses or a mix of uses consistent with the land use permissibility of the existing 'Kwinana Town Centre' zone and Challenger Precinct

Policy objective. This is to ensure that the site will be used for the most appropriate activity once the structure plan area has developed and matured.

It is envisaged that the site could be suitable for institutions catering to education, health, recreation, employment or civic uses complementary to the Kwinana Town Centre. If such uses are already provided in the adjacent Kwinana Town Centre at the time the final stages are developed, the site may also be used for Mixed Use and high density residential. In doing so, it should be noted that this approach is consistent with the Master Plan workshops which identified the need to retain this site for a period of 5 years.

It should be noted that the underlying zones for the strategic precinct, which include residential and mixed use, both either permit, or permit with discretion, all of the envisaged land uses. The intention in identifying the 'Town Centre - Strategic Site' boundary on the Structure Plan is so as to demonstrate robustness, flexibility and appropriate integration. The site comprises a relatively regular shape surrounded by existing or proposed roads and a proposed public open space area.

3.5.2 Design and Development

The specific design objectives for this site to be addressed as part of any future subdivision and development, regardless of the land use proposed within, being to:

- Promote a high quality and high density development which will offer an employment, educational, recreational or living environment to a high number of people;
- Promote a pedestrian friendly environment with good connectivity around and through the site corresponding with its land use and location and in recognition of its proximity to public transport nodes;
- Achieve a high level of passive surveillance of the adjoining roads, town centre, public open space and drainage areas;
- Achieve a good level of articulation and interest in the built form along all facades, including through the use of verandahs, balconies, fenestration, porticos, differential materials, shading devices and windows;
- Promote the use of sustainable and energy efficient building techniques;
- A Landscape Plan is to be prepared and implemented for the collective site regardless of subsequent land tenure or land use, with consideration to any established adjoining or town centre theme, consideration to retention of, or revegetation with, locally indigenous species, and requirements for shading;
- A vehicle (and traffic if applicable) management plan is to be prepared at the development application stage(s), car parking is to be provided in accordance with the Local Planning Scheme requirements for the applicable land use categories. The objective being to reduce the impact of car parking, servicing and crossovers on the local amenity and pedestrian environment,

(undercroft or multi-level car parking may therefore be desirable for large scale of high density development).

3.5.3 Staging

Should no further planning or no sale or transfer of land occur during the approval and construction of the balance of the structure plan area (currently estimated as a 5 year time frame), the landowners can then progress to subdivision and development of the site for either strategic or non-strategic land uses, ensuring the vitality of the Kwinana Hub and the Structure Plan continues to occur.

3.6 Local Development Plans (Detailed Area Plans under the Scheme) and Design Guidelines

The intention is for Local Development Plans (LDPs) to be prepared for portions of the LSP as is determined relevant at the subdivision stage. The key areas identified as appropriate for LDPs are reflected in Part One.

LDPs will assist in addressing more detailed matters such as setbacks and garage locations, surveillance from the home, surveillance of laneways, air circulation, car parking, interface to any adjoining parks or mixed uses, style and extent of fencing and objectives for the built form to as to ensure a high quality and well planned dwelling layout ultimately results on each lot, contributing to sustainable streets and the overall estate.

Detailed Design Guidelines are also being prepared for the Structure Plan neighbourhood, providing guidance to all development with regard to built form, materials, colours, landscaping, amenity, orientation and the appropriate placement of infrastructure. The intention is that these shall be provided to purchasers, architects and builders to assist in ensuring a quality built form outcome results across the estate and in a manner that helps reflect the original objective for development of this strategic town centre land parcel as outlined in the Town Centre Master Plan and policy guidelines.

3.7 Movement Network

Figure 8 highlights the local road and path network envisaged for the site and is used to address the traffic and transport implications of the proposed Structure Plan, such as road hierarchy, adequacy of road widths and distribution. A Transport and Access Report based on the Plan has been prepared by SKM and is attached at Appendix 4.

Importantly, the advantageous location and characteristics of the subject land should mitigate car dependence and private vehicle trip generation may be a small percentage less on a daily basis, when compared with a conventional suburban development in outer areas of the metropolitan region.

3.7.1 Road Network & Treatments

The proposed road network is based upon integration with the existing and well established roads currently forming the perimeter of the subject land and linking the subject land with the secondary centre to the north, public transport routes and surrounding neighbourhood parks and schools.

The planned internal street network incorporates a north-south and east-west Neighbourhood Connector, and a permeable network of local access streets and laneways.

It is proposed that the site will have nine access points, with three of the accesses from Gilmore Avenue, one from Wellard Road, two from Challenger Avenue and four from Meares Avenue.

The majority of the roads are proposed to be constructed within a minimum 15 metre road reserve, reduced only where immediately abutting POS, or 6 metre laneways. The key entry roads are wider so as to accommodate additional traffic movement, designated key cycle routes and possibly some additional car parking and landscaping.

Recommended key external and internal intersection treatments and indicative cross sections have been developed for the key streets proposed within Structure Plan area.

Other more minor road treatments, such as distinguishing laneways from access streets, provision of car parking and boulevard treatment of the 25m entry road are to be investigated further at the more detailed subdivision stage

The road network design is consistent with the requirements of *Liveable Neighbourhoods*.

3.7.2 Traffic Distribution

Given the proposed high number of linkages with the external road network and the range of trip attractors in different directions, it is predicted that development traffic will distribute fairly evenly.

The intersection of the proposed East-West 'gateway' Road and Gilmore Avenue at AM peak hour will be the crucial period for traffic distribution, when the majority of outbound traffic using this intersection during the AM peak is likely to turn right to access destinations to the north and sub-regional routes such as Thomas Road.

Proposed road treatments will safely and adequately accommodate traffic movements in to and out of the Structure Plan area, with the large number of linkages ensuring traffic will distribute via other routes if any spot congestion occurs.

3.7.3 Car Parking

In general, needs in relation to car parking can be identified at the subdivision planning stage. Notwithstanding this, the Traffic Report recommends the following with respect to car parking:

a) Visitor car parking should generally be provided on street, given that typical street cross section designs incorporate car parking adjacent to kerbs;

b) Car parking for the proposed retail uses will need to be in accordance with the Town Planning Scheme No.2. However, the parking ratios may be

reduced at the Council's discretion subject to approval of acceptable land uses and detailed planning;

c) Access to any on-site car parking for the proposed retail uses should be from the service road to the south of the development rather than from Challenger Avenue.

3.7.4 Public Transport

Residents in the new development should benefit from a good level of access to public transport services as the subject land is located within the walkable catchment of the Kwinana bus station and is a short distance outside of the walkable catchment of Wellard train station (See Figure 7 – Site Plan).

Bus services link the Kwinana Town Centre area with the Kwinana and Wellard train stations, Rockingham and Fremantle.

3.7.5 Pedestrians & Cyclists

While proximity to public transport is important, pedestrian and cycle linkages are also required to facilitate public transport trips.

The LSP depicts a fine-grained and permeable pedestrian and cycling network that has been planned to interface the new development with the shopping centre to the north and existing pedestrian and cycling infrastructure on surrounding streets.

A permeable internal walking and cycling network is proposed, this is reflected in the overall development plan and indicative cross sections within the Traffic Report. It is intended that this network will be integrated with existing external infrastructure, which itself will be enhanced through the installation of shared paths on the eastern side of Gilmore Avenue, the western side of Meares Avenue and the northern side of Challenger Avenue. A new footpath should also be constructed on the south side of Challenger Avenue.

The proposed locations of shared paths and footpaths to be provided within the LSP are shown in Figure 8.

3.7.6 Access

The site is highly permeable with cell blocks less than 200m long and in a grid-like layout so as to offer variety of route possibilities Traffic access to and from the development is considered to be sufficiently permeable to allow good site access and traffic circulation.

As such, there should be good multimodal access to and from the Structure Plan area without adverse traffic impacts on the surrounding network.

3.8 Water Management

In addition to recreational function, most POS areas offer a drainage component as detailed in the corresponding Local Water Management Strategy, prepared by 360 environmental and provided at Appendix 6.

Specific calculations of drainage associated with Public Open Space have evolved in consultation with the project engineers and hydrologists, as part of the preparation of the local water management strategy, and the landscape architects in regard to the treatment of the drainage components. More detailed engineering design and landscape treatment refinement as part of the detailed subdivision works is required to more accurately determine the design, depths and therefore surface area equivalents of each drainage requirement.

A summary of the LWMS report findings is provided below:

3.8.1 Water Source

Water will be supplied to individual properties through Water Corporation's reticulated potable water network, sourced from extension of nearby water supply pipelines.

Wastewater transfer from each individual property will be via Water Corporations reticulated sewer network.

Irrigation of POS areas will be via the construction of groundwater bores. All irrigation shall be installed to the local authority's standard specifications and industry best practice.

3.8.2 LWMS Design Objective

Drainage will be accommodated in a useable landscaped manner to create an amenity for residents as well as allowing for natural nutrient stripping and infiltration processes to occur.

Natural vegetation retention will be maximised for conservation purposes.

Sensitive urban design principles will be implemented into planning and design features of the development.

3.8.3 Stormwater Management

Stormwater will be managed onsite with no offsite stormwater flows proposed.

The proposed strategy to manage drainage within the site involves incorporating the drainage discharge into the various public open space areas. This will alleviate the need for fenced drainage sumps and provides better use of land as well as better aesthetic values for the community.

The soils of the site have been assessed as having low to no risk of salinity, waterlogging, water erosion, phosphorus loss and wind erosion (DAFWA, 2009). Accordingly, the site soils are considered well suited to infiltration drainage.

Stormwater from the site will be collected from impervious areas through an integrated network of collection pits and pipes discharging into drainage swales located in public open spaces throughout the site.

The proposed development includes six areas of POS, totalling approximately 7 ha. Specifically, five of the six POS Areas offer a drainage function. Refer to the Public Open Space Schedule located at Figure 9 for drainage land area requirements.

Storm events equal to or greater that a 1 in 10 year event will discharge into the drainage swales, with water from smaller storm events contained within the collection pits and pipes. The stormwater drainage swales will be landscaped to create functional, passive recreational areas when not in use for drainage.

Surface drainage within the subdivision areas will be via a conventional system of road gullies and underground pipes draining to the detention basins within the POS.

3.8.4 Groundwater Management

Groundwater monitoring wells were installed across the site on 2 July 2009 with groundwater sampling being carried out during November 2009, March 2010 and May 2010. Further groundwater quality monitoring is recommended during construction, for up to two years, to monitor for changes to groundwater quality potentially as a result of construction activities.

Post-development groundwater levels across the site are not expected to alter significantly from pre-development levels as there is currently no infrastructure or disturbance expected to occur below the groundwater level.

3.8.5 Developer Responsibilities

The developer commits to the following actions:

- Implementation of the strategies outlined in the LWMS and subsequent planning documents.
- Development and implementation of an UWMP to provide further detail on the responsibilities and water management plan options during the subdivision design stage

3.9 Education Facilities

The subject land is located in an area that has access to several public and private primary and high schools (See Figure 2 – Location and Context Plan). Peter Carnley Anglican Community School (private primary and secondary school) and Calista Primary School (public) are both located within 500 metres of the subject land and Gilmore College (previously known as the Kwinana Senior High School) is located approximately 900 metres north of the subject land and caters for secondary students in the area.

The existing public schools in the area have capacity to cater for the additional students anticipated to emanate from the subject development site.

3.10 Activity Centres and Employment

Kwinana Town Centre is considered a higher order 'secondary centre' under SPP 4.2.

Within the Structure Plan area, as described under the Mixed Use heading above, commercial land uses are permitted in the 'Mixed Use' zoned at below ground, on the ground floor and on the first floor of development. There will be no cap on commercial floor spaces within the Mixed Use zone except that 'shop' uses will be capped at a maximum plot ratio area of 0.3, which will result in a maximum 'shop' plot ratio area of 4032m² NLA.

This relatively small area of retail floorspace is in accordance with SPP 4.2 which permits development of up to 6000m² NLA of 'Shop-Retail' floor space in activity centres without requiring a Retail Needs Assessment or referral to the WAPC for development approval.

3.11 Infrastructure Coordination, Servicing and Staging

The Engineering Servicing Report at Appendix 3 confirms the manner in which infrastructure will be provided. The Report confirms that there are no identified servicing constraints that prevent the land from being developed as intended with the site able to be serviced with all essential services and infrastructure. The report is summarised below

a) Earthworks: The preliminary earthworks design does indicate the need to import material to obtain the required levels.

b) Power: Electricity supply for the proposed development will be via an extension of the existing high voltage system in adjacent road reserves. At this stage it is not expected that any sites for sub-stations, etc, other than for padmount transformers, will be required.

c) Telecommunications: communication supply for the proposed development will be via an extension of the existing services located in adjacent road reserves.

d) Water: The Engineering Servicing Report and communications with Water Corporation during the preparation of the Structure Plan confirm that extensions to existing distribution and reticulation water mains are readily available.

e) Sewer: The Water Corporation of WA (WCWA) has made provision for the sewerage the subject land in its planning.

f) Gas: Natural Gas supply for the proposed development will be via an extension of the existing service located in the adjacent road reserves.

4 IMPLEMENTATION

4.1 Development Contribution Arrangements

The Structure Plan area falls within Development Contribution Area 15 'Townsite' under Schedule V of Town Planning Scheme No.2, for community facilities. Any contributions required at the time of subdivision will be determined in accordance with TPS2 and Council policies as well as standard Western Australian Planning Commission development control policies.

Any infrastructure works requiring development contributions that fall outside the provisions of TPS2 are subject to further discussion and negotiation between the City of Kwinana and the Department of Housing (being the landowner).

It is acknowledged that the proponent is to pay a contribution to the City of Kwinana's Mosquito Management Contribution fund for the creation of each residential lot and strata lot.

Any contributions required at the time of subdivision will be determined in accordance with TPS2 and Council policies as well as standard Western Australian Planning Commission development control policies.

4.2 Staging of Subdivision and Development

Upon successful advertising, adoption and endorsement of the LSP, the intention is to lodge a subdivision over the entire subject area to create the comprehensive lot variety and various areas of public open space. Development of the site shall progress in a staged approach.

The intention is that the early stages of construction shall radiate northwards from Wellard Avenue leaving the 'Strategic Site' as a final stage so as to allow the opportunity to revisit the land uses and design within that specific site. Staging is also partially reliant upon availability and cost effectiveness of extensions to servicing infrastructure as detailed engineering design progresses. The review of the Strategic Site in consultation with the Town of Kwinana is likely to occur in five years from the submission of this Structure Plan.

4.3 Implementation Requirements

As part of, or in addition to, the normal subdivision and development tasks, the following investigations or conditions may likely be required in fulfilling the implementation of the Structure Plan:

- Refinement of engineering design and landscape treatment to inform the final POS credits;
- Preparation of an Urban Water Management Plan as a condition of subdivision including the implementation of groundwater and stormwater management and design in POS areas;
- Identification of trees suitable for retention and protection, including within POS, road reserves and any lot setback areas as may be possible;

- Implementation of any revegetation works as may be required;
- The preparation of Detailed Area Plans for applicable lots as a condition of subdivision;
- The preparation of Design Guidelines (as may be desired) by the developer to assist in achieving the Structure Plan vision;
- Review of the need and timing of the Strategic Site;
- Maintenance Periods are to be negotiated with the Town and outline processes and minimum requirements for management plans.
- Additionally, a Mosquito and Midge Management Plan is likely required, in accordance with the Environmental Protection Authority's *Guidance Statement for Management of Mosquitoes by Land Developers (No.40 June 2000)*.

5 CONCLUSION

The plan has been based on sustainable and contemporary planning principles with emphasis on promoting community health and physical activity through a permeable, legible and logical road layout that promotes walking and cycling both within and to key destinations, as well as via the well-placed and sizeable open spaces that form the heart of the site and offer a great asset for future residents.

The provision of 21% Gross POS is greatly more than the 10% required under the State Government Liveable Neighbourhoods Policy. The over provision of public open space has been a key feature of the planning process in an attempt to retain existing vegetation, both for landscape amenity and for environmental conservation purposes.

Pedestrian Permeability throughout the Structure plan, and increases in density around high amenity areas have also received special attention. High density Mixed Use development is proposed along Challenger Avenue and will assist in providing opportunities for people to live and work in the same area.

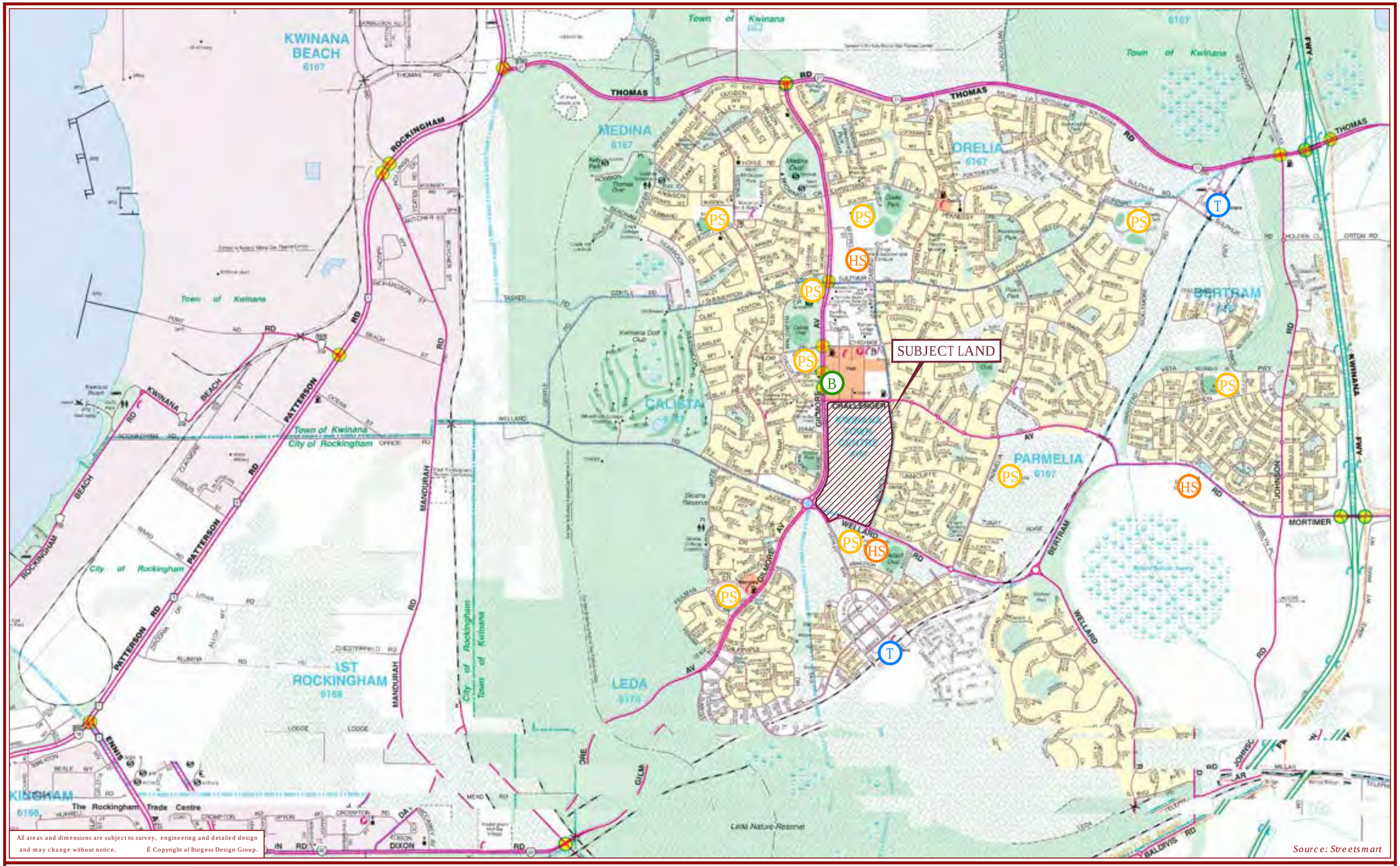
The plan also interfaces with the preliminary planning over adjoining land holdings as per the Kwinana Master Plan and reinforces the existing facilities such as the shopping centre, high school and playing fields to the north, bus routes and direct access to the train station.

Overall the Structure Plan ensures a coordinated and integrated approach to planning in Kwinana that will result in the introduction of a great range of new housing products catering to ever diversifying household structures and living arrangements .

The Structure Plan also recognises, and responds to, the site's key strategic identity in the broader metropolitan region as also emphasised in Directions 2031 and beyond.

It is also important to acknowledge the highly collaborative approach taken to the preparation of this Structure Plan. The ongoing and active inputs of City of Kwinana officers and elected members has contributed considerably to the submission of a comprehensive and highly scrutinised Structure Plan that will complement and enhance the ongoing developments of the Kwinana Town Centre.

FIGURE 2
Location and Context Plan



All areas and dimensions are subject to survey, engineering and detailed design and may change without notice. É Copyright of Burgess Design Group.

LEGEND

- PS Primary School
- HS High School
- B Bus Station
- T Train Stations

NORTH

LOCATION AND CONTEXT PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING

CITY OF KWINANA

burgess design group
TOWN PLANNING + URBAN DESIGN
PO Box 374 Northbridge WA 6865
www.burgessdesigngroup.com.au
P (08) 9328 6411
F (08) 9328 6511

Plan No: SAT KWI 9-04a_LC Client: SATTERLEY/DOH
Date: 26.02.13 Planner: JD

0 0.25 0.5 0.75 1km
SCALE 1:25,000 (A3)

FIGURE 3
Aerial Image



LEGEND

Subject Land

NORTH

0 20 40 60 80 100m

SCALE 1:3,000 (A3)

AERIAL PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

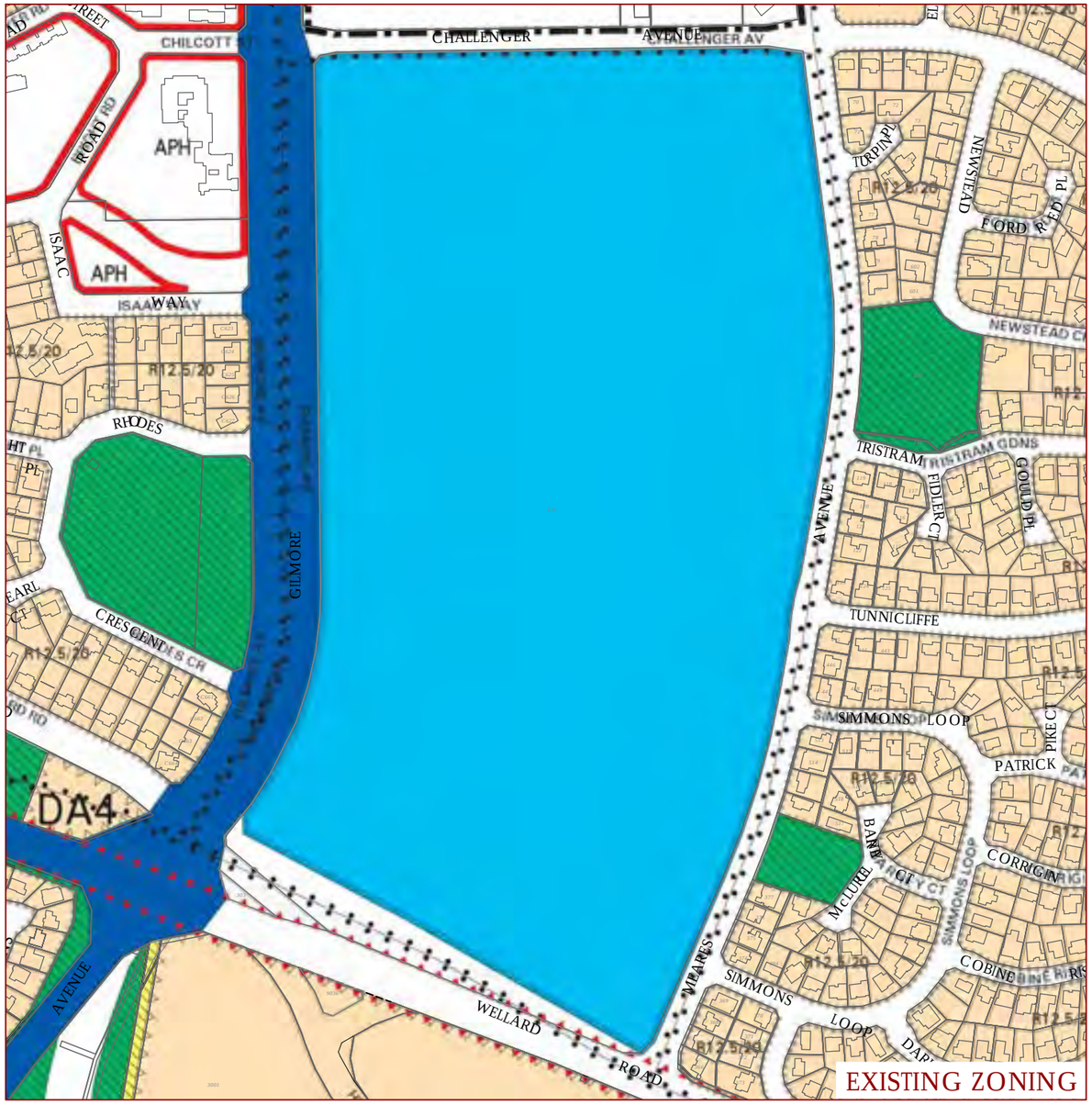
SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING

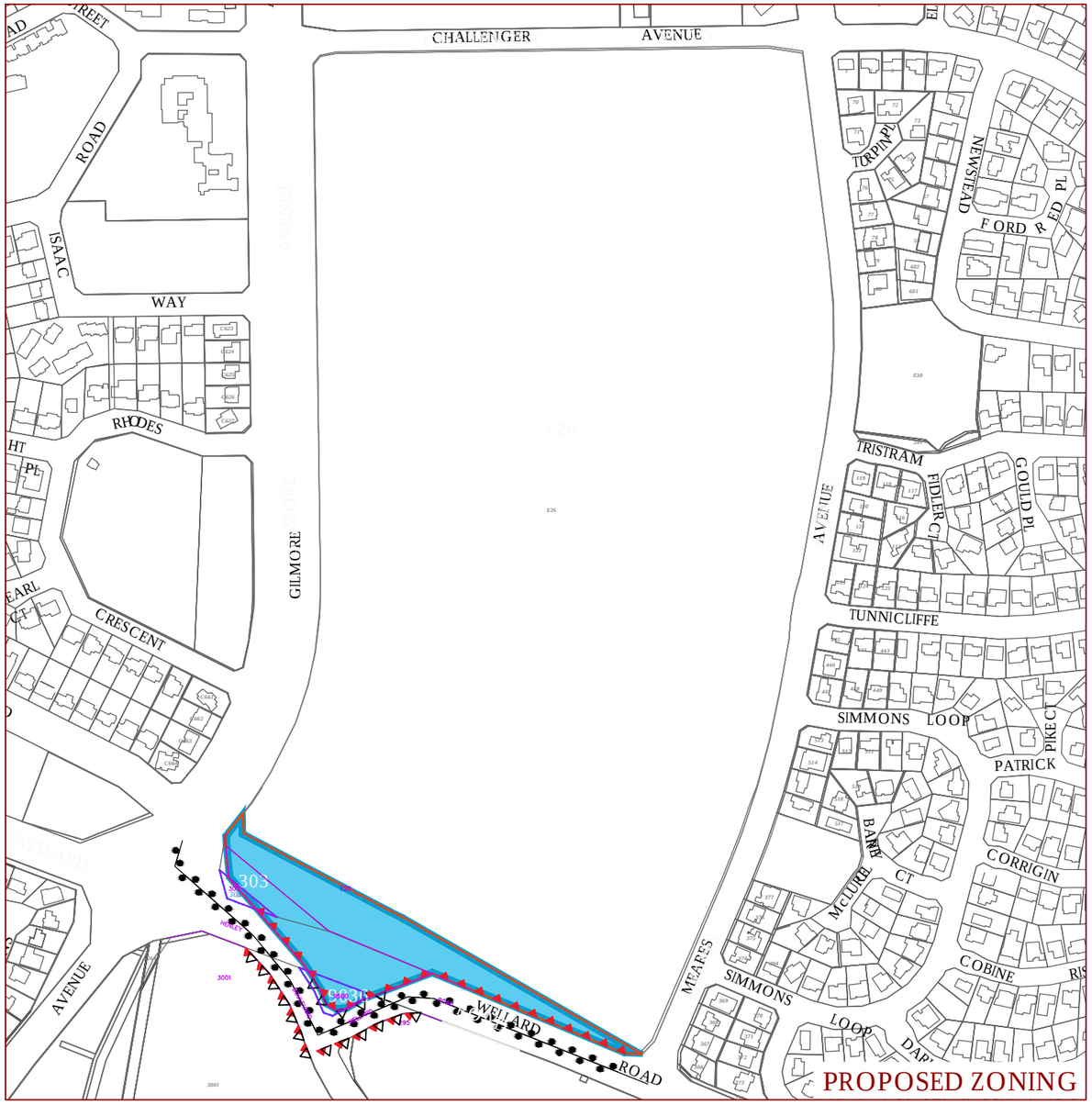
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Plan No: SAT KWI-9-04a_A
Planner: JD
Date: 26.02.13
Client: SATTERLEY/DOH

CITY OF KWINANA

FIGURE 4
Current Zoning





LEGEND

METROPOLITAN REGION SCHEME RESERVES
- OTHER REGIONAL ROADS

LOCAL SCHEME RESERVES
- PARK RECREATION & DRAINAGE
- PUBLIC PURPOSES

ZONES
- RESIDENTIAL
- KWINANA TOWN CENTRE
- SPECIAL USE

OTHER
- R20
- POLICY AREAS (SEE SCHEME TEXT)
- DRAINAGE CATCHMENT MANAGEMENT
- DEVELOPMENT AREA
- DEVELOPMENT CONTRIBUTION AREA (SEE SCHEME TEXT)

ZONES
- KWINANA TOWN CENTRE

OTHER
- DEVELOPMENT AREA
- DEVELOPMENT CONTRIBUTION AREA (SEE SCHEME TEXT)
- POLICY AREAS (SEE SCHEME TEXT)

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NORTH

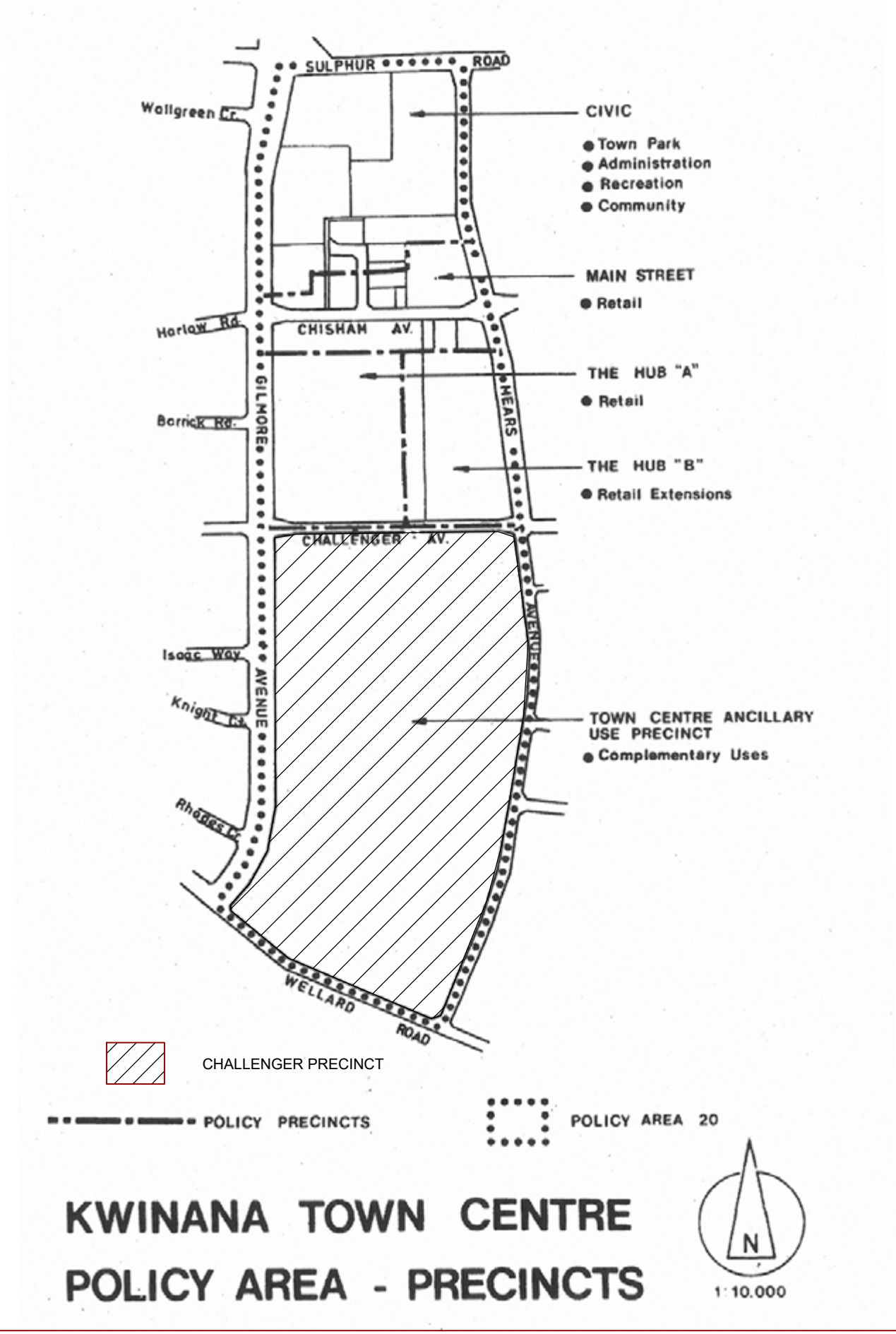
CITY OF KWINANA TPS No.2
LOTS E26, 303 & 9036 GILMORE AVENUE
CITY OF KWINANA

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P (08) 9328 6411
F (08) 9328 6511

Plan No: SAT KWI 9-04a_5 Client: Satterley
Date: 21.06.13 Planner: JD

0 50 75 100 150
SCALE 1:5,000 (A3)

FIGURE 5
Town Centre Policy Area Map



KWINANA TOWN CENTRE POLICY AREA - PRECINCTS

KWINANA TOWN CENTRE POLICY AREA

TOWN PLANNING SCHEME No.2

CITY OF KWINANA

Planner: JD Date: 26.02.13
Client: SATTERLEY Plan No: SAT KWI-9-04a_PA

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FIGURE 6

Town Centre Master Plan



NORTH

0 100 200 300 400 500m

SCALE 1:7,500 (A3)

KWINANA TOWN CENTRE MASTER PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

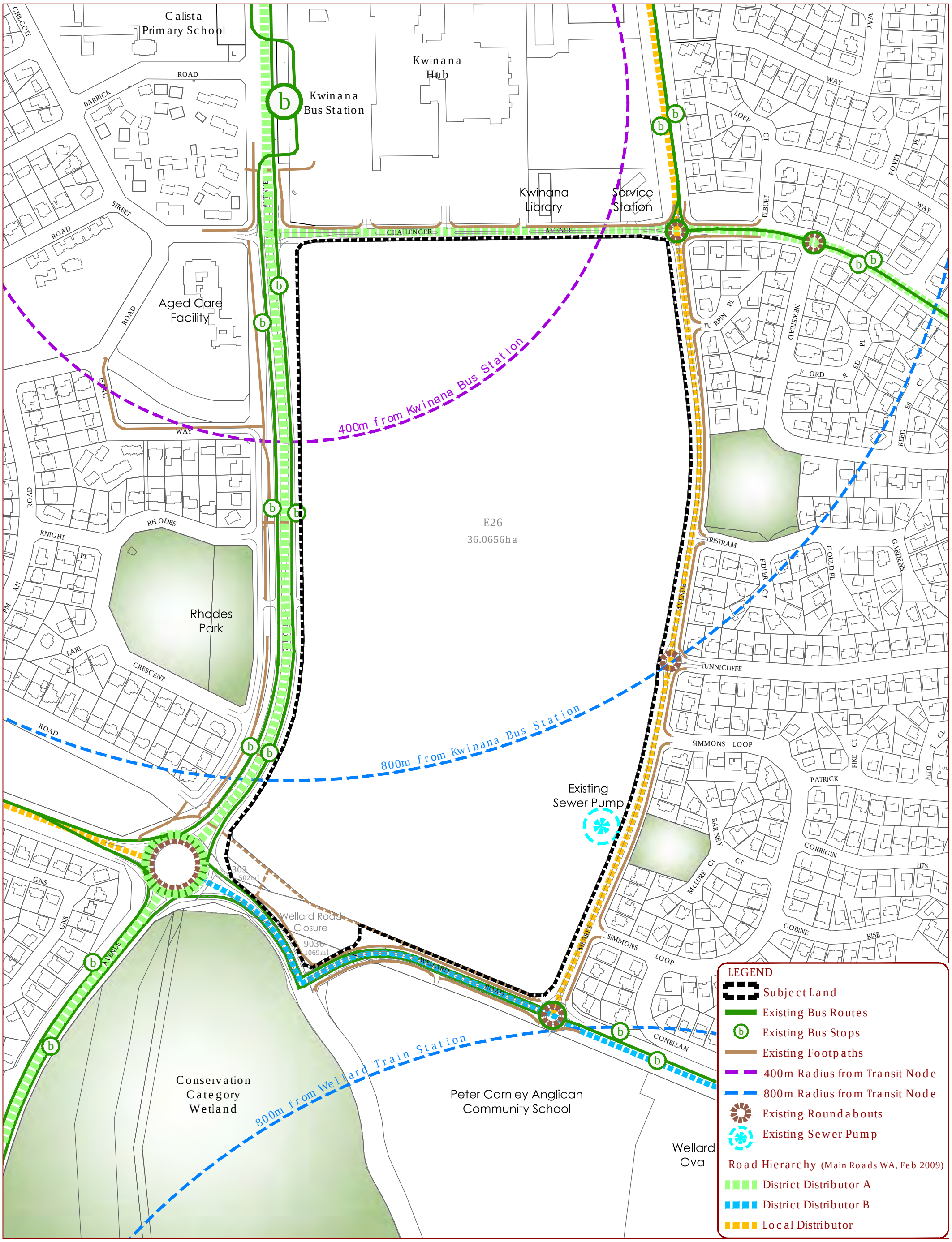
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F (08) 9328 6511

Plan No: SAT KWI-9-04a_MP Date: 26.02.13
Planner: JD Client: SATTERLEY/DOH

CITY OF KWINANA

FIGURE 7
Site Plan



NORTH

0 25 50 75 100m

SCALE 1:4,000 (A3)

SITE PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING

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www.burgessdesigngroup.com.au
P (08) 9328 6411
F (08) 9328 6511

Plan No: SAT KWI-9-04a_SP Date: 26.02.13
Planner: JD Client: SATTERLEY/DOH

CITY OF KWINANA

FIGURE 8
Land Use and Density Code Plan



LAND USE & DENSITY CODE PLAN

LOTS E26, 303 & 9036 GILMORE RD & PT CLOSED WELLARD RD

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TOWN PLANNING + URBAN DESIGN
PO Box 374 Northbridge WA 6865
www.burgessdesigngroup.com.au
P (08) 9328 6411
F (08) 9328 6511

Plan No: SAT KWI-1-14L Date: 15.07.13
Planner: JD Client: SATTERLEY/DOH

CITY OF KWINANA

FIGURE 9

Public Open Space Schedule

CHALLENGER PRECINCT STRUCTURE PLAN **PUBLIC OPEN SPACE SCHEDULE**			
Gross Site Area			36.85 ha
Deductions			
Dedicated Drainage Reserve	0.1441 ha		
1:1 Drainage within POS	0.5153 ha		(0.6594 ha)
Net Site Area (NSA)			36.19 ha
POS Required @ 10%			**3.6191 ha**
May Comprise Min 80% Unrestricted POS		2.8953 ha	
May Comprise Max 20% Restricted POS	0.7238 ha		
Total POS Areas			
POS 1			1.1447 ha
POS 2			1.1123 ha
POS 3			1.6324 ha
POS 4			0.6873 ha
POS 5			1.0867 ha
POS 6			1.1814 ha
Restricted POS			
1:5 Drainage within POS 1	0.0480 ha		
1:5 Drainage within POS 2	0.5688 ha		
1:5 Drainage within POS 3	0.3240 ha		
1:5 Drainage within POS 5	0.0945 ha		
1:5 Drainage within POS 6	0.2025 ha		
(SUB TOTAL)	(1.2378 ha)		
Landscape 4	0.2114 ha		
Landscape 5	0.1660 ha		
(SUB TOTAL)	(0.3774 ha)		
TOTAL RESTRICTED			**1.6152 ha**
Unrestricted POS			
POS 1		1.0438 ha	
POS 2		0.5435 ha	
POS 3		0.9484 ha	
POS 4		0.6873 ha	
POS 5		0.8898 ha	
POS 6		0.9789 ha	
(SUB TOTAL)		(5.0917 ha)	
Landscape 1		0.1260 ha	
Landscape 2		0.2990 ha	
Landscape 3		0.2668 ha	
(SUB TOTAL)		(0.6918 ha)	
TOTAL UNRESTRICTED			**5.7835 ha**
TOTAL CREDITABLE POS PROVIDED			7.3987 ha
FUNCTIONALITY OF POS	Restricted	Unrestricted	
Overall Percentage (%)	21.83 %	78.17 %	
TOTAL CREDITABLE POS PROVIDED (AS % OF NSA)			**20.45 %**

**The surface area requirements for drainage are estimates in accordance with the E26 Challenger Precinct Local Water Management Strategy.*

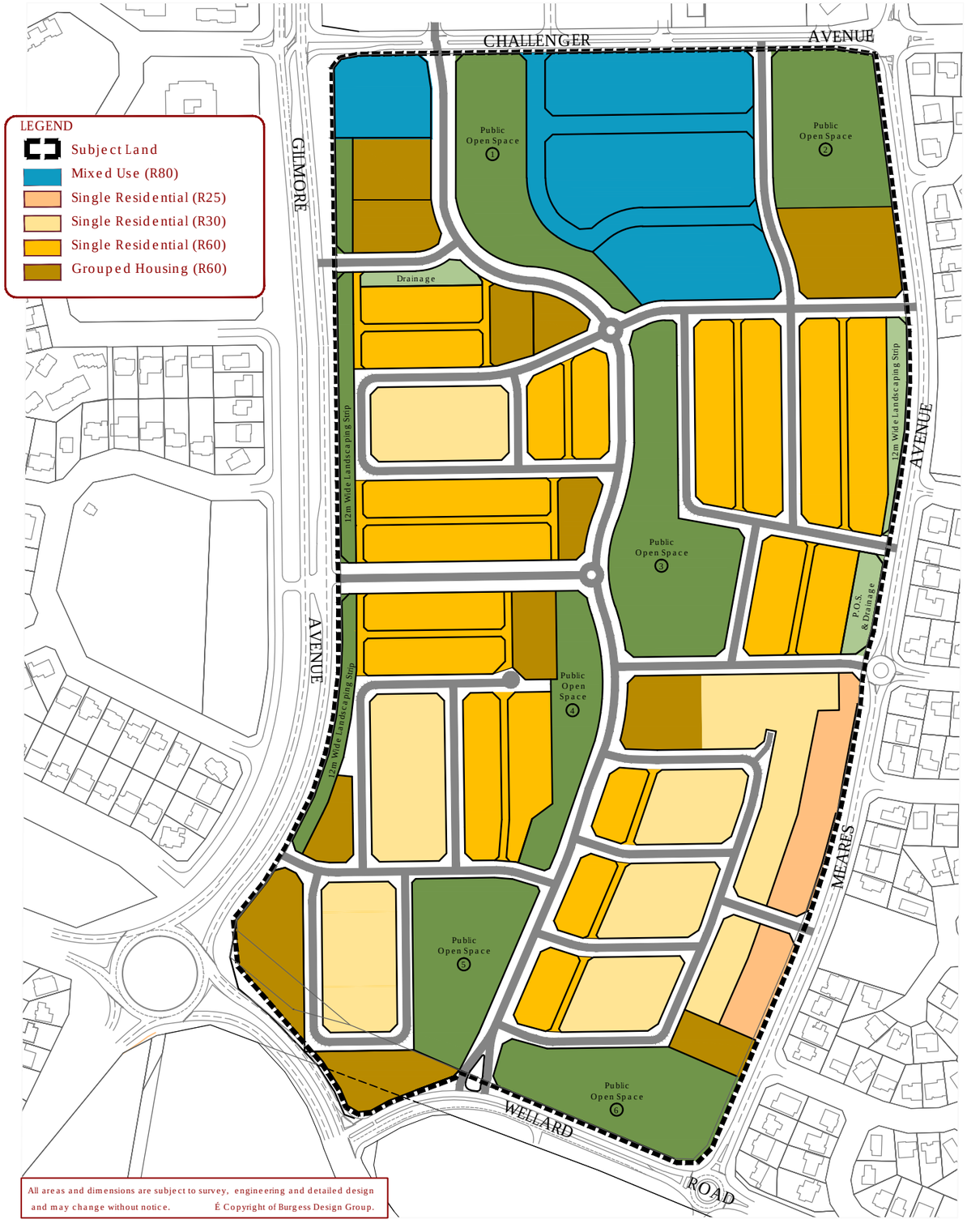
***1:1 year drainage areas have been deducted from the gross site area*

****For POS Areas 2 and POS Area 6, 1:1 year drainage is being contained within below ground Atlantis Cell Systems (or similar as approved by the City)*

*****These figures have been derived for the purposes of structure planning and shall be refined as part of the detailed engineering design, subdivision and landscape treatment in consultation with the City of Kwinana.*

FIGURE 10

Built Form Housing Typologies



All areas and dimensions are subject to survey, engineering and detailed design and may change without notice. É Copyright of Burgess Design Group.

KWINANA STRUCTURE PLAN & HOUSE TYPES

R25/30/60 Single Residential



R60 Grouped Housing



R80 Maisonette



Public Open Space



Residential/Mixed Use



Key Bus Routes



Key Cycle Routes





NORTH

STRUCTURE PLAN & HOUSE TYPES

LOTS E26, 303 & 9036 GILMORE RD & PT CLOSED WELLARD RD

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING

CITY OF KWINANA

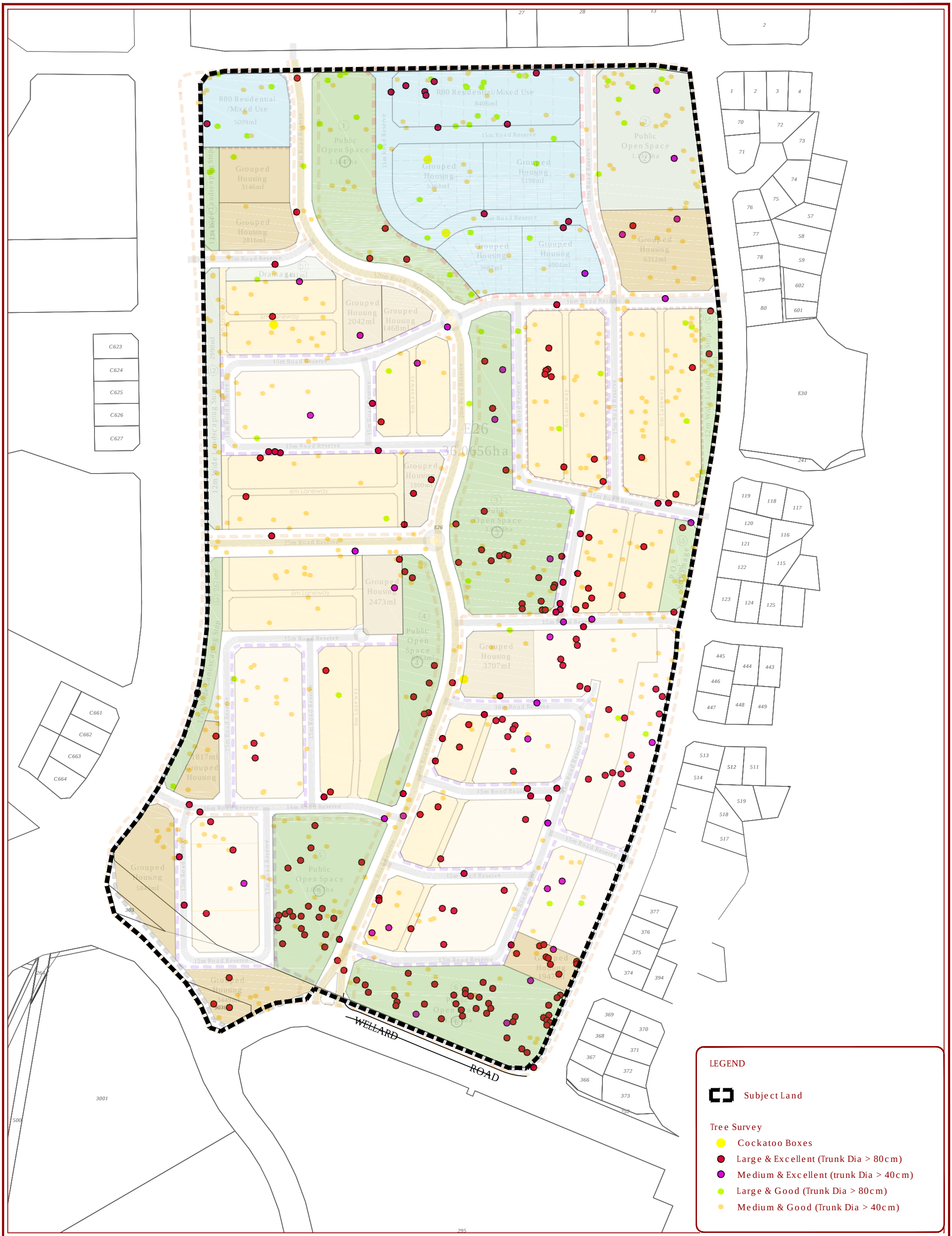
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F (08) 9328 6511

Plan No: SAT KWI-1-14k Date: 11.07.13
Planner: JD Client: SATTERLEY/DOH

0 25 50 75 100m
SCALE 1:4,000 (A3)

FIGURE 11

Aerial with LSP Overlay



TREE SURVEY OVERLAY PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

SATTERLEY/ PROPERTY GROUP / DEPARTMENT OF HOUSING

CITY OF KWINANA

Plan No: SAT KWI-1-14R Date: 09.01.14
Planner: JD Client: SATTERLEY/DOH

APPENDIX 1
Land Ownership – Certificates of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
E26/DP214425	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 2157 FOLIO 159

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

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT E 26 ON DEPOSITED PLAN 214425

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

THE STATE HOUSING COMMISSION OF 99 PLAIN STREET, EAST PERTH
(A H058912) REGISTERED 22 MARCH 1999

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

1. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE.
2. D418163 EASEMENT TO WATER AUTHORITY OF WESTERN AUSTRALIA. SEE SKETCH ON VOL 2157 FOL 159. REGISTERED 16.2.1987.

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

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

STATEMENTS:

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

SKETCH OF LAND:	2157-159 (E 26/DP214425).
PREVIOUS TITLE:	1548-304.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	TOWN OF KWINANA.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1: A000001A LAND PARCEL IDENTIFIER OF KWINANA TOWN LOT/LOT E26 (OR THE PART THEREOF) ON SUPERSEDED PAPER CERTIFICATE OF TITLE CHANGED TO LOT E26 ON DEPOSITED PLAN 214425 ON 30-SEP-02 TO ENABLE ISSUE OF A DIGITAL CERTIFICATE OF TITLE.

NOTE 2: THE ABOVE NOTE MAY NOT BE SHOWN ON THE SUPERSEDED PAPER CERTIFICATE OF TITLE OR ON THE CURRENT EDITION OF DUPLICATE CERTIFICATE OF TITLE.

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WESTERN AUSTRALIA

REGISTER NUMBER	
303/DP47729	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF QUALIFIED CERTIFICATE OF CROWN LAND TITLE

VOLUME LR3137 FOLIO 321

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

LAND DESCRIPTION:

LOT 303 ON DEPOSITED PLAN 47729

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE UNDER MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: TOWN OF KWINANA OF PO BOX 21, KWINANA
(XE J582389) REGISTERED 12 JANUARY 2006

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

1. J920795 PART RESERVE 48475 FOR THE PURPOSE OF RECREATION REGISTERED 19.9.2006.
J582389 MANAGEMENT ORDER. CONTAINS CONDITIONS TO BE OBSERVED. REGISTERED 12.1.2006.

Warning: (1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

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

SKETCH OF LAND:	DP47729 [SHEET 1].
PREVIOUS TITLE:	THIS TITLE.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	TOWN OF KWINANA.
RESPONSIBLE AGENCY:	DEPARTMENT OF REGIONAL DEVELOPMENT AND LANDS (SLSD).

NOTE 1: J634115 CORRESPONDENCE FILE 51156-2005-01RO

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WESTERN AUSTRALIA

REGISTER NUMBER	
9036/DP75365	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	N/A

RECORD OF CERTIFICATE OF TITLE

VOLUME 2806 FOLIO 173

UNDER THE TRANSFER OF LAND ACT 1893

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

REGISTRAR OF TITLES

Subject to Dealing

LAND DESCRIPTION:

LOT 9036 ON DEPOSITED PLAN 75365

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

1. HOUSING AUTHORITY OF 99 PLAIN STREET, EAST PERTH
(AF M114972) REGISTERED 17 JANUARY 2013

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

1. *I886032 CAVEAT BY WESTERN AUSTRALIAN PLANNING COMMISSION AS TO PORTION ONLY. LODGED 14.5.2004.
2. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 58621.
3. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR WATER PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 58621.
4. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 70906.
5. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION - SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 70930.
6. *L686275 CAVEAT BY PEET SOUTHERN JV LTD LODGED 20.7.2011.
7. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 72682
8. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR ELECTRICITY PURPOSES TO ELECTRICITY NETWORKS CORPORATION SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 72682
9. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR SEWERAGE PURPOSES TO WATER CORPORATION SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 73956.
10. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR WATER PURPOSES TO WATER CORPORATION SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 73956.
11. *EASEMENT BURDEN CREATED UNDER SECTION 167 P. & D. ACT FOR ELECTRICITY PURPOSES TO ELECTRICITY NETWORKS CORPORATION SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 73956.
12. *EASEMENT BURDEN CREATED UNDER SECTION 136C T.L.A. FOR RIGHT OF SUPPORT PURPOSES - SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 73956 AND INSTRUMENT M38788.
13. *EASEMENT BURDEN CREATED UNDER SECTION 136C T.L.A. FOR RIGHT OF SUPPORT PURPOSES - SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 73956 AND INSTRUMENT M38789.

END OF PAGE 1 - CONTINUED OVER

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*** SUBJECT TO DEALING *** *** SUBJECT TO DEALING ***

14. *EASEMENT BURDEN CREATED UNDER SECTION 136C T.L.A. FOR RIGHT OF SUPPORT PURPOSES - SEE DEPOSITED PLAN 75365 AS CREATED ON DEPOSITED PLAN 73956 AND INSTRUMENT M38790.

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SKETCH OF LAND:	DP75365 [SHEET 1].
PREVIOUS TITLE:	2802-374.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	TOWN OF KWINANA.
RESPONSIBLE AGENCY:	DEPARTMENT OF HOUSING (SSHC).

NOTE 1: DUPLICATE CERTIFICATE OF TITLE NOT ISSUED AS REQUESTED BY DEALING M38792

NOTE 2: M191457 DEPOSITED PLAN 75373 LODGED

Subject to Dealing

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*** SUBJECT TO DEALING *** *** SUBJECT TO DEALING ***

APPENDIX 2
Environmental Assessment

360 environmental

Lots E26, 303 and 9014
Gilmore Avenue, Kwinana

Environmental Assessment Report

Prepared for:
Department of Housing/Satterley Property Group

April 2012

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
665 AB	A DRAFT	JT	TS, PE, DW	1 Electronic (email) 1 hard copy	9 April 2009
665 AB	B CLIENT FINAL	JT	TC	1 Electronic (email) 1 hard copy	28 May 2009
LD008 AA	C CLIENT FINAL	RH	JT	1 Electronic (email) 1 hard copy	17 June 2011
LD008-3 AB	D CLIENT FINAL	MH	RH, FD. PE	1 Electronic (email) 1 hard copy	13 April 2012

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Appendix B Department of Sustainability, Environment, Water, Population and Communities' *Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool* results

Appendix C Department of Environment and Conservation's *Threatened and Priority Ecological Communties Database* Search Results

Appendix D Department of Environment and Conservation's *Threatened and Priority Fauna Database* Search Results

Appendix E Department of Indigenous Affairs' *Aboriginal Heritage Inquiry System* Search Results

1 Introduction

1.1 Background

In October 2005, 360 Environmental Pty Ltd (360 Environmental) provided a preliminary report to Satterley Property Group (Satterley), on behalf of the Department of Housing (DoH) on the environmental opportunities and constraints associated with the potential development of Lots E 26, 303 and 9014 Gilmore Avenue, Kwinana, known as the Kwinana Town Centre (the site) (Figure 1). This report was updated in 2011 by 360 Environmental.

A proposed local structure plan (LSP) has been submitted to the Town of Kwinana (ToK) for review under Clause 6.17.4 of Town of Kwinana Town Planning Scheme No 2. The Town of Kwinana has provided a response to Satterly and DoH on 30 January 2012. This environmental assessment report has been updated to incorporate current information to meet the requirements of the ToK's response to the LSP.

1.2 Objective

The main objective of the assessment was to undertake a review of the environmental opportunities and constraints associated with the site. This report has been updated in April 2012 to reflect current information.

1.3 Scope of Work

The following scope of work has been undertaken:

- A review of the previous environmental opportunities and constraints assessment undertaken by 360 Environmental in 2005 and 2011;
- Update the previous environmental opportunities and constraints assessment with current environmental information including desktop fauna assessment; and
- Review the 2006 flora and vegetation survey undertaken by 360 Environmental.

1.4 Report Format

The remainder of this report is comprised of the following components:

- Section 2 – Site Description and Preliminary Assessment;
- Section 3 –Site History;
- Section 4 –Opportunities and Constraints Summary;
- Section 5 – Recommendations;
- Section 6 - Limitations; and

- Section 7 - References

2 Site Description and Preliminary Assessment

The site, encompassing an area of 36.7 hectares (ha), is located on the corner of Gilmore Avenue and Wellard Road in Kwinana and is known as Lots E 26, 303 and 9014 Gilmore Avenue, Kwinana (Figure 1). The site is currently owned by the State Housing Commission and is zoned 'Kwinana Town Centre' under the ToK's Town Planning Scheme No. 3 (Western Australia Planning Commission [WAPC], 2012). The zoning of the site has recently been updated under Kwinana Town Planning Scheme No. 3. The southern portion of the site is now zoned 'Shopping/Business'. The centre portion of the site is zoned 'Market Square'. The north-west corner is zoned 'General Town Centre' and the eastern portion is zoned 'Town Centre Residential' (WAPC, 2012).

The majority of the subject site is comprised of uncleared bushland. A small portion of the site on the eastern boundary has been cleared and fenced for Water Corporation sewage infrastructure.

The site surface ground level is undulating with several drainage features on the western and northern sides. Some uncontrolled fill, predominantly comprising of soils, has been stockpiled in the southern and northern portions. The site vegetation generally appears to be in good condition, however, there is a significant amount of general rubbish and several weed species. The site has several dirt paths and tracks throughout.

2.1 Proposed Development

It is proposed the site is to be developed as a mix of residential densities with some commercial sites in the northern portion.

2.2 Surrounding Land Use

The site is bounded by the Kwinana Hub Shopping Centre to the north and uncleared bushland and Conservation Category Wetland to the south. Residential areas can be found on the western and eastern boundaries of the site. The site and surrounding areas are currently zoned 'Residential' under the Town of Kwinana –Town Planning Scheme No. 3 (WAPC, 2012).

2.3 Topography and Surface Hydrology

The site currently features an undulating surface with existing ground levels ranging between approximately seven metres (m) Australian Height datum (AHD) and 13.5 mAHD.

The majority of the site features undeveloped bushland. On the western boundary there are a number of road drains that enter the site and flow into several sump areas. On the

northern boundary a large drainage sump is present which appears to take stormwater runoff from the adjacent Kwinana Hub Shopping Centre car park.

Due to the site drainage features and the Town of Kwinana Subdivision Standards (2005), a stormwater drainage management system may be required due to the amount of stormwater currently diverted into the site and the additional stormwater management that will be required for the development. It is also expected the Western Australian Planning Commission's (WAPC) *Liveable Neighbourhoods* and the Department of Water's (DoW's) *Stormwater Management Manual for Western Australia* (2004-2007) will be applicable.

2.4 Regional Geology and Hydrogeology

Regional geological mapping (Gozzard, 1986 and Davidson, 1995) identifies the site as comprised of sands derived from Tamala Limestone. They feature pale yellow brown, fine-to-coarse grained, sub-angular to well rounded quartz, with high-to-medium permeability and contribute to groundwater infiltration. Site observations confirm the sandy nature of the site soils.

Hydrogeological information obtained from the DoW's Perth Groundwater Atlas (2012) indicates groundwater is located at approximately three mAHD and ranges between approximately 4 - 10.5 m below the natural ground surface. It is expected that groundwater will generally flow in an approximate west, south-west direction.

The site is not located in a Public Drinking Water Source Protection Area.

2.5 Acid Sulfate Soils

The WAPC's (2009) Planning Bulletin Number 64 indicates the site has a no known risk of Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soils (PASS) occurring generally at depths greater than three metres (Figure 2).

However, as the site is within 500 m of an area mapped as high risk for the presence of AASS or PASS, an Acid Sulfate Soils investigation is required. An Acid Sulfate Soils Dewatering Management Plan will be required if Acid Sulfate Soils are present in the area and dewatering is to be undertaken or there is significant disturbance of soils below groundwater level (Department of Environment, 2003-2006).

The Acid Sulfate Soils investigation should assess the extent and nature of AASS or PASS at the site and will determine if any management requirements are needed in the event of future earthworks or groundwater dewatering that may be associated with future development of the site (DEC, 2006).

2.6 Wetlands

There are no Ramsar wetlands or Directory of Important Wetlands on the site (SEWPAC, 2012). Three wetlands of international significance were identified as

occurring within 10 km of the site (SEWPAC, 2012), the nearest is Forrestdale and Thomsons Lake approximately 9.7 km to the north of the site. The nearest Directory of Important Wetlands site is located approximately 2.6 km to the north-east of the site and is known as "Spectacles Swamp" (SEWPAC, 2012) and is part of the Spectacles Wetlands.

Wetlands of the site have been described and mapped by Hill et al. (1996) and assigned a management category which reflects their condition and environmental values. There are three categories that wetlands are assigned, 'Conservation Category' (CCW), 'Resource Enhancement' (REW) and 'Multiple Use' (MUW) depending on their condition and environmental values. 'Conservation Category' wetlands being those with the highest level of ecological attributes and functions, followed by 'Resource Enhancement' then "Multiple Use".

There are no wetlands mapped as occurring on the site, however there is a CCW wetland located approximately 280 m south of the site (Figure 2). This distance is outside any separation distance guidelines (EPA, 2008).

2.7 Flora and Vegetation

2.7.1 Desktop Searches

A search of the DEC's Threatened (*Declared Rare)* and *Priority Flora* database (DEC, 2012a), and the Western Australian Herbarium Database (WA Herbarium, 2012), was undertaken to identify the potential for DRF or priority species to exist on the site (Figure 3) (Appendix A). The results of the search indicated there are no Declared Rare Flora (DRF) or Priority species that have been previously recorded within the site. One Priority Four (P4) flora species, *Stylidium ireneae,* was however listed as occurring within 1.5 km of the site.

A search of SEWPAC's *Environment Protection and Biodiversity Conservation (EPBC) Act 1999 Protected Matters Search Too*l (2012) (Appendix B) was undertaken and identified six significant species of flora that potentially may occur within the area. These are:

- *Andersonia gracilis* (Slender Andersonia) – Endangered;
- *Caladenia huegeli*i (King Spider-orchid, Grand Spider-Orchid) – Endangered;
- *Centrolepis caespitosa* – Endangered;
- *Darwinia fotetida* (Muchea Bell) – Critically Endangered;
- *Drakaea elastica* (Glossy-leaved Hammer-orchid, Praying Virgin) – Endangered; and
- *Lepidosperma rostratum* (Beaked Lepidosperma) – Endangered.

A search of the DEC's Threatened Ecological Community (TEC) database (2012b) identified that there were no TECs known to occur within 2.5 km of the site (Figure 3) (Appendix C).

2.7.2 Flora and Vegetation Survey

A flora and vegetation survey was undertaken on 20 September and 9 October, 2006. During the survey there were no DRF, Priority Flora or species of conservation significance recorded (360 Environmental, 2006).

110 species of native flowering plants and two native Gymnosperms (one native cycad (the Zamia Palm, *Macrozamia riedlei*) and one native pine (*Callitris canescens*) were recorded from the survey area. In addition, a high number of weed species (37) were recorded from the survey area. A relatively low number of annual or ephemeral native plants (particularly herbs) were recorded during the survey. The significant weed cover in most parts of the survey area would have impacted on the presence or abundance of these plants.

No DRF species were recorded in the survey area during the survey work carried out for this report. No Priority species were recorded during the survey. None of the species recorded in the survey area were considered to be 'Significant Flora of the Perth Metropolitan Region' (DEP, 2000). No other species recorded in the survey area were considered of special conservation significance.

Nine vegetation units were defined and mapped for the survey area (Figure 4). These could be classified into four broader vegetation groups: Jarrah Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands. The Tuart woodlands included Jarrah and Banksia elements and are therefore closely related to the Jarrah Banksia woodlands group. The Jarrah-Banksia vegetation units covered the largest part of the survey area.

The condition of vegetation in the survey area was mostly in the range of 'Good' to 'Very Poor'. Some 'Completely Degraded' areas were also recorded. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover. Perennial veldt grass (**Ehrharta calycina*) formed a grassland and sometimes a closed grassland over most of the survey area and was the most dominant and widespread weed. Some physical disturbance occurred in various places in the survey area.

It was noted that the crowns of many of the Jarrah trees in the survey area were very brown and the trees appeared to be in poor health. This was due to what appeared to be intensive Jarrah leafminer damage (caused by the larvae of the moth, *Perthida glyphopa*).

Dead Banksia trees were recorded at four sites in the survey area. Between 1 and 6 dead trees were recorded at each location. One group of deaths was around a sump and

the deaths may be related to the sump. No other obvious signs of Jarrah dieback were noted. An accredited dieback interpreter would need to survey the dead Banksia sites to determine if dieback was in the survey area.

A review of the DEC's Floristic Community Types (FCT) data shows that Spearwood FCT's 21a, 24, 25 and 28 occur in the locality of the site. The Jarrah Banksia woodland unit quadrats and Tuart woodland units had similarities with all of the FCT's 21a, 24, 25 and 28, but appeared to be closest to FCT 28. The limestone shrubland units were most similar to FCTs 24 and 28. None of the Spearwood FCTs 21a, 24, 25 and 28 have TEC status, though FCTs 24 and 25 are listed as Priority 3 Priority Ecological Communities (PECs).

A search of the DEC's *Threatened Ecological Community* database showed that two TECs had been recorded within five kilometres of the site. The vegetation in the site survey area did not belong to either of these TECs.

112 native species were recorded from the survey area and this is a modest number for the size of the survey area (36.7) on Spearwood sands. The number of species recorded in the site suggests a 'moderate general' value for flora.

As no DRF or Priority taxa were recorded in the survey area and no species were recorded that would be considered to be 'Significant Flora of the Perth Metropolitan Region' (DEP, 2000), the conservation value for species of conservation significance in the survey area could be considered low.

The vegetation units in the site were inferred to be FCTs 28 or 24, which are not TEC units. Nor were either of the TECs that occur in the locality of the site (TEC26a and 19b) found to occur in the site. As no TECs appeared to occur in the site is was suggested the vegetation conservation values for the site is likely to be considered moderate.

However, Tuart occurred in the survey area as Tuart open woodland and in other units as a scattered trees in the tree strata. Tuart vegetation has high conservation status because of the variation within Tuart vegetation relative to the area protected and because of the extensive significant impact by grazing, frequent fire, weed invasion and other threatening processes on tuart communities. However, the Tuart units in the survey area were ranged from mostly 'Good' to 'Very Poor', with small patches in 'Good' to 'Very Good' condition.

With regard to the regional significance of the survey area vegetation, it belonged to the Cottesloe Complex – Central and South. The remaining area of the Cottesloe Complex – Central and South is 41.1percent, while its remaining area in secure tenure is 8.8 percent (EPA, 2003).

The site contains one landform unit, with a modest diversity of vegetation units and could therefore be considered as having moderate values for diversity. Therefore, the overall vegetation conservation value for the site was considered to be moderate to high. While

there are no TECs in the survey area, the vegetation has additional value because of the presence of Tuart vegetation units (albeit in generally poor condition) and the fact that less than 15 percent of the Cottesloe Complex – Central and South is in secure tenure.

A Level 2 Flora and Vegetation Survey will be undertaken in Spring 2012.

2.8 Fauna

2.8.1 Desktop Searches

A search of the DEC's (2012c) *Threatened and Priority Fauna database* has indicated several threatened or priority fauna have been recorded within a 5 km radius of the site (Appendix D), as follows:

- *Calyptorhynchus latirostris* (Carnaby's Black-Cockatoo) –Threatened;
- *Charadrius rubricollis* (Hooded Plover) – Priority 4;
- *Falco peregrines* (Peregrine Falcon) – Specially Protected;
- *Hydromys chrysogaster* (Water rat) – Prirority 4;
- *Isoodon obesulus subsp. fusciventer* (Quenda) – Priority 5;
- *Lerista lineata* (Lined Skink / Perth Slider) – Priority 3;
- *Macropus Irma* (Western Brush Wallaby) – Priority 4;
- *Neelaps calonotos* (Black-striped Snake) – Priority 3;
- *Notoscincus butleri* (Lined Soil Crevice Skink) – Priority 3; and
- *Tiliqua rugosa subsp. konowi* – Threatened.

A search of SEWPAC's (2012) *Protected Matters Search Tool* (Appendix B) was undertaken and identified five vulnerable, three endangered and five migratory species listed under the EPBC Act as potentially occurring within three kilometres of the site:

- *Calyptorhynchus banksii naso* (Forest Red Tailed Black Cockatoo) – Vulnerable – species or species habitat likely to occur within area;
- *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo) – Endangered – species or species habitat likely to occur within area;
- *Leipoa ocellata* (Malleefowl) – Vulnerable/Migratory – Species or species habitat may occur within area;
- *Rostratula australis* (Australian Painted Snipe) – Vulnerable/Migratory – Species or species habitat may occur within area;
- *Sternula nereis nereis* (Fairy Tern) – Vulnerable – Species or species habitat known to occur within area;

- *Synemon gratiosa* (Graceful Sun Moth) – Endangered – species or species habitat likely to occur within area;
- *Dasyurus geoffroii* (Chuditch, Western Quoll) – Vulnerable – Species or species habitat likely to occur within area;
- *Phascogale calura* (Red-tailed Phascogale) – Endangered – Species or species habitat may occur within area;
- *Setonix brachyurus* (Quokka) – Vulnerable – Species or species habitat may occur within area;
- *Apus pacificus* (Fork-tailed Swift) – Migratory – species or species habitat likely to occur within area;
- *Ardea alba* (Great Egret) – Migratory – species or species habitat likely to occur within area;
- *Ardea ibis* (Cattle Egret) – Migratory – species or species habitat likely to occur within area;
- *Haliaeetus leucogaster* (White-Bellied Sea Eagle) – Migratory – species or species habitat likely to occur within area; and
- *Merops ornatus* (Rainbow Bee-eater) – Migratory – species or species habitat likely to occur within area.

Due to the modified environment it is considered unlikely that many of these species rely on the site for habitat or feeding.

Of the bird species listed, the cockatoo species are the most likely to be present as there are mature eucalypts and banksias present on the site. These trees are utilised by cockatoo species for nesting and feeding habitat.

The flora and vegetation survey observed at least six native flora species that are known to be utilised by Carnaby's Cockatoo as a food source. The flora species observed are:

- *Xanthorrhoea preisssii* (seed);
- *Allocasuarina fraseriana* (seed);
- *Banksia attenuata* (seed, flower, invertebrates associated with flora species);
- *Banksia grandis* (seed, flower);
- *Hakea prostrate* (seed); and
- *Acacia salinga* (bark, invertebrates associated with flora species).

2.8.2 Targeted Black Cockatoo Survey

A targeted black cockatoo survey was undertaken across the site in March 2009. The survey included traversing the site to identify and confirm the presence/absence of site

usage by black cockatoos. The results indicate the site is utilised by both Carnaby's Black Cockatoo and the Forest Red-Tailed Black Cockatoo (*Calyptorhynchus banksii naso* – listed as 'Rare or likely to become extinct' under Schedule 1 of the *Wildlife Conservation Act 1950*) for feeding and potentially also for nesting. The level of use though was not as high as was expected based on the flora and vegetation present.

2.8.3 Graceful Sun Moth Survey

A survey methodology following DEC Graceful Sun Moth Information Kit and Survey Methods Version 1.2 (Nov 2010) was undertaken at the site in 2010 and no Graceful Sun Moths were recorded (360 Environmental, 2010).

2.9 Conservation Areas

The Kwinana Town Centre site is outside any Bush Forever Sites (BFS), environmentally sensitive areas (ESA) and wetlands of conservation significance (Figure 2 and 3). The proposed development site is situated outside conservation reserves and parks, including the Leda Nature Reserve.

A search of the SEWPAC's *Protected Matters Search Tool* (SEWPAC, 2012) indicated the site is within 10 km of one Ramsar site (Forrestdale and Thompsons Lakes) and is located upstream of two others (Peel-Yalgorup System and Becher Point Wetlands).

2.10 Heritage

2.10.1 Aboriginal

In Western Australia, the *Aboriginal Heritage Act 1972* protects places and objects customarily used by, or traditional to, the original inhabitants of Australia. A register of such places and objects is maintained under the Act, however, all sites are protected under the Act whether they have been registered or not.

A search of the Aboriginal Heritage database shows nearby sites of Aboriginal heritage of significance, however, no sites have been reported for the Kwinana Town Centre (Appendix E). S If any heritage sites are found within the Kwinana Town Centre, a Section 18 application under the *Aboriginal Heritage Act 1972*, will be required to disturb sites.

2.10.2 European

A search of the Heritage Council database of culturally significant sites in Western Australia was undertaken for the Kwinana Town Centre area. Whilst there are significant sites adjacent to the Kwinana Town Centre, such as the Leda Nature Reserve and the Fire Station, the search found that there are no reported culturally significant heritage on the site (Heritage Council of Western Australia, 2012).

2.11 Town of Kwinana Biodiversity Strategy

The Town of Kwinana has developed a Local Biodiversity Strategy (LBS), by which the preservation of vegetation can be advanced to ensure biological systems are protected (Town of Kwinana, 2009). The LBS highlights that much of the remaining Bassendean Central and South Vegetation Complex remaining in the Town is located within the Eastern Residential Intensification Concept (ERIC) Area (438.5 ha) or on Special Rural type subdivisions of the localities of Wandi, Anketell, Casuarina and Wellard (878 ha). The LBS recommends protecting at least 30 hectares of vegetation within the future residential areas created through the Eastern Residential Intensification Concept. The LBS further recommends that the following principles be considered when preserving bushland in urban areas:

- At least 4 hectares in size;
- Compact in size and shape, with a low perimeter to area ratio;
- Have at least 75% of their area in good or better condition; and
- Is within 500 m of another protected natural area and located within a planned ecological linkage.

The Town of Kwinana also recommend:

- That any development be designed and implemented to ensure a high resilience against weed invasion and other threats, such as fire and disease (dieback);
- The Local Structure Planning process may require two spring surveys to confirm the presence of any Declared Rare Flora, Priority Flora, TECs and PECS; and
- Spring vegetation surveys should include an assessment of the conservation significance of the vegetation surveyed.

The results of spring surveys will be used to determine areas of natural vegetation for protection (Town of Kwinana, 2009).

3 Site History

3.1 Site History Investigations

A site history study was undertaken as part of the initial environmental opportunities and constraints assessment (360 Environmental, 2005). Historical site activities within the site were investigated from the following sources:

- A review of historical aerial photographs from 1953 to present;
- A review of historical title information to identify previous landholders and any memorial listings;
- Discussions with a Town of Kwinana's Environmental Officer; and
- A site inspection by an environmental scientist to observe environmentally relevant aspects.

3.2 Site History Findings

The main findings of the site history review are:

- There is no evidence that the site has been historically cleared;
- The site has remained in the ownership of the State Housing Commission since the Crown granted it the parcel of land known as Kwinana Lot E26 in 1979;
- A portion of the land on the eastern boundary was transferred to the former Water Authority of Western Australia for sewage infrastructure purposes in 1987;
- Surrounding land uses include residential subdivisions to the west and north of the Kwinana Town Centre site that were developed between 1964 and 1973. The neighbouring eastern residential subdivision was developed between 1984 and 1994;
- The site appears to be used as an area for road drainage and nearby shopping centre car park drainage;
- The Town of Kwinana, Environmental Officer has indicated that the site has been subject to illegal dumping, frequent fires and significant weed invasion at the site; and
- The pathways though the site are currently used by school children (walking and on bikes) and other public.

4 Summary of Environmental Factors

Information has been provided on site characteristics including past land uses, hydrology, hydrogeology, geology, soils, flora, vegetation, fauna, conservation, heritage and contamination.

Based on this assessment of current available information, there are minimal environmental constraints associated with the three investigation areas. The environmental factors at each of the investigation areas are summarised below (Table 1):

Table 1: Summary of Environmental Factors

Factors		Considerations
Flora and Vegetation	• Removal of vegetation across the site will likely require a Clearing Permit in accordance with the EP Act and the Environmental Protection *(Clearing of Native Vegetation) Regulations 2004.* • No DRF, TECs or PECs are recorded as occurring on site.	• Possibility to retain mature Eucalypt and Banksia trees where possible.
Fauna	• Cockatoo survey indicates site is used by Carnaby's and Forest-Red Tailed Black Cockatoo species. • Site used by Black Cockatoos for foraging and potentially nesting. • GSM survey has already ruled out the presence of GSM on the site	• Where possible, retain the larger and mature trees for habitat and feeding purposes.
Wetlands and Drainage	• Several offsite drains empty into site. • No wetlands present on site. • Nearest conservation significant wetland is approximately 280 m south of the site.	• Follow the DoW's *Stormwater Management Strategy*.
Contamination and site history	• Site history indicates there is unlikely to be contamination issues associated with the site.	• There is unlikely to be any considerations relating to contamination.

5 Recommendations

The initial environmental opportunities and constraints assessment undertaken by 360 Environmental (2005) was reviewed and compared against current information. The comparison of Town of Kwinana's Local Biodiversity Strategy and other relevant regulatory frameworks indicates recent changes in policy have increased what is considered significant.

Comparing the results of the current desktop flora and vegetation assessment against the results of the flora and vegetation field survey undertaken in spring 2006 (360 Environmental, 2006) indicated there are areas of the site considered to be in good condition, no DRF, PECs or TECs. Although the site contains remnant vegetation, and potentially one priority flora species, no specifically protected conservation values were present.

The results of the flora and vegetation survey indicated the presence of flora species that may be utilised by conservation significant fauna species such as Black Cockatoos. A search of the DEC's and SEWPAC's threatened fauna databases indicated several species of Threatened, Vulnerable or Endangered species may be present or utilise the site for feeding or habitat. Based on the results it is considered the most likely conservation significant fauna species to utilise the site are Black Cockatoos. Mature eucalypts and banksias are utilised by Black Cockatoos for food and/or nesting. A number of other flora species present are also likely to be utilised for feeding however these two are considered significant indicator of cockatoo presence.

A cockatoo survey was undertaken in March (2009) that indicated the site is utilised by two species of Black Cockatoo – Carnaby's and Forest-Red Tailed Black Cockatoos. The Carnaby's Black Cockatoo is listed under both the EPBC Act and the Western Australian *Wildlife Conservation Act 1950*, whilst the Forest-Red Tailed Black cockatoo is listed only under the *Wildlife Conservation Act 1950*.

Based on the current literature, it is unlikely the potential nesting hollows identified on the site would be utilised by Carnaby's Black Cockatoo as they typically nest in the Wheatbelt and Great Southern regions and are known to require eucalypt woodland, comprising principally of salmon gum and wandoo (SEWPAC, 2009). The site is located on the Swan Coastal Plain and does not support these vegetation types; however there is limited evidence that indicates Carnaby's Black Cockatoos have occasionally utilised nesting sites outside of traditional areas. The hollows on site may also be utilised by Forest Red Tailed Black Cockatoos for nesting and if they cannot be retained, there are several management options that may be considered as part of a fauna management plan to minimise the potential impact the loss of these hollow may result in.

Although the site supports vegetation types utilised by both Carnaby's and Forest Red Tailed Black Cockatoos for feeding, the results of the black cockatoo survey indicated a

lower than expected use of the site particularly by Carnaby's Black Cockatoos (pers. comm. T. Kirkby, 20/03/2009). This may be due to the presence of significantly larger areas of remnant bushland within one kilometre of the site, protected as Bush Forever. Retaining remnant vegetation on site is however an important consideration for minimising the potential impact on fauna species. Current site planning indicates approximately 6.38 ha (from a total 36.7 ha), or approximately 17.3%, of the site will be retained for public open space. Although this will include areas for drainage and parkland, areas of remnant bushland will be retained and native species also be utilised for revegetation, landscaping and streetscaping.

In summary, the most significant environmental constraint is the presence of the black cockatoo feeding and potential nesting habitat. The following recommendations should be considered moving forward:

- Implement a development design that minimises potential loss of cockatoo habitat by retaining, where possible, feeding and potential nesting habitat;
- Engage SEWPAC to discuss likely requirements with regard to the referral of the site under the EPBC Act; and
- Develop a fauna management plan that incorporates discussion of the most appropriate native flora species for use in landscaping and revegetation to provide foraging and potential habitat.

Recommendations associated with other site characteristics include the following:

- Implement drainage and stormwater management and design in accordance with relevant guidelines and standards;
- Manage offsite drainage to minimise potential impacts on the conservation significant wetland to the south of the site through an Urban Water Management Strategy; and
- As the site is within 500 m of an area mapped as high risk ASS, according to DEC guidance, and ASS investigation is required to determine the presence or absence of ASS.

6 Limitations

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

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

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

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

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FIGURES



Legend

- Lot E26
- Cadastral Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- CADASTRAL BOUNDARY SOURCED FROM LANDGATE 2008
- TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2008

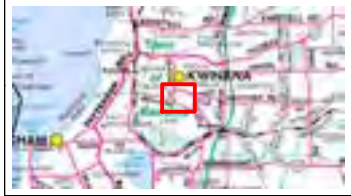
SCALE

0 40 80 160 240 320 400

Metres

1:10,000 @ A4

LOCALITY MAP



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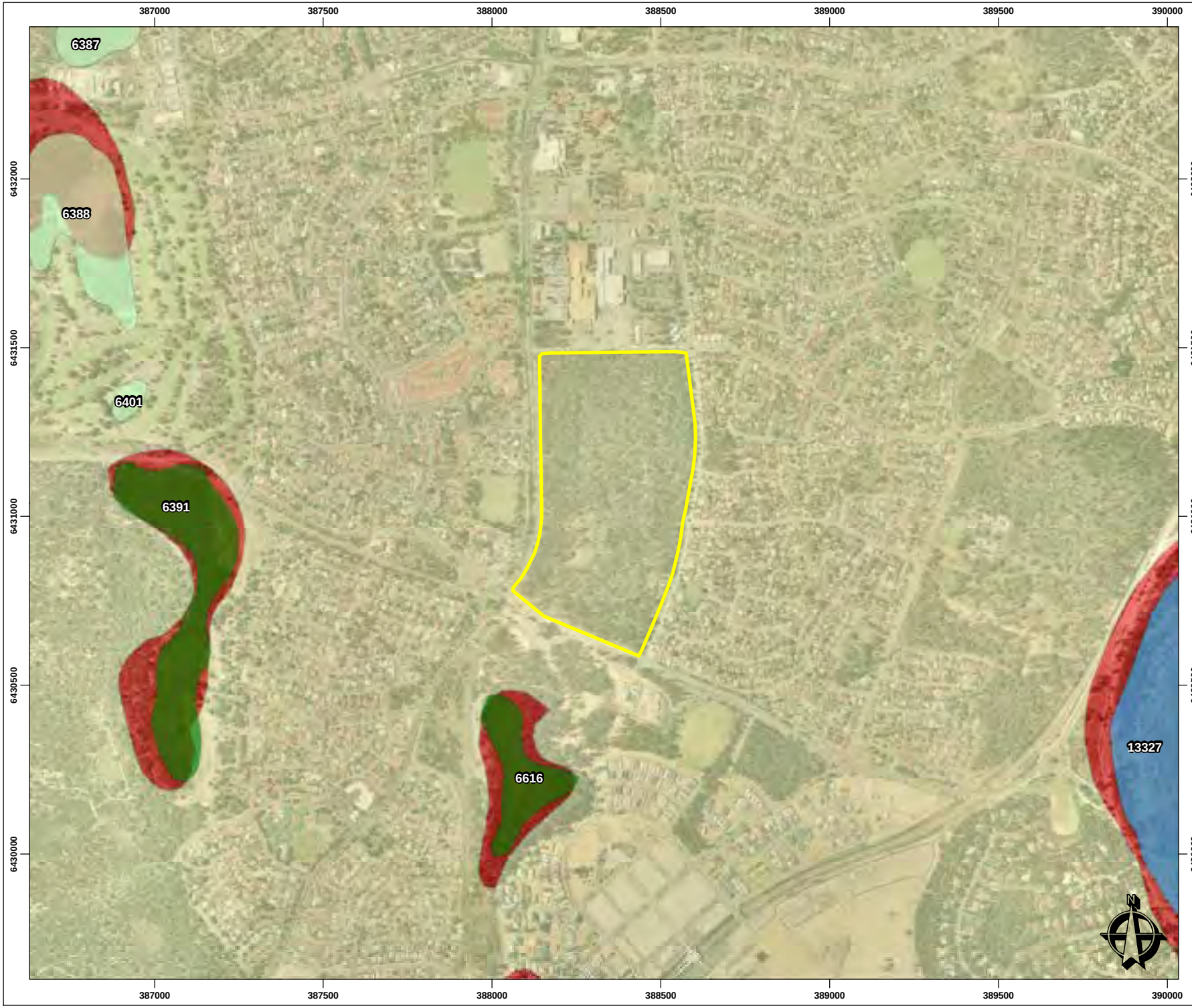
METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

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TD	MH	
DATE	**REVISION**	**DRAWING ID**
11.04.12	0	LD008-3.01

SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Kwinana Town Centre Environmental Assessment Report
Site Location

Figure 1



Legend

- Lot E26 Boundary

Geomorphic Wetlands, Swan Coastal Plain

- Conservation
- Resource Enhancement
- Multiple Use
- Not Assessed
- Not Applicable

Acid Sulfate Soil Risk (<3 m from surface)

- High to moderate ASS disturbance risk
- Moderate to low ASS disturbance risk
- No known ASS disturbance risk

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- ASS RISK MAPPING SOURCED FROM DEC 2007
- GEOMORPHIC WETLANDS SOURCED FROM DEC 2010
- TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2006

SCALE

0 75 150 300 450 600

Metres

1:15,000 @ A4

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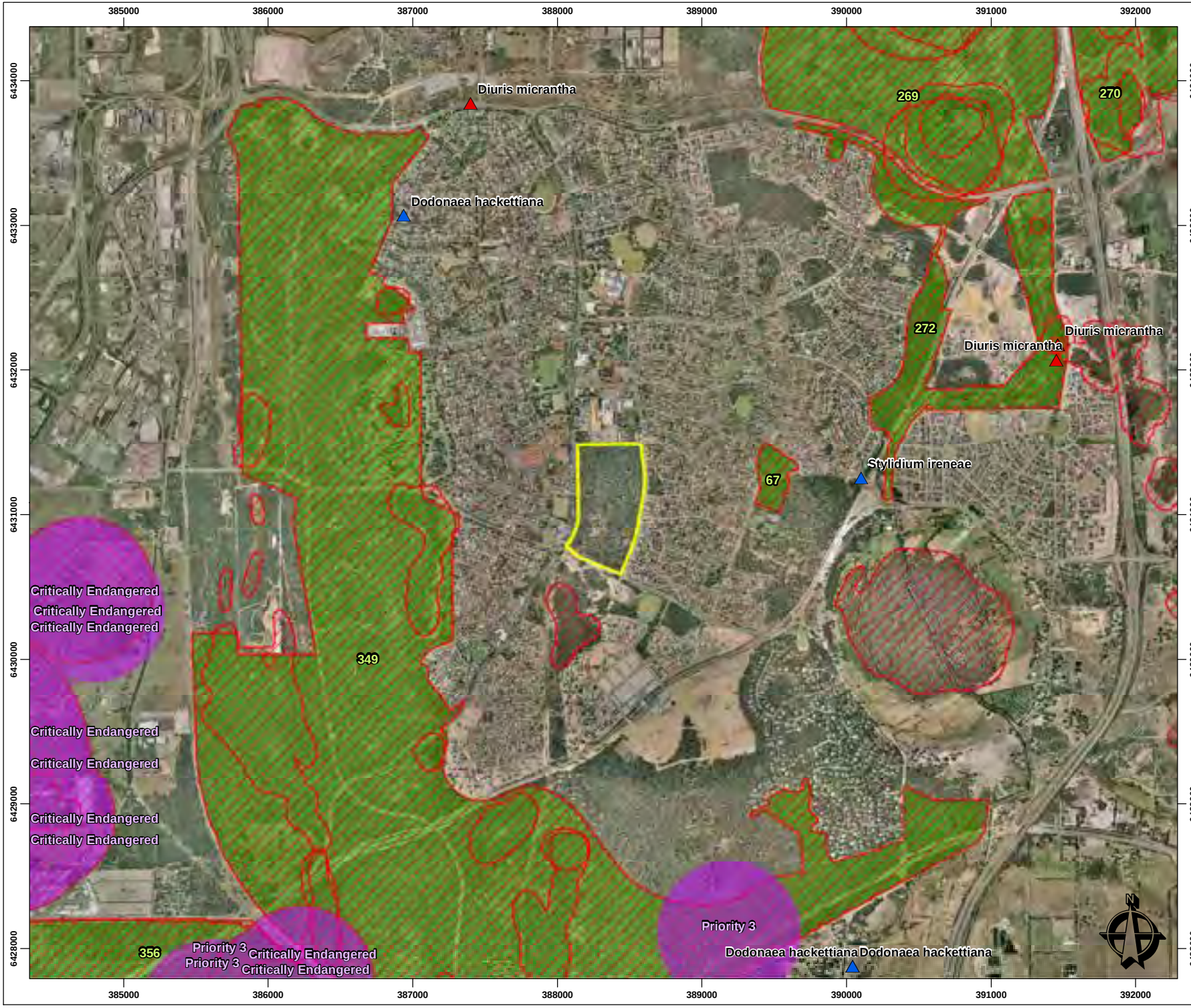
METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
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DATE	**REVISION**	**DRAWING ID**
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SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Kwinana Town Centre Environmental Assessment Report
Acid Sulfate Soil Risk Mapping and V
Conservation Significance
Figure 2

360



Legend

- Lot E26
- TEC/PEC Buffer
- Environmentally Sensitive Area
- Bush Forever Site

Flora of Conservation Significance

- Priority 3
- Priority 4
- Threatened

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- LISTED FLORA SOURCED FROM WA HERBARIUM AND DEC 2012
- ESAs SOURCED FROM DEC 2006
- TECs SOURCED FROM DEC 2009
- BUSH FOREVER SITES SOURCED FROM DPI 2003
-TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2006

SCALE

0 215 430 860 1,290

Metres

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100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

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DATE	**REVISION**	**DRAWING ID**
11.04.12	0	LD008-3.03

SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Kwinana Town Centre Environmental Assessment Report
DRF, TECs, ESAs and Bush Forever Sites

Figure 3



Jarrah-Banksia woodlands

Em *Eucalyptus marginata* subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, Acacia pulchella scattered shrubs over *Gompholobium tomentosum*, *Hibbertia hypericoides* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* very open grassland with *Conostylis aculeata* very open herbland.

EmBa (*Eucalyptus gomphocephala* scattered trees over) *Eucalyptus marginata* subsp *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmocladus aspera*, *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* (perennial veldt grass) open grassland to grassland.

EmAf *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over Acacia pulchella, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre*, *Lupinus blue very open herbland.

EgEm *Eucalyptus gomphosephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* (=KM2-10) scattered tall shrubs over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladus aspera* very open sedgeland and *Conostylis aculeata* very open herbland.

Tuart woodlands

Eg *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preisii* high open shrubland over *Macrozamia riedlei* and *Acacia pulchella* open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* open herbland.

Marri woodlands

Cc *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon* ? prop scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Limestone shrublands

Gv *Grevillea vestita* subsp. *vestita* heath over *Desmocladus aspera* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

EgDs *Eucalyptus gomphocephala* scattered trees over Dryandra sessilis high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

AfDs (*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, Dryandra sessilis scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over Acacia pulchella, Pimelea rosea, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* very open herbland.

Legend

- Lot E26

Vegetation Units

- Jarrah-Banksia woodlands
- Limestone shrublands
- Marri woodlands
- Tuart woodlands
- Completely Degraded

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
-TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2006

SCALE

0 25 50 100 150 200

Metres

1:5,000 @ A4

LOCALITY MAP



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METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
TD	MH	
DATE	**REVISION**	**DRAWING ID**
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SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Kwinana Town Centre Environmental Assessment Report
Site Vegetation Units Surveyed During Spring 2006
Figure 4

360 environmental

APPENDIX A

Department of Environment and Conservation's Threatened and Priority Flora Database Search Results

Department of Environment and Conservation
Our environment, our future

Your Ref: **LD008-3**
Our Ref: **08-0412FL**
Enquiries: Jessica Donaldson
Phone: (08) 9334 0123
Fax: (08) 9334 0278
Email: jessica.donaldson@dec.wa.gov.au

360 Environmental
PO Box 14
West Perth WA 6872

Attention: Melissa Hobson

Dear Melissa Hobson,

REQUEST FOR THREATENED AND PRIORITY FLORA INFORMATION

I refer to your request of 27 March 2012 for Threatened (Declared Rare) and Priority Flora information in the Kwinana Town Centre area. The search was conducted within a 5km radial area from the central coordinate you submitted.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) and Priority Flora* database (for results, *if any*, see "TPFL" – coordinates are GDA94), **(2)** the *Western Australian Herbarium Specimen* database for priority species opportunistically collected in the area of interest (for results, *if any*, see "WAHERB"- coordinates are GDA94 – see condition number 9 in the attached 'Conditions in Respect of Supply' and **(3)**, the Department's *Threatened and Priority Flora List* [this list is searched using 'place names'. This list, which may also be used as a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) – for results, *if any*, see "TP List"]. The results are attached electronically to this email.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the seventh point, which refers to the requirement to undertake field investigations for the accurate determination of Threatened and Priority flora occurrence at a site. *The information supplied should be regarded as an indication only of the Threatened and Priority flora that may be present and may be used as a target list in any surveys undertaken.*

The information provided does not preclude you from obtaining and complying with, where necessary, land clearing approvals from other agencies.

An invoice for $300 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of Threatened and Priority flora you encounter in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss Threatened and Priority flora management, please contact Dr Ken Atkins, Manager, Species and Communities Branch, on (08) 9334 0455.

Yours faithfully

Jessica Donaldson
.....
for Keiran McNamara
DIRECTOR GENERAL

4 April 2012

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

THREATENED (DECLARED RARE) AND PRIORITY FLORA INFORMATION

CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data to be made in writing to the Director General, Department of Environment and Conservation, Attention: Threatened Flora Database Officer, Species and Communities Branch.

2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the Director General, Department of Environment and Conservation.

3. Specific locality information for Threatened and Priority Flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information may not be used in public reports without the written permission of the Director General, Department of Environment and Conservation. Publicly available reports may only show generalised locations or, where necessary, show specific locations without identifying species. Species and Communities Branch is to be contacted for guidance on the presentation of Threatened and Priority Flora information.

4. Note that the Department of Environment and Conservation respects the privacy of private landowners who may have Threatened and Priority Flora on their property. Threatened and Priority Flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Environment and Conservation.

5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Environment and Conservation accepts no responsibility for this.

6. Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.

7. **It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened and Priority Flora of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. The receiving organisation should employ a botanist, if required, to undertake a survey of the area under consideration.**

8. Acknowledgment of the Department of Environment and Conservation as source of the data is to be made in any published material. The unique reference number that is given upon the request for information should be quoted when referencing the data. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention: The Manager, Species and Communities Branch.

9. The development of the PERTH Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being databased. It is only in recent times that collections have been submitted with GPS coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.

Species and Communities Branch
17 Dick Perry Ave, Technology Park, Kensington
Phone: (08) 9334 0455 Fax: (08) 9334 0278
Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

www.dec.wa.gov.au

DECLARED RARE AND PRIORITY FLORA LIST

CONSERVATION CODES

for Western Australian taxa

T: **Threatened Flora** (Declared Rare Flora - Extant)
Schedule 1 under the *Wildlife Conservation Act 1950* Rare Flora Notice

Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

X: **Presumed Extinct Flora** (Declared Rare Flora – Extinct)
Schedule 2 under the *Wildlife Conservation Act 1950* Rare Flora Notice

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

Threatened Flora (Schedule 1)are further ranked by the Department according to their level of threat using IUCN Red List criteria:

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 DEC's Listing of species and ecological communities webpage at
http://www.dec.wa.gov.au/content/view/852/2010/

Species and Communities Branch
17 Dick Perry Ave, Technology Park, Kensington
Phone: (08) 9334 0455 Fax: (08) 9334 0278
Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

www.dec.wa.gov.au

Possibly threatened species that have not been adequately surveyed to be listed as Threatened are added to the Priority Flora List 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. 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 are placed in Priority 5.

1: Priority One: Poorly-known species

Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two: Poorly-known species

Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three: Poorly-known species

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities 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 localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.

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.

Recommendations for additions, deletions or changes to the Declared Rare and Priority Flora List should be forwarded to the Flora Administration Officer or Senior Botanist Species and Communities Branch, DEC.

Species and Communities Branch
17 Dick Perry Ave, Technology Park, Kensington
Phone: (08) 9334 0455 Fax: (08) 9334 0278
Locked Bag 104, Bentley Delivery Centre, Bentley, Western Australia 6983

www.dec.wa.gov.au

ABBREVIATIONS USED IN THREATENED AND PRIORITY FLORA DATABASE

VESTING

AAP	Aboriginal Planning Authority
AGR	Chief Executive, Dep. of Agriculture
ALT	Aboriginal Land Trust
APB	Agricultural Protection Board of WA
BGP	Botanical Gardens & Parks Authority
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
CRW	Crown
DAG	Dep. of Agriculture
DOW	Dep. of Water
DPI	Dep. of Planning
EXD	Exec Direc CALM
FES	Fire and Emergency Services Aust.
HOW	Dep. of Housing/State Housing Commission
ILD	Industrial Lands Develop. Auth
LAC	LandCorp
LGA	Shire/LGA
MAG	Minister for Agriculture
MCB	Metropolitan Cemeteries Board
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
PLB	Pastoral Lands Board
PRI	Private/Freehold
RAI	Public Transport Authority
REL	Religious Organisation
SPC	State Planning Commission
SYN	Synergy (ex Western Power)
SWA	State of Western Australia
TEL	Telstra
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

PURPOSES

ABR	Aboriginal Reserve
ACC	Access Track
AER	Aerodrome
AIR	Airport
ARS	Agricultural Research Station
BAP	Baptist Union of WA
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CMN	Communications
COM	Common
CON	Conservation Park
CPK	Car Park
CRM	Conservation & Resource Management
DEF	Defence
DRA	Drain
EDE	Educational Endowment
EDU	Educational purposes UWA
ENE	Enjoyment of Natural Environ.
EPL	Ex-pastoral Lease (Sect 33(2) CALM Act)
EPS	Explosives
EXC	Excepted from sale
EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
FP	Foreshore Purposes
GE	General Lease
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
LGA	LGA/Shire Requirements
LPR	Landscape Protection
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PFF	Protection of Flora & Fauna
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
PMC	Protection of Meteorite Crater
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUR	Purchase Lease
PUT	Public Utility
QUA	Quarry
RAC	Racecourse
RAD	Radio Station
REC	Recreation
REH	Rehabilitation/Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAL	Saleyards
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHO	Showgrounds
SNN	Sanitary
SOI	Soil Conservation
STO	Stopping place
STK	Stock Route
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
UCL	Unallocated Crown Land
UNK	Unknown
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WLS	Wildlife Sanctuary
WOO	Firewood

Threatened and Priority Flora Database

POPID	TAXONID	SPNAME	CONSVCODE	RANK	POPNUMBER	SUBPOPCODE	GDA94LAT	GDA94LONG	STATUS	VESTING	PURPOSE1	DATE_
84399	141	*Aponogeton hexatepalus*	4		22		-32.24184	115.84788		NON	UCL	16/09/1993 0:00
101444	12938	*Diuris micrantha*	T	VU	1	A	-32.24278	115.84778		NON	UCL	22/09/2009 0:00
101445	12938	*Diuris micrantha*	T	VU	1	B	-32.24184	115.84788		NON	UCL	24/09/2002 0:00
87256	4763	*Dodonaea hackettiana*	4		15		-32.21823	115.84315		PRI		5/01/1987 0:00
87263	4763	*Dodonaea hackettiana*	4		22		-32.28044	115.83233		NON	UCL	16/10/2003 0:00

Western Australian Herbarium

SHEET_NO	SPECIES	CONSCODE	SITE	VEGETATION	LOCALITY	LAT	LONG_	DATE_
PERTH 07858736	*Cyathochaeta teretifolia*	3	Black peat.	Melaleuca preissiana, Eucalyptus rudis subsp. rudis, Pteridium esculentum	Lot 100, Treeby Rd, Anketell	-32.25785	115.8599	24 10 2007
PERTH 04981588	*Diuris micrantha*	T			Medina	-32.22638	115.805	24 09 1984
PERTH 01157647	*Dodonaea hackettiana*	4	Level, but disturbed sand.		The Spectacles, near Medina	-32.23333	115.8	22 04 1986
PERTH 07104588	*Dodonaea hackettiana*	4	Plain. Reserve. Lake upland. Beeliar Regional Park. Grey dry sand. Soil disturbed 20 years ago.	Tall trees with Eucalyptus rudis and paperbarks.	About 40 m S of Osprey Drive and just E of the drain going under Osprey Drive (which is W of Parkes Road); Yangebup	-32.28045	115.8323	16 10 2003
PERTH 07746865	*Stylidium ireneae*	4			Kwinana	-32.25	115.8333	02 12 2004

APPENDIX B

Department of Sustainability, Environment, Water, Population and Communities' Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool results

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

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 about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

Report created: 13/03/12 12:11:49

Summary
Details
Matters of NES
Other Matters Protected by the EPBC Act
Extra Information
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 3.0Km



Summary

Matters of National Environment 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 - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	15
Migratory Species:	9

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 and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

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.

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. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

Place on the RNE:	6
State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR)	[Resource Information]
Name	Proximity
Becher point wetlands	Upstream from Ramsar
Forrestdale & thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	Upstream from Ramsar

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		

Name	Status	Type of Presence
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis		
Fairy Tern (Australian) [82950]	Vulnerable	Species or species habitat known to occur within area
INSECTS		
Synemon gratiosa		
Graceful Sun Moth [66757]	Endangered	Species or species habitat may occur within area
MAMMALS		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura		
Red-tailed Phascogale [316]	Endangered	Species or species habitat may occur 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		
Muchea Bell [83190]	Critically Endangered	Species or species habitat may occur within area
Drakaea elastica		
Glossy-leaved Hammer-orchid, Praying Virgin [16753]	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

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 may occur within area

Name	Threatened	Type of Presence
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
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 may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [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 may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Rostratula benghalensis s. lat.		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area
Sterna dougallii		
Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Bollard Bulrush Swamp	WA	Indicative Place
Leda Area	WA	Indicative Place
Beeliar Regional Park and Adjacent Areas	WA	Interim List
Historic		
Greenkeepers Cottage	WA	Indicative Place
Woodlands Cottage and Reserve 25132	WA	Indicative Place
Smirks Cottage	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Leda	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Mammals		
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
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

Name	Status	Type of Presence
		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 may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may 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 reichardtiji 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

Coordinates

-32.25111 115.81444

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 Heritage and Register of National Estate properties, Wetlands of International 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

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

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.

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
-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.

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Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX C

Department of Environment and Conservation's Threatened and Priority Ecological Communties Database Search Results

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

THREATENED AND PRIORITY ECOLOGICAL COMMUNITIES INFORMATION

CONDITIONS IN RESPECT OF SUPPLY OF INFORMATION

1. All requests for data are to be made in writing to the Director General, Department of Environment and Conservation Attention: Species and Communities Branch

2. The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided, without the prior written consent of the data custodian (Val English), Species and Communities Branch.

3. Specific locality information for threatened and priority ecological communities (TECs/PECs) is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for TECs/PECs may not be used in public reports without the written permission of the Director General, Department of Environment and Conservation. Publicly available reports may only show generalised locations (ie buffer locations). The TEC database manager is to be contacted for guidance on the presentation of TEC/PEC information.

4. Note that the Department of Environment and Conservation respects the privacy of private landowners who may have threatened and priority ecological communities on their property. Locations of TECs/PECs identified in the data as being on private property should be treated in confidence, and contact with property owners made through the Department of Environment and Conservation.

5. Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data provided, they may be present. The Department of Environment and Conservation accepts no responsibility for this.

6. Receiving organisations must also recognise that the Threatened Ecological Communities database is subject to continual updating and amendment, and such considerations should be taken into account by the user.

7. It should be noted that the supplied data do not necessarily represent a comprehensive listing of the threatened and priority ecological communities of the area in question. Its comprehensiveness is dependant on the amount of survey carried out within the specified area. Private property has been relatively little surveyed. The receiving organisation should employ a consultant, if there is any likelihood of the presence of any threatened or priority ecological community, to undertake a survey of the area under consideration.

8. Acknowledgment of the Department of Environment and Conservation as source of the data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention: Manager, Species and Communities Branch.

APPENDIX D

Department of Environment and Conservation's Threatened and Priority Fauna Database Search Results

Government of Western Australia
Department of Environment and Conservation

Your ref:
Our ref: 2011/005506 #4076
Enquiries: Briana Wingfield
Phone: (08) 9219 8636
Fax: (08) 9334 0199
Email: fauna.data@dec.wa.gov.au

360 Environmental
Attn: Melissa Hobson
PO Box 14
WEST PERTH WA 6872

Dear Melissa,

REQUEST FOR THREATENED FAUNA INFORMATION

I refer to your request of 27th March for information on threatened fauna occurring in the vicinity of the Shire of Kwinana.

A search was undertaken for this area of the Department's Threatened Fauna database, which includes species which are declared as '*Rare or likely to become extinct* (Schedule 1)', '*Birds protected under an international agreement* (Schedule 3)', and '*Other specially protected fauna* (Schedule 4)'.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the sixth point that refers to the requirement to undertake field investigations for the accurate determination of threatened fauna occurrence at a site. The information supplied should be regarded as an indication only of the threatened fauna that may be present.

An invoice for $300.00 (plus GST), being the set charge for the supply of this information, will be forwarded.

It would be appreciated if any populations of threatened fauna encountered by you in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss threatened fauna management, please contact our Principal Zoologist on 08 9334 0455.

Yours sincerely



……
for Keiran McNamara
DIRECTOR GENERAL
Department of Environment and Conservation

2 April 2012

Species and Communities Branch
17 Dick Perry Avenue, Technology Park, Kensington
Phone: (08) 9334 0455 Fax: (08) 9334 0278 Teletype: (08) 9334 0546
Postal Address: Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
www.dec.wa.gov.au

2008518

Attachment

DEPARTMENT OF ENVIRONMENT AND CONSERVATION

THREATENED FAUNA INFORMATION

Conditions In Respect Of Supply Of Information

* All requests for data to be made in writing to the Executive Director, Department of Environment and Conservation, Attention: Principal Zoologist, Species and Communities Branch.

* The data supplied may not be supplied to other organisations, nor be used for any purpose other than for the project for which they have been provided without the prior consent of the Executive Director, Department of Environment and Conservation

* Specific locality information for Threatened Fauna is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for Threatened Fauna may not be used in reports without the written permission of the Executive Director, Department of Environment and Conservation. Reports may only show generalised locations or, where necessary, show specific locations without identifying species. The Principal Zoologist is to be contacted for guidance on the presentation of Threatened Fauna information.

* Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Environment and Conservation accepts no responsibility for this.

* Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.

* It should be noted that the supplied data do not necessarily represent a comprehensive listing of the Threatened Fauna of the area in question. Its comprehensiveness is dependent of the amount of survey carried out within a specified area. The receiving organisation should employ a biologist/zoologist, if required, to undertake a survey of the area under consideration.

* Acknowledgment of the Department of Environment and Conservation as the source of data is to be made in any published material. Copies of all such publications are to be forwarded to the Department of Environment and Conservation, Attention; Principal Zoologist, Species and Communities Branch.

NAME	VERNACULAR	KINGDOM	CONSERVATION	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
Calyptorhynchus latirostris	Carnaby's Cockatoo	Animalia	T	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Calyptorhynchus latirostris	Carnaby's Cockatoo	Animalia	T	BIRD	20	07	2000	MEDINA	Thomas Oval, Medina
Calyptorhynchus latirostris	Carnaby's Cockatoo	Animalia	T	BIRD	19	09	2002	POSTANS	The Spectacles
Charadrius rubricollis	Hooded Plover	Animalia	4	BIRD	10	01	1998	COOLOONGUP	Cooloongup Lake, City of Rockingham
Tiliqua rugosa subsp. *konowi*		Animalia	T	REPTILE	09	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.5
Falco peregrinus	Peregrine Falcon	Animalia	S	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Hydromys chrysogaster	Water-rat	Animalia	4	MAMMAL	10	06	1973	MEDINA	Medina
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	06	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 3.5
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.5
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	10	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	01	11	2001	COOLOONGUP	N end of Lake Cooloongup, Cooloongup (Site 3)
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	01	12	1974	CASUARINA	Mortimer Rd, Wellard.
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	25	05	2010	LEDA	Leda Wetlands
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	01	11	2001	LEDA	Leda Reserve, Leda (Site 2)
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	22	06	1961	MEDINA	
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	01	11	2001	PARMELIA	Bushland opposite Sicklemore Rd, Parmelia/Bertram (Site 1)
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	06	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	03	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	04	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	09	07	2004	HOPE VALLEY	Alcoa development site on Anketell Rd, E of Abercombe Rd
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	02	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	05	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	02	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	06	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	04	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles
Isoodon obesulus subsp. *fusciventer*	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Lerista lineata		Animalia	3	REPTILE	05	01	1979	MEDINA	Spectacle Swamp, near Medina
Macropus irma	Western Brush Wallaby	Animalia	4	MAMMAL	01	01	1989	WELLARD	Leda Nature Reserve, Town of Kwinana
Neelaps calonotos	Black-striped Snake	Animalia	3	REPTILE				COOLOONGUP	East Rockingham
Notoscincus butleri		Animalia	4	REPTILE	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 3.2
Notoscincus butleri		Animalia	4	REPTILE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 1.9
Lerista lineata		Animalia	3	REPTILE	13	11	2007	THE SPECTACLES	roadside south of Anketell Rd, adjacent to the Spectacles
Lerista lineata		Animalia	3	REPTILE	05	01	1979	THE SPECTACLES	Spectacle Swamp, near Medina
Pletholax gracilis subsp. *edelensis*		Animalia	3	REPTILE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 4.3
Neelaps calonotos	Black-striped Snake	Animalia	3	REPTILE				COOLOONGUP	East Rockingham
Tiliqua rugosa subsp. *konowi*		Animalia	T	REPTILE	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.3

APPENDIX E

Department of Indigenous Affairs' Aboriginal Heritage Inquiry System Search Results

Search Criteria

4 surveys in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 50	
Northing	Easting
6429806	387394
6432196	389278

Disclaimer

Heritage Surveys have been mapped using information from the reports and / or other relevant data sources. Heritage Surveys consisting of small discrete areas may not be visible except at large scales. Reports shown may not be held at DIA. Please consult report holder for more information. Refer to www.dia.wa.gov.au/heritage for information on requesting reports held by DIA.

Copyright

Copyright in the information contained herein is and shall remain the property of the State of Western Australia. All rights reserved. This includes, but is not limited to, information from the Register of Aboriginal Sites established and maintained under the Aboriginal Heritage Act 1972 (AHA).

Legend

Access

Some reports are restricted. The type of restriction is shown as a code in brackets following the catalogue number. No code indicates an unrestricted report.

[CLOSED]	Closed
[OWE]	Open with exception
[TBD]	To be determined
[RESTRICTED PENDING]	Restricted pending

Survey 1885

Project	South West Corridor Transport Reserve
Start Date	14 Sep 1994
Proponents	Department of Planning and Urban Development State Planning Commission
Consultants	A. Yates Gary Quartermaine R. O'Connor
Survey Types	Archaeological and Ethnographic
Aboriginal People Consulted?	Yes

Related Reports

Report ID	Catalogue Number	Title	Recorders	Held At
105233	HSR SW 1994 OCO	Report on an Aboriginal Site Survey of the Proposed South West Corridor Transport Reserve	Dr Amanda Yates Gary Quartermaine Rory O'Connor Caroline Heine	DIA

Survey 3737

Project	Ballaruk, (Traditional Owners of Whadjuk territory) Site Recording Project
Start Date	01 Jan 1994
Proponents	Heritage Council of Western Australia
Consultants	Tamora Pty Ltd
Survey Types	Ethnographic
Aboriginal People Consulted?	Yes

Related Reports

Report ID	Catalogue Number	Title	Recorders	Held At
21817	HSR MW 1994 MAC	Ballaruk (traditional owners) Aboriginal site recording project	Barrie Machin	Department of Indigenous Affairs

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Survey 3737 (continued)

Related Reports (continued)

Report ID	Catalogue Number	Title	Recorders	Held At
21818	HSR MW 1995 MAC	Ballaruk (traditional owners of Whadjuk territorial boundaries the lands of the Ballaruk Peoples) Aboriginal site recording project : additional material	Barrie Machin	

Survey 2357

Project	Leda Subdivision, Kwinana
Start Date	01 Apr 1989
Proponents	Land Corp
Consultants	C. Bodney Gary Quartermaine R. O'Connor
Survey Types	Archaeological and Ethnographic
Aboriginal People Consulted?	Yes

Related Reports

Report ID	Catalogue Number	Title	Recorders	Held At
102185	HSR MW 1989 OCO	Report on a Survey for Aboriginal Sites at the Proposed Leda Subdivision Near Kwinana. May 1989.	C Bodney Gary Quartermaine Rory O'Connor Caroline Heine Marney Quartermaine	DIA

Survey 2274

Project	The Perth Area.
Start Date	01 Apr 1970
Proponents	University of Western Australia
Consultants	University of Western Australia
Survey Types	Archaeological and Archaeological and Ethnographic
Aboriginal People Consulted?	No

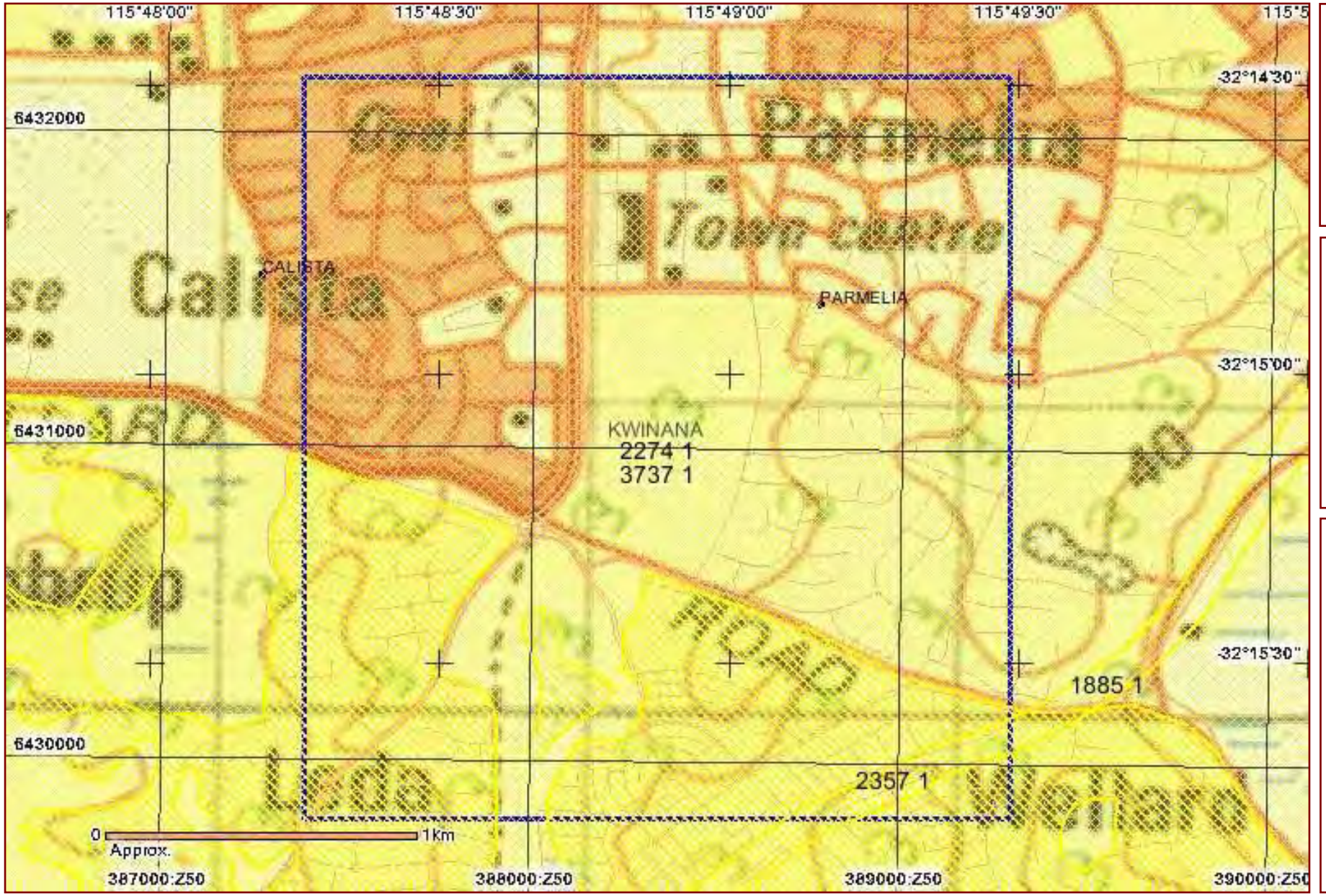
Related Reports

Report ID	Catalogue Number	Title	Recorders	Held At
103564	HSR MW 1972 UWA	An Archaeological Survey Project: The Perth Area, Western Australia. Apr 1972.	University of Western Australia H. Polach	DIA
104023	Not in Catalogue	An Archaeological Survey Project. The Perth Arch. Area. Western Australia Report no.4 April 1971.	University of Western Australia H. Polach	DIA

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Aboriginal Heritage Inquiry System

Heritage Survey Database





Legend

Selected Heritage Surveys

- Heritage Survey
- Town
- Map Area
- Search Area

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Aboriginal Heritage Inquiry System

Aboriginal Sites Database

Search Criteria

0 sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 50	
Northing	Easting
6429822	387385
6432206	389265

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Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

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Legend

Restriction

N	No restriction
M	Male access only
F	Female access

Access

C	Closed
O	Open
V	Vulnerable

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Status

L - Lodged		ACMC Decision Made
Information lodged, awaiting assessment	→	R - Registered Site I - Insufficient information S - Stored Data

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

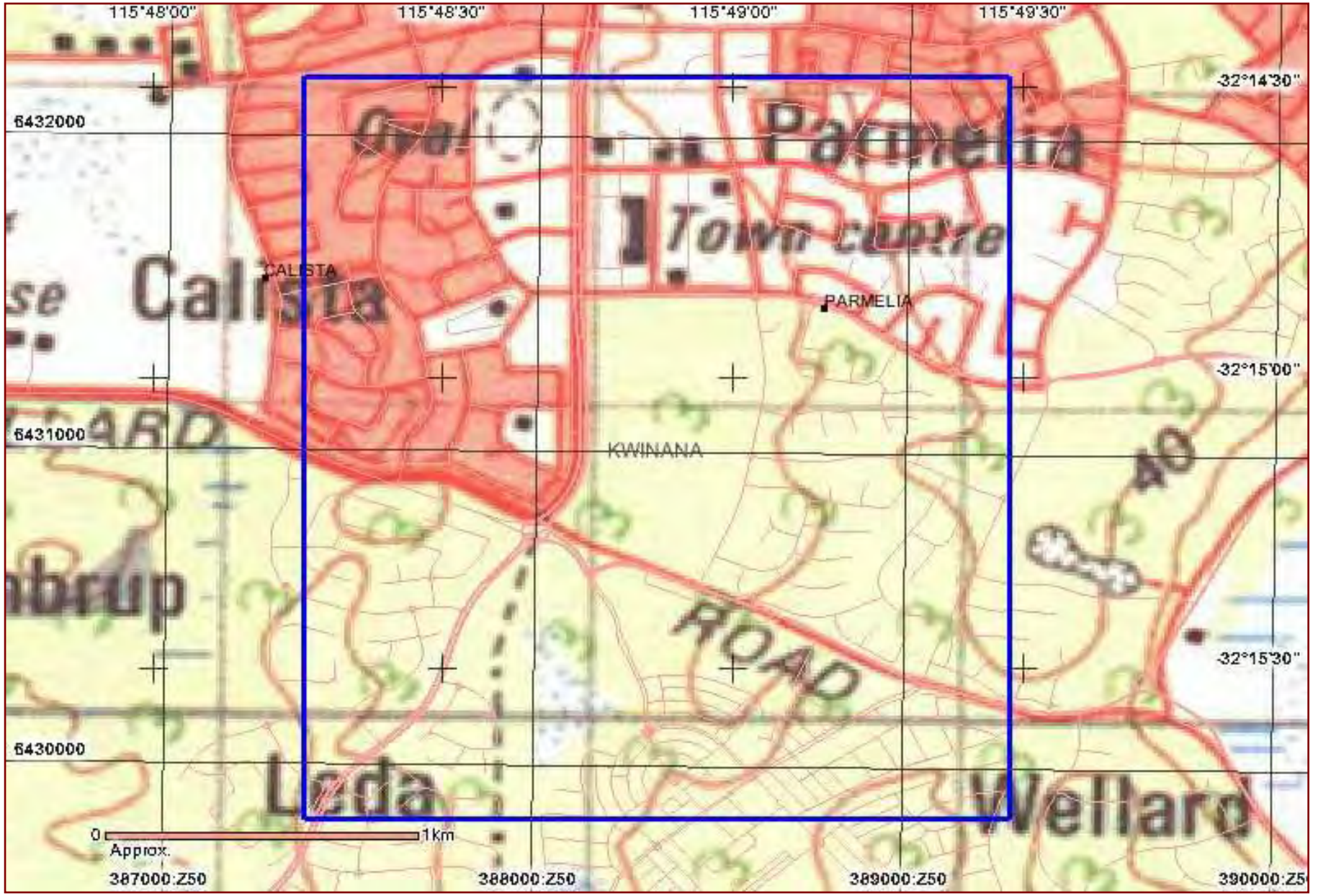
Sites Shown on Maps

Site boundaries may not appear on maps at low zoom levels

List of Registered Aboriginal Sites with Map

No results

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Legend

Selected Heritage Sites

Registered Sites

Town

Map Area

Search Area

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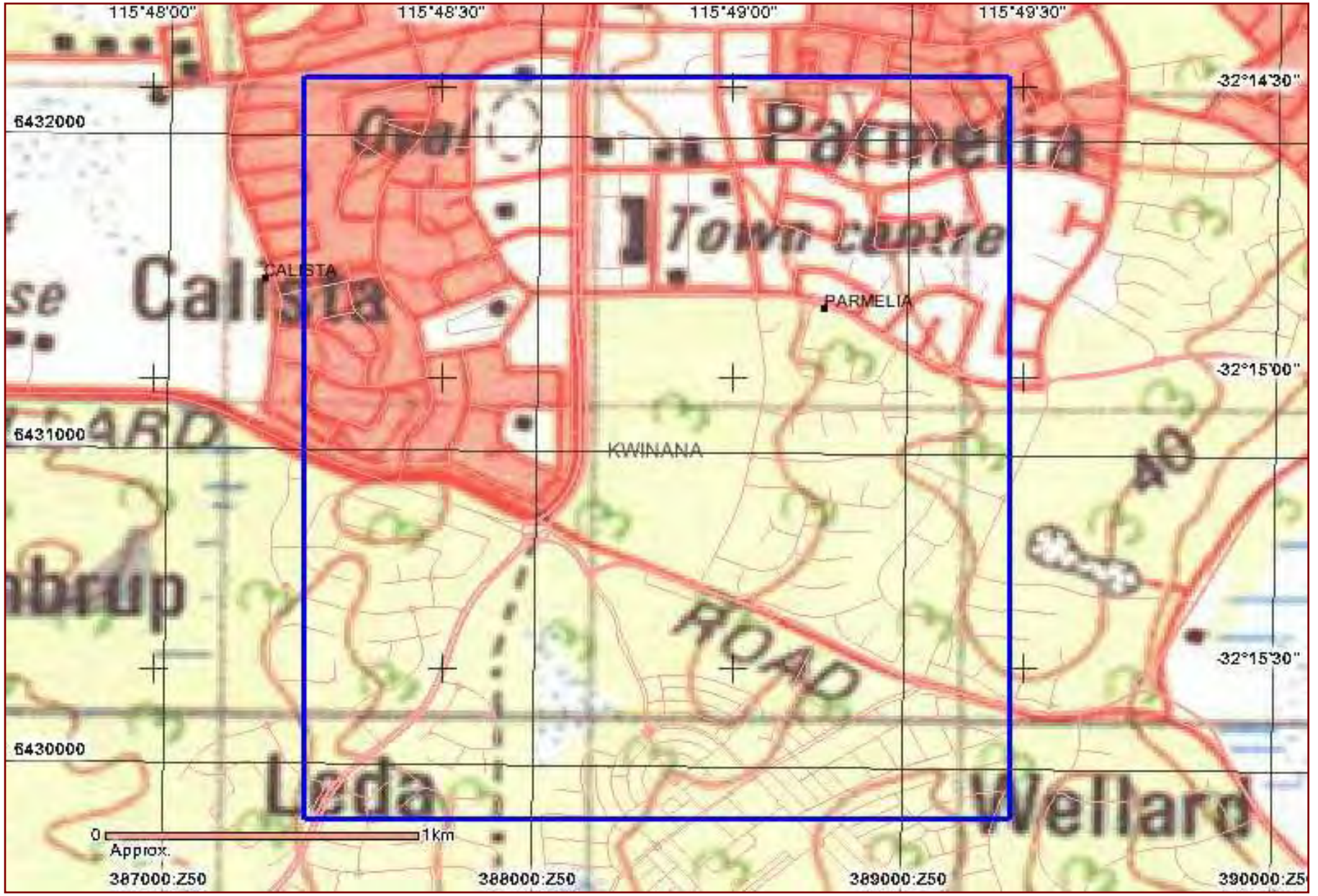
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List of Other Heritage Places with Map

No results

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Legend

Selected Heritage Sites

Other Heritage Places

Town

Map Area

Search Area

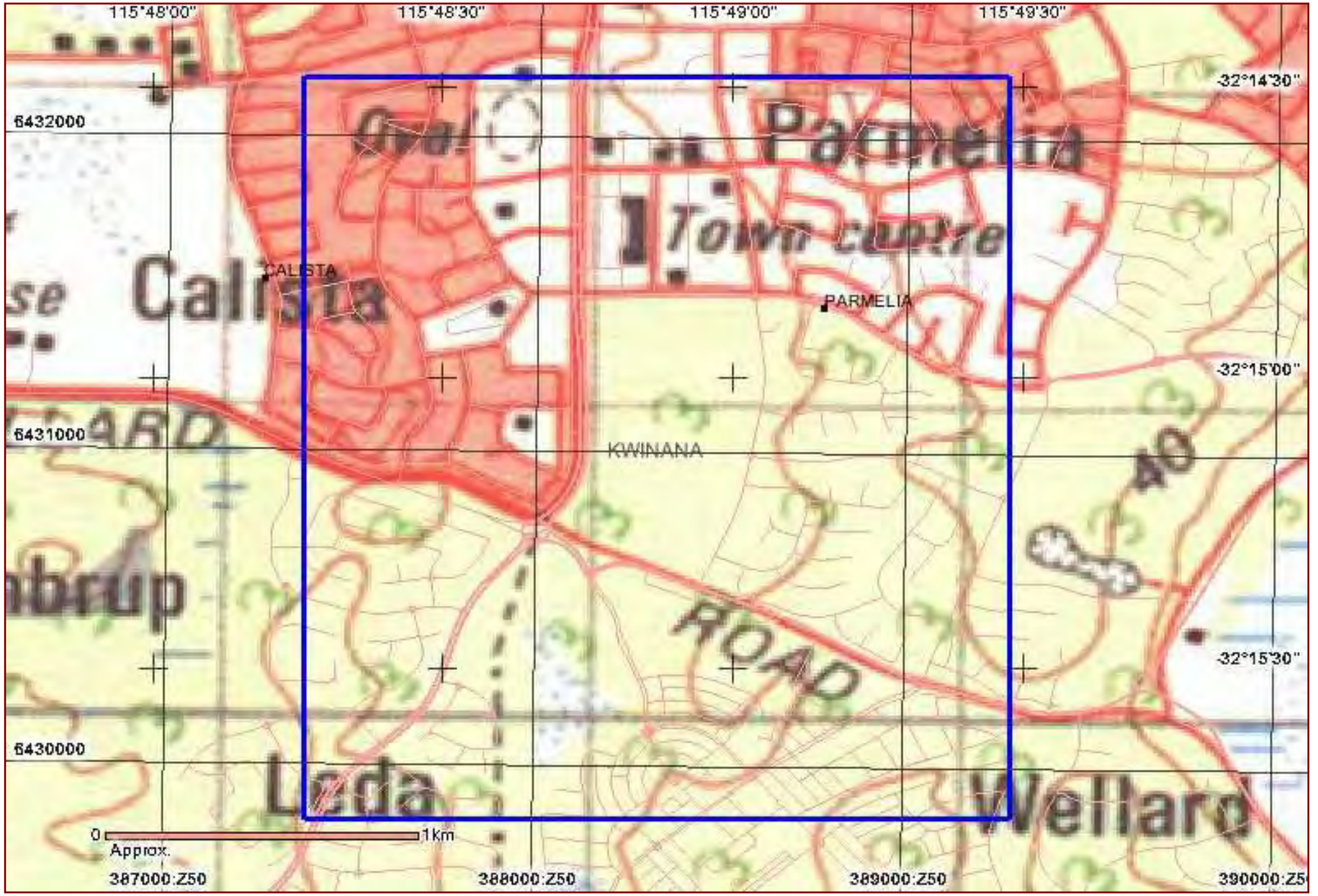
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Map Showing Registered Aboriginal Sites and Other Heritage Places





Legend

Selected Heritage Sites

- Registered Sites
- Other Heritage Places
- Town
- Map Area
- Search Area

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360 environmental

Level 1 Vertebrate Fauna Survey – Kwinana Town Centre

Prepared for:

Department of Housing/
Satterley Property Group

May 2012

people • planet • professional

360 Environmental Pty Ltd

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS165-3AB	INTERNAL DRAFT	AH	FD	-	24/05/12
EBS165-3AB	CLIENT REPORT	AH	Client	1 Electronic copy	30/05/12

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Appendix E Department of Environment and Conservation Search

Executive Summary

Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing to undertake baseline surveys for the Site (Kwinana Town Centre). The baseline survey included a Level 1 Vertebrate Fauna Survey. The survey area is approximately 36 hectares (ha) and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The majority of the Site is uncleared bushland. The Site is located in the Town of Kwinana, approximately 32 km south of Perth.

Methods

A total of ten (10) survey sites were established to assess four (4) broad fauna habitat types. Passive detection methods were implemented to identify all vertebrate fauna species across the Site. Emphasis was placed on detecting fauna species of Conservation Significance that may occur within the Site.

Results

Four broad fauna habitat types were identified within the Site. This included Jarrah-Banksia woodlands, Marri woodlands, Tuart woodlands and Limestone shrublands.

During the survey a total of twenty eight (28) bird species, six (6) mammal species, two (2) reptile species and zero (0) amphibians were recorded within the Site.

A desktop study revealed that twelve (12) bird, six (6) native mammal and five (5) reptile species currently listed as Conservation Significant under State and/or Commonwealth legislation and/or the Department of Environment and Conservation (DEC) Priority list were predicted to occur within the Site. One insect of Conservation Significance was also predicted to occur. Analysis of the data prior to the field survey suggested that two of these species may occur within the Site and two of the species were likely to occur within the Site.

During the reconnaissance survey the three species predicted as likely to occur within the Site (Black Cockatoo species and Quenda) were confirmed as being present on Site.

Below are the three species of Conservation Significance recorded at the Site:

- Canaby's Black Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered;
- Forest red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) listed as Vulnerable; and
- Quenda (*Isoodon obesulus*) listed as a Priority 5 species.

Discussion

The fauna species and assemblage recorded at the Site were expected and generally representative for the area. No unexpected species were recorded. The current species list for this Site is not exhaustive and there are likely to be many more species present at the Site, particularly reptiles and bats. However a much higher survey intensity involving trapping techniques would need to be implemented at the Site to record many of these species and these techniques were outside of the scope of work for this report.

Generally, the fauna habitat at the Site is in good condition and provides significant fauna value with large older growth habitat trees such as Tuart, Marri, Jarrah and Banksia being present. Levels of annual weeds within the Site were relatively high at the time of the survey; this lowered the Site's overall condition. The isolated and fragmented nature of the Site does also remove some of the fauna value, with the Site being surrounded on all sides by residential housing. This is particularly true for ground dwelling species such as mammals and reptiles, as it is difficult for some species to persist within a Site of this size and furthermore it makes it difficult for new migrants to move into the area.

That being said it would appear Quenda still persist within the Site. It would be necessary to conduct species specific monitoring at the Site to assess the abundance of Quenda on the Site. As the Quenda is listed as Priority 5 it is only of Conservation Significance at a State level; it is not listed protected under Commonwealth legislation.

Both Carnaby's Black Cocaktoo and the Red-tailed Black Cockatoo were recorded at the Site. Both species appeared to be utilising the Site for feeding, however this appeared relatively infrequent with mostly old evidence of feeding being recorded during the Black Cockatoo Survey (360 Environmental 2012). The Red-tailed Black Cockatoo is listed as Vulnerable under Commonwealth legislation and Schedule 1 at a State level. The Carnaby's Black Cockatoo is of greater Conservation Significance being listed as Endangered under Commonwealth legislation and Schedule 1 at a State level. Therefore significant effort should be implemented to minimise or mitigate the habitat clearing at the Site, particularly of the large habitat trees considered significant for the two Black Cockatoo species.

Recommendations

In summary, the recommendations include:

- Minimise the clearing of remnant native vegetation wherever possible. For example, previously disturbed areas should be used in preference to clearing remnant vegetation wherever possible;
- It is recommended that a Fauna removal specialist be engaged to trap for Quenda at the site to confirm their presence and to relocate the species from the Site prior to vegetation clearing. Trapping at the Site will require approval

from the Department of Environment and Conservation. Prior to the translocation taking place it will also be necessary to liaise with the local council to determine an appropriate location for the animals to be released;

- Implement a Flora and Fauna Management Plan for the Site for the clearing and construction period;
- Retain trees that display hollows where possible. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the Site; and
- Feral bee control could be implemented on Site to remove feral bees from the hollows of trees that remain on Site.
- It is suggested that no further fauna survey work will be required at the Site (with the exception of Quenda trapping and relocation). A Level 1 Vertebrate Fauna Survey should be sufficient for the Site.

1 Introduction

1.1 Background

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Level 1 Vertebrate Fauna Survey at Lot 26 Meares Avenue, Kwinana (the Site), known as Kwinana Town Centre (Figure 2). The Site is approximately 36 hectares in size and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The Site is composed of uncleared bushland. The vegetation within the survey area can be classified into four broad vegetation groups (360 Environmental 2006). These groups are Jarrah-Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands.

The Department of Housing/ Satterley Property Group has proposed the area be utilised for residential development.

1.2 Existing Environment

1.2.1 Bioregion

1.2.1.1 Site Location

The survey Site is approximately 36 hectares (ha) and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road, Kwinana. The majority of the Site is uncleared bushland.

1.2.1.2 Regional Context

The Site lies within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion (Appendix A). The Swan Coastal Plain subregion is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on out-washed plains, and paperbark in swampy areas.

1.2.1.3 Climate

The climate is classified as Warm Mediterranean and rainfall ranges between 600 and 1,000 mm annually. The closest official Bureau of Meteorology (BoM) weather station currently operating is Medina Research Station where climate data is available between 1983 and 2012. The annual average rainfall at the Site is approximately 762.2 mm per annum (Based on annual average rainfall at Medina Research Station).

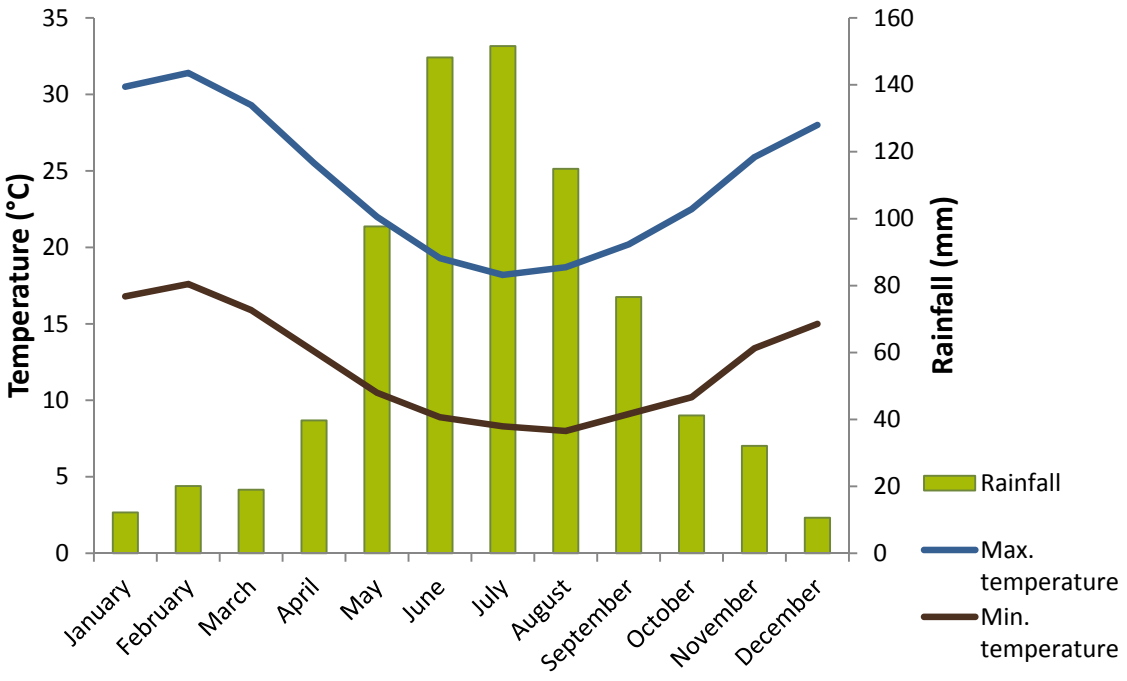


Figure 1: Mean rainfall and temperature for Medina Research Station recorded between 1983 and 2012 (Bureau of Meteorology, 2012).

1.2.1.4 Geology

The Site is located on the Spearwood Dune System. This consists primarily of coastal limestone (Town of Kwinana 2003). The sediment is composed of Quaternary deposits which are unconsolidated or lithified. The Spearwood dune system occurs within the Cottesloe and Karrakatta sands soil unit, which consists of calcareous sands (Bennett Environmental Consulting 2004). The predominant geology of the Site is limestone and calcrete (Department of Water 2012a).

1.2.1.5 Hydrology

The Site is located in the Serpentine River Catchment. This forms part of the Peel-Harvey Drainage Catchment (Cardno 2011). The sandy nature of the soils of this area result in good drainage of surface waters into the groundwater table (GHD 2007). The Perth Groundwater Atlas indicates that the ground water below the Site ranges between approximately five and 10 m below the ground surface (Department of Water 2012b). The major aquifers in the area which may have influences on the Site are Yarragadee North, Leederville, Superficial Swan and Rockingham Sand. These aquifers all have marginal salinity except Yarragadee which has brackish salinity (Department of Water 2012a).

1.2.2 Physical Environment

1.2.2.1 Soils and Landforms

The Kwinana area is located on the Spearwood Dune System (Town of Kwinana 2003). This system comprises red/brown, yellow and pale yellow/grey sands. Regional geological mapping identifies the Site as comprised of sand derived from Tamala Limestone (360 Environmental 2011). This features pale yellow brown, fine-to-coarse grained, sub-angular to well-rounded quartz, with high-to-medium permeability and contribute to groundwater infiltration. Site observations confirm the sandy nature of the soils (360 Environmental 2011). The Site currently features an undulating surface with existing ground levels ranging between approximately seven meters Australian Height Datum (AHD) and 13.5 mAHD (360 Environmental 2011).

1.2.3 Biological Environment

1.2.3.1 Flora and Vegetation

There are four broad vegetation groups present at the Site: Jarrah-Banksia woodlands; Marri woodlands; Tuart woodlands and shallow limestone shrublands. The Jarrah-Banksia vegetation units covered the largest part of the survey area. The Tuart woodlands include Jarrah and Banksia elements and are therefore closely related to the Jarrah-Banksia woodlands group (360 Environmental 2011). The vegetation of the area belongs to the Cottesloe Complex – Central and South vegetation unit (360 Environmental 2011). The vegetation condition on the Site was mostly in the range of 'Good' to 'Very Poor'. Some 'Completely Degraded' areas were also recorded. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover. Some physical disturbance has occurred in various places on the Site (360 Environmental 2011).

1.2.3.2 Expected Fauna/ Habitat Assemblage

The vertebrate fauna of the Swan Coastal Plain, as a subset of the species assemblage found elsewhere in the southwest of Western Australia, recognized as being particularly historically diverse. This high species richness comprised some 176 avifauna species (excluding seabirds), 33 species of native mammals (28 non-volant and five bats) and 77 herpetofauna species. Of this total, populations of over half the birds have declined, with 13 considered to be extinct, and only ten of the 28 terrestrial mammals are still found. The primary threats that have led to, and are exacerbating, this decline include the clearing of native bushland, particularly wetlands, the associated encroachment of urban and industrial areas and the influence of feral predators.

Given the threats listed above, it is unsurprising that the results of the decline in native fauna on the Swan Coastal Plain is mostly keenly observed in the greater metropolitan area, although surrounding agricultural zones are also significant. Larger pockets of

remnant bushland may harbour the greatest number of species, although the value of smaller such areas cannot be overlooked, as they often contribute to the movement of animals through urban areas.

Fauna surveys in the Perth area therefore often yield reasonable numbers of avifauna, as they tend to be more active and obvious during the day. The potential for terrestrial vertebrates such as herpetofauna and mammals, which tend to be less easy to observe, to occur often relies on the veracity of habitat assessments. Where habitat assessments are considered to be insufficient, and often where fauna species of elevated Conservation Significance (protected either at State or federal administrative levels) are considered likely to occur, multiple phase Level 2 surveys may be required.

1.3 Study Objectives

The objectives of the Level 1 Vertebrate Fauna Survey were as follows:

- Provide an inventory of the fauna habitats and assemblage of the Site;
- To identify significant constraints associated with the faunal values within the Site;
- To assist the client with the evaluation of potential impacts on vertebrate fauna and/ or habitat of Conservation Significance; and
- Provide recommendations to mitigate fauna impacts.

1.4 Scope of Work

In order to achieve the objective, 360 Environmental undertook a Level 1 Vertebrate Fauna Survey for the Site. The scope of works for the fauna survey included a desktop study followed by a Site visit (Appendix B).

The purpose of the desktop study was to gather background information relevant to the Site by searching literature, data sources and map based information. The reconnaissance survey aimed to verify the accuracy of the desktop study delineate and characterise fauna and faunal assemblages present within the Site and identify potential impacts.

The Level 1 Vertebrate Fauna Survey was planned and implemented in accordance with the EPA *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) and *Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). To ensure adequate data of a high standard the survey was conducted with reference to the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010) to meet the EPA and DEC's expectations for undertaking a Level 1 Vertebrate Fauna Survey.

1.5 Report Format

This Report has been structured in the following format:

- Section 1. Introduction;
- Section 2. Methods;
- Section 3. Results;
- Section 4. Conservation Significant Fauna;
- Section 5. Conclusion and Recommendations;
- Section 6. References; and
- Section 7. Report Limitations.

388000 388100 388200 388300 388400 388500 388600 388700

6431500 6431400 6431300 6431200 6431100 6431000 6430900 6430800 6430700 6430600

N

Legend

Site Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.01	18/04/2012

HORIZONTAL DATUM AND PROJECTION

GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
TD	AH	AH	0

Department of Housing/Satterley Property Group

Level 1 Vertebrate Fauna Survey
Kwinana Town Centre
Site Location

Figure 2

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2 Methods

2.1 Desktop Study

A desktop review was undertaken to collect current data relevant to the Site and its surrounds. This involved a search of available literature and survey data, web based mapping tools and map-based information (Table 1). A desktop survey of species potentially occurring within the Site was performed using data from:

- Searches of the Department of Environment and Conservation (DEC) databases;
- Search of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database;
- Search of the International Union for Conservation of Nature (IUCN) Red-list;
- Search of Birds Australia *Birdata database*;
- Various reference books (Wilson and Swan [2003]; Pizzey and Knight [1997]; Morcombe [2003]; Simpson and Day [1996]; Van Dyke and Strahan [2008]; Menkhorst and Knight [2004]); and
- Previous fauna survey's in the area.

All species of elevated Conservation Significance recorded or expected to occur on the Site were cross-checked against the Federal EPBC Threatened Matters Database (SEWPaC 2012a) and the Government Gazette Number 12 (Government of Western Australia 2010) for their status under the EPBC Act and *Wildlife Conservation Act 1950* (WC Act).

Table 1: Database Sources

PROVIDER	DATABASE	PARAMETERS
Department of Sustainability, Environment, Water, Population and Communities	Protected Matters Database Search Tool. Accessed 29 February 2012 (Appendix C)	Buffer of one kilometre from the area bounded by coordinates -32.2477, 115.81236, -32.2477, 115.81735, -32.25537, 115.81735, -32.25537, 115.81236, -32.2477, 115.81236
Department of Environment and Conservation	Naturemap (Appendix D)	Buffer of five kilometres centred around 32.250833, 115.814722.
Department of Environment and Conservation	Fauna Search (Appendix E)	Buffer of five kilometres centred around 32.250833, 115.814722.

2.2 Survey Timing and Weather

The primary objectives of the survey were to verify the presence, and provide Site-specific descriptions, of fauna habitats and verify the likelihood of the occurrence of EPBC Act and WC Act listed fauna species within the Site.

A reconnaissance survey was undertaken during the mornings of 21 March, 24 April and 21 May 2012 in accordance with the EPA's Guidance Statement 56 (EPA 2004). Weather conditions during all survey days were warm and fine (Table 2). The survey was spread throughout autumn in an attempt to record the full fauna assemblage of the area, particularly post major rainfall event. The conditions throughout March and May were still relatively dry (Table 3).

Rainfall occurred on 29 April 2012 (40.8 mm) prior to the final survey trip.

Table 2: Weather at Time of Survey

Date	Minimum Temperature (°C)	Maximum Temperature (°C)	Rainfall 24hrs to 9am (mm)	Weather
21/03/12	8.6	25.4	0.0	Fine, no cloud
24/04/12	12.2	26.4	0.0	Fine, Light cloud
21/05/12	8.6	25.4	0.0	Fine, no cloud

Table 3: Last Five Months of Rainfall (mm) Compared to Average (Medina weather station)

	January	February	March	April	May
Average (1983 - 2012)	12.1	20.1	18.3	40.3	97.7
Rainfall 2012	18.1	23.6	0.2	69.2	49 (to 23/5/12)

2.3 Fauna Survey Team

360 Environmental's Senior Environmental Scientist Andrew Hide coordinated and operated the field survey and was responsible for fauna identification and documentation during the survey. Andrew has appropriate tertiary qualifications and a minimum of five years of relevant field experience enabling him to competently satisfy EPA requirements for a Level 1 Vertebrate Fauna Survey.

2.4 Fauna Habitat Assessment

A Level 2 Flora and Vegetation survey was conducted at the Site in 2006 (360 Environmental 2006). The survey outlined four broad fauna habitat types recorded within the Site (Figure 3). The figure contains a detailed description of each habitat type. A brief description of each of the four broad fauna habitats is discussed below:

Jarrah-Banksia woodland Composed primarily of Jarrah (*Eucalyptus marginata*), low open forest over *Banksia grandis* and *Banksia attenuata* low woodland over *Jacksonia furcellata*. The understorey consists of *Macrozamia riedlei* and *Xanthorhoea preeissii*. In areas scattered Tuart (*Eucalyptus gomphocephala*) trees are present over the Jarrah.
Marri woodlands Marri *Corymbia calophylla* woodland over *Jacksonia furcellata, Macrozamia riedlei* and *Xanthorhoea preeissii*.
Tuart woodlands Tuart woodland over Jarrah low open woodland over *Banksia grandis* and *Banksia attenuate* over *Jacksonia furcellata, Macrozamia riedlei* and *Xanthorhoea preeissii.*
Limestone shrubland Scattered Tuart trees over *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata, Banksia sessilis* scattered tall shrubs. Contains open grassland and herbland.

A significant tree survey conducted in 2012 revealed the distribution of significant tree species, including Tuart, Jarrah, Marri, Banksia and Sheoak throughout the Site. The results of this survey are displayed in Figure 4.



Jarrah-Banksia woodlands

Em *Eucalyptus marginata* subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, Acacia pulchella scattered shrubs over *Gompholobium tomentosum*, *Hibbertia hypericoides* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* very open grassland with *Conostylis aculeata* very open herbland.

EmBa (*Eucalyptus gomphocephala* scattered trees over) *Eucalyptus marginata* subsp *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmocladus aspera*, *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* (perennial veldt grass) open grassland to grassland.

EmAf *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over Acacia pulchella, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre*, *Lupinus blue very open herbland.

EgEm *Eucalyptus gomphosephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* (=KM2-10) scattered tall shrubs over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladus aspera* very open sedgeland and *Conostylis aculeata* very open herbland.

Tuart woodlands

Eg *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preisii* high open shrubland over *Macrozamia riedlei* and *Acacia pulchella* open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* open herbland.

Marri woodlands

Cc *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon* ? prop scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Limestone shrublands

Gv *Grevillea vestita* subsp. *vestita* heath over *Desmocladus aspera* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

EgDs *Eucalyptus gomphocephala* scattered trees over Dryandra sessilis high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

AfDs (*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, Dryandra sessilis scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over Acacia pulchella, Pimelea rosea, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* very open herbland.

Legend

- Lot E26

Vegetation Units

- Jarrah-Banksia woodlands
- Limestone shrublands
- Marri woodlands
- Tuart woodlands
- Completely Degraded

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
-TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2006

SCALE

0 25 50 100 150 200

Metres

1:5,000 @ A4

LOCALITY MAP



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METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
TD	MH	
DATE	**REVISION**	**DRAWING ID**
11.04.12	0	LD008-3.04

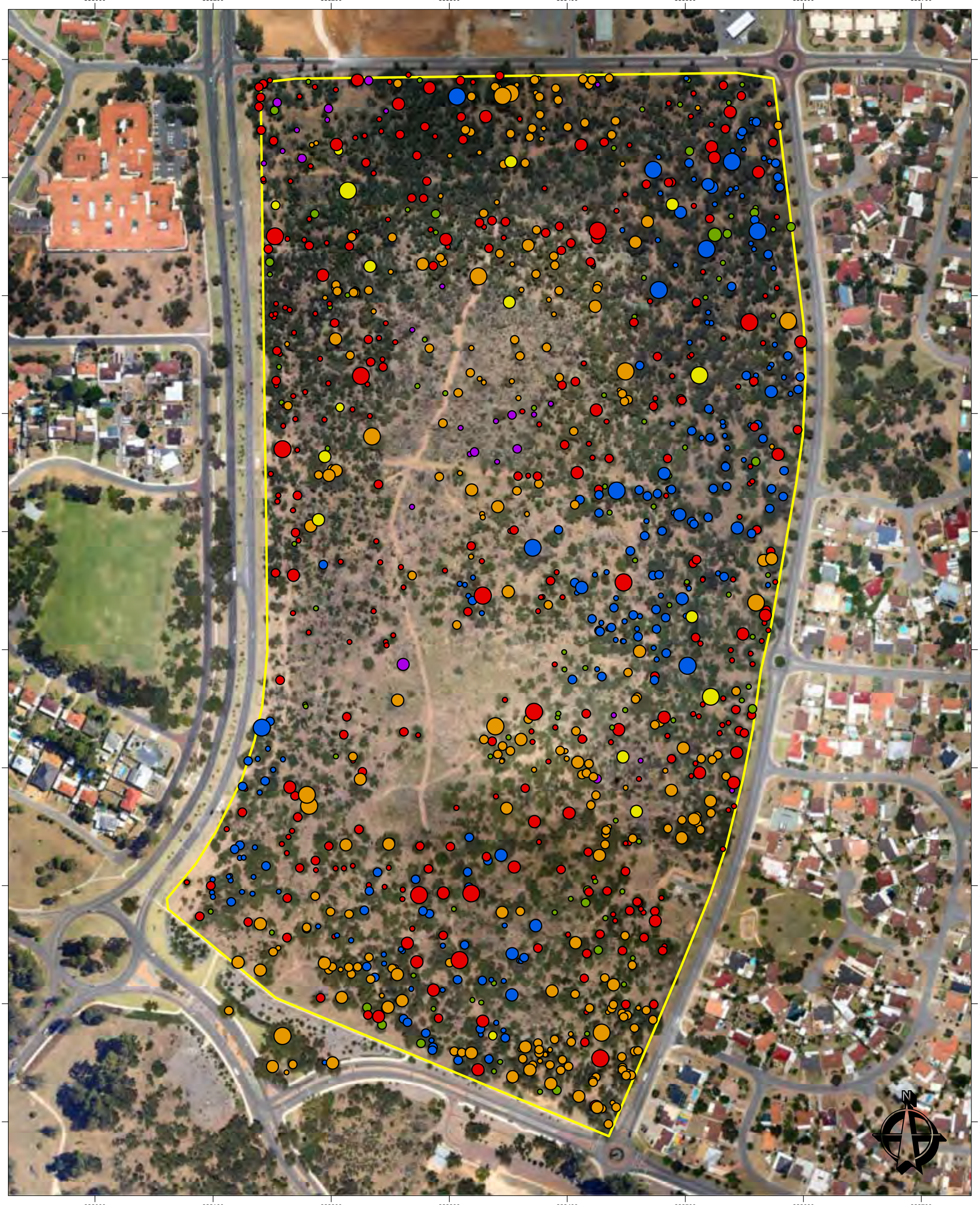
SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Kwinana Town Centre Environmental Assessment Report
Site Vegetation Units Surveyed During Spring 2006
Figure 3

360 environmental

388000 388100 388200 388300 388400 388500 388600 388700

6431500 6431400 6431300 6431200 6431100 6431000 6430900 6430800 6430700 6430600



388000 388100 388200 388300 388400 388500 388600 388700

Legend

Site Boundary

Trunk Diameter (mm)

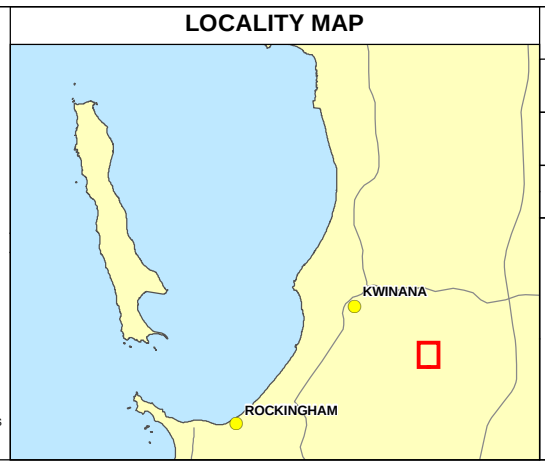
- 400 - 500
- 500 - 800
- 800 - 1200
- >1200

Species

- Banksia
- Jarrah
- Marri
- Sheoak
- Stag
- Tuart

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.03	10/05/2012

HORIZONTAL DATUM AND PROJECTION

GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	AH	AH	0

Department of Housing/Satterley Property Group

Level 1 Vertebrate Fauna Survey
Kwinana Town Centre
Significant Tree Survey Results from Black Cockatoo Survey
Figure 4

360 environmental

K:\Projects\1.0 EBS\EBS165-1 KTC Black Cockatoo Survey\Figures\EBS165-1 Figure 3 - Tree Diameter (9.5.12)

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2.5 Survey Locations

The Site reconnaissance survey was comprised of detailed habitat descriptions at specific survey locations as well as traversing the entire Site from length to length to cover all broad habitat types. Survey sites were chosen randomly to remove any bias in site locations and to allow adequate spread throughout the Site (Table 4; Figure 5). Efforts were made to incorporate each broad habitat type within a survey location. All broad fauna habitat types were surveyed during the transect walk throughout the Site. This involved walking up and down the entire length of the Site in order to cover all areas and increase the chance of opportunistically sighting fauna.

Table 4: Survey Location, Including GPS Location (GDA 1994) and Broad Habitat Type

Survey Location	GPS Location			Plate No	Broad Habitat
	Zone	Easting	Northing		
Site 1	50H	388512	6431248	Plate 1	Marri Woodland
Site 2	50H	388407	6430783	Plate 2	Jarrah-Banksia Woodland
Site 3	50H	388293	6430951	Plate 3	Completely degraded open habitat
Site 4	50H	388306	6431052	Plate 4	Jarrah-Banksia woodland fringing Marri Woodland
Site 5	50H	388285	6431348	Plate 5	Jarrah-Banksia woodland
Site 6	50H	388502	6431378	Plate 6	Marri Woodland
Site 7	50H	388395	6431175	Plate 7	Marri Woodland
Site 8	50H	388201	6430818	Plate 8	Jarrah-Banksia Woodland
Site 9	50H	388480	6430961	Plate 9	Jarrah-Banksia Woodland
Site 10	50H	388241	6431199	Plate 10	Jarrah-Banksia woodland fringing Limestone shrubland

2.6 Site Design and Survey Effort

2.6.1 Systematic Sampling

The principal component of this survey comprised a total of ten (10) systematic survey locations (Figure 5). Each survey location was recorded using a Differential Global Positioning System (DGPS). Survey sites were positioned randomly as such that they sampled all dominant fauna habitats available within the Site and without including bias to their location. Efforts were made to try and include the less dominant fauna habitat types however this was not always possible during the systematic sampling survey.

Sampling at each location involved a detailed fauna search for more than 30 minutes. Sampling was conducted early morning during peak fauna activity and involved searching within a two hectare area around the survey location. This survey method was primarily focused on avian species, but any other fauna species sighted, or any sign of fauna species was recorded. The nomenclature used to record the birds, mammals, amphibians and reptiles species observed within the Site is described below.

- Nomenclature for each bird species recorded was checked against Christidis and Boles (Christidis and Boles 2008);
- Nomenclature for each mammal species recorded was checked against the *Checklist of the mammals of Western Australia* (How *et al.* 2009);
- Nomenclature for each amphibian species recorded was checked against the *Checklist of the amphibians of Western Australia* (Doughty and Maryan 2010a); and
- Nomenclature for each reptile species recorded was checked against the *Checklist of the reptiles of Western Australia* (Doughty and Maryan 2010b).

Photos were taken at each survey location to provide a visual description of each survey location. Survey location plates are provided in Appendix B. These also give an indication of the habitat present at the Site.

2.6.1.1 Ornithological Survey

At each survey site, as part of the systematic survey, a dedicated bird survey was conducted to identifying bird species within a two hectare area. This involved experienced staff members recording all species seen and heard during peak bird activity for a minimum of 30 minutes per session. Peak bird activity was between sunrise and 9 am. Surveys were not conducted in the afternoon.

Opportunistic sightings of birds were also recorded at all times while traversing the Site.

2.6.2 Non-systematic Fauna Sampling

Within each broad fauna habitat type a non-systematic fauna search was conducted to identify and document additional species (sightings) as well as scats, tracks and diggings. The search involved detailed inspection of fauna habit within the Site such as inspecting leaf litter, rock crevices, potential burrows and nests over approximately two hectares per survey site. The search involved a minimum of 30 search minutes at each broad fauna habitat type and was also conducted opportunistically while walking transects throughout the area.

The survey transect of the Site involved walking throughout each broad fauna habitat at a slow observational pace in an attempt to observe all fauna utilising the habitat within the Site.

388000 388100 388200 388300 388400 388500 388600 388700

6431500 6431400 6431300 6431200 6431100 6431000 6430900 6430800 6430700 6430600

Loc 6
Loc 5
Loc 1
Loc 10
Loc 7
Loc 4
Loc 9
Loc 3
Loc 8
Loc 2

N

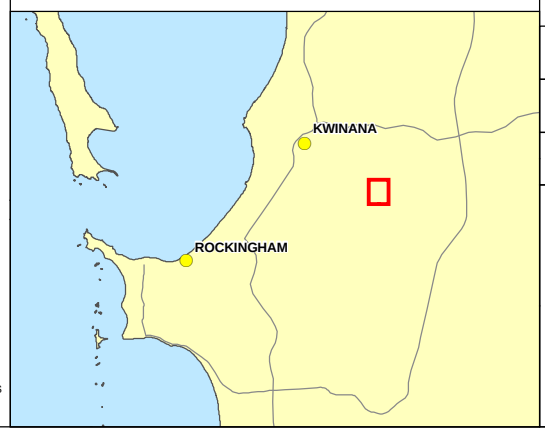
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Legend

- Site Boundary
- Fauna Survey Locations

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.01	18/04/2012

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
TD	AH	AH	0

Department of Housing/Satterley Property Group

Level 1 Vertebrate Fauna Survey
Kwinana Town Centre
Site Location

Figure 2

K:\Projects\1.0 EBS\EBS165-1 KTC Black Cockatoo Survey\Figures

2.7 Survey Limitations

Table 5 addresses potential limitations and constraints associated with the Level 1 Fauna Survey. The following limitations have been addressed with reference to Guidance Statement 56 (EPA 2004).

Table 5: Limitations and Constraints

POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Competency and experience of the consultant (s) carrying out the survey	Negligible	The 360 Environmental staff member who completed the field work and prepared this report has appropriate training and experience in conducting Fauna Surveys.
Scope	Negligible	The purpose of a Level 1 Fauna Survey is to conduct a reconnaissance survey to support a desktop study of a particular site in order to compile an inventory of fauna habitats and species and to identify any fauna of elevated Conservation Significance within the proposed Project area.
Proportion of fauna identified, recorded and/ or collected	Negligible	As this is a Level 1 Fauna Survey a suitable amount of diversity has been recorded. A higher diversity of fauna species would require fauna trapping and is not within the scope of a Level 1 Fauna Survey.
Sources of Information	Negligible	Vertebrate fauna information was accessed by searching available literature and survey data; web based mapping tools and map-based information.
Proportion of the task achieved	Negligible	The field component fulfils EPA's requirements for a Level 1 Fauna Survey.
Timing/ weather/season/ cycle	Negligible	A total of three dedicated fauna survey visits were conducted throughout Autumn. The final survey was conducted following a significant rainfall event, increasing the chance of observing the full composition of fauna within the Site. The weather on all survey days was fine.
Disturbances which affected results of the survey	Negligible	Human disturbances are regular throughout the Site. However these are not recent disturbances and therefore would not have affected the survey results.
Intensity of survey effort	Negligible	The intensity of survey effort was sufficient for a Level 1 Fauna Survey.
Completeness	Negligible	The survey was completed in detail over three site visits and the relevant literature and data for the Site was reviewed. Further detail would require a Level 2 Fauna Survey.

POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Resources	Negligible	Adequate resources were available.
Remoteness and/ or access problems	Negligible	Access to and within the Site was not an issue.
Availability of contextual information on the region	Negligible	360 Environmental had adequate access to fauna databases to determine which species were likely to be identified within the Survey area.

*Constraint (yes/ no); Significant – greater than 60%; Moderate – 20-60%; Negligible – less than 20%

3 Results

3.1 Desktop Study

3.1.1 Conservation Significant Fauna

A search of the DEC's Threatened and Priority Fauna Database, NatureBase and the EPBC Protected Matters Database search were undertaken to identify fauna species predicted to occur within a buffer of between one (1) and five (5) kilometres of the Site.

A total of one hundred and ten (110) bird species, nine (9) native terrestrial mammal species, thirty four (34) reptile species, six (6) amphibian species and five (5) invasive mammal species were identified as potentially occurring within the Site.

The desktop fauna list was used to determine specially protected fauna under State and/or Commonwealth legislation that may occur within the Site (Table 7).

Conservation Significant fauna predicted to occur in the area comprised a total of twelve (12) bird species, six (6) terrestrial mammal species and five (5) reptile species. One insect of Conservation Significance was also predicted to occur within the Site.

3.1.2 Previous Fauna Surveys

There have been a number of flora and fauna surveys conducted in the Kwinana area. A flora survey was conducted in 2004 by Bennett Environmental Consulting. This survey occurred at the Kwinana Beach area and no Declared Rare or Priority Flora were recorded during the survey (Bennett Environmental Consulting 2004). 360 Environmental conducted a flora survey at the project Site in 2006. No Declared Rare Flora species and no Priority Flora species were identified during the survey. None of the species recorded during the survey were considered of Conservation Significance (360 Environmental 2006). In 2008, Greg Harewood conducted a Level 1 Fauna survey in the East Rockingham area and found evidence of only one species of Conservation Significance, the southern brown bandicoot (Harewood 2008; Table 6). A Black Cockatoo Survey has also been conducted at the Site during 2009 and 2012 (360 Environmental 2009; 360 Environmental 2012).

Table 6: Other Surveys in the Area

	East Rockingham WWTP Fauna Assessment	Black Cockatoo Survey Kwinana Town Centre
Consultant	Greg Harewood	Tony Kirkby
Duration	31st July 2008	March 2009 and March 2012
Type	Level 1 Survey	Black Cockatoo Survey
Approx. Distance from Current Survey	10km	At Site
Total Trap Nights	N/A (reconnaissance survey)	N/A (reconnaissance survey)
Amphibians	0	-
Reptiles	3	-
Mammals	3	-
Birds	30	Carnaby's and Forest Red-tailed Black Cockatoo
Total species	36	-
Conservation Significant species recorded	Quenda (Southern Brown Bandicoot)	Carnaby's and Forest Red-tailed Black Cockatoo
No. Conservation Significant species	1	2
Duration	31 July 2008	19 March 2009; 21 March 2012

Table 7: Desktop Study Results

Common Name	Scientific Name	International	Federal	State	
		IUCN	EPBC	DEC	WCA
Birds					
Australian Painted Snipe	*Rostratula australis*	Endangered	Vulnerable	Vulnerable	Schedule 1
Carnaby's Black Cockatoo	*Calyptorhynchus latirostris*	Endangered	Endangered	Endangered	Schedule 1
Cattle Egret	*Ardea ibis*		Migratory Marine, Migratory Wetland		Schedule 3
Forest Red-Tailed Black Cockatoo	*Calyptorhynchus banksii naso*		Vulnerable	Vulnerable	Schedule 1
Fork-Tailed Swift	*Apus pacificus*		Migratory Marine		Schedule 3
Great Egret, White Egret	*Ardea alba*		Migratory Marine, Migratory Wetland		Schedule 3
Malleefowl	*Leipoa ocellata*	Vulnerable	Vulnerable, Migratory Terrestrial	Vulnerable	Schedule 1
Painted Snipe	*Rostratula benghalensis s. lat.*		Migratory Wetland		Schedule 3
Rainbow Bee-Eater	*Merops ornatus*		Migratory Terrestrial		Schedule 3
White-bellied Sea-Eagle	*Haliaeetus leucogaster*		Migratory Terrestrial		Schedule 3
Mammals					
Chuditch	*Dasyurus geoffroii*	Near Threatened	Vulnerable	Vulnerable	Schedule 1
Quenda	*Isoodon obesulus subsp. fusciventer*			Priority 5	
Quokka	*Setonix brachyurus*	Vulnerable	Vulnerable	Vulnerable	Schedule 1
Red-Tailed Phascogale	*Phascogale calura*	Near Threatened	Endangered	Endangered	Schedule 1
Water Rat	*Hydromys chrysogaster*			Priority 4	
Western Brush Wallaby	*Macropus Irma*			Priority 4	
Reptiles					

Common Name	Scientific Name	International	Federal	State	
		IUCN	EPBC	DEC	WCA
Lined Skink	Lerista lineata			Priority 3	
Rottnest Bobtail	Tiliqua rugosa subsp. konowi			Vulnerable	Schedule 1
Insects					
Graceful Sun Moth	*Synemon gratiosa*		Endangered		Schedule 1

3.2 Fauna Survey and Fauna Assemblage

The following section summarises the mammals, birds and herpetofauna recorded during the survey. Table 8 summarises the total species recorded during the survey. A more intensive survey including trapping (Level 2 Vertebrate Fauna Survey) would need to be implemented to complete a more comprehensive list for the Site.

Avifauna was recorded the most, as the species is much more active during the day and trapping techniques are usually required to survey the remaining fauna assemblages. Species abundance and diversity at the Site did not differ greatly between the broad habitat types and therefore did not have a significant impact on the fauna distribution at each survey location.

Table 8: Total Fauna

FAUNA GROUP	NUMBER SPECIES
Birds	28
Native Mammals	2
Introduced Mammals	4
Bats	0
Reptiles	2
Amphibians	0
Total	**36**

3.2.1 Avifauna

A total of 28 bird species were observed during the survey (Table 9), of the potential 110 predicted to occur in the area. Silvereye (*Zosterops lateralis*), Weebill (*Smicrornis brevirostris*), Western Gerygone (*Gerygone fusca*) and Australian Ringneck (*Barnardius zonarius*) were recorded most commonly throughout the Site. Several species were only recorded once, and two of these were identified by a call in the distance.

The Southern Boobook (*Ninox novaeseelandiae*) was recorded opportunistically during a significant tree survey at the Site during wet. The bird flushed from a tree and was observed perching in a Jarrah tree.

Grey Fantail (*Rhipidura albiscapa*), Scarlet Robin (*Petroica boodang*) and Splendid Fairy-wren (*Malurus splendens*) were not regularly sighted throughout the Site. However when they were present within an area they were very obvious.

What appeared to be Stubble Quail (*Coturnix pectoralis*) were observed on two occasions, however as the sighting was so brief it was difficult to confidently identify the species.

Location 1, 5, 6 and 9 recorded the most bird species. These locations were in the north north-east extent of the Site. Habitat within this area was denser and appeared to be of a higher quality.

3.2.1.1 Avifauna of Conservation significance

Fauna sightings were recorded in conjunction with a Black Cockatoo survey conducted during March, April and May. During this time two small flocks of Carnaby's Black Cockatoo were observed at the Site. One small flock was observed just outside the Site within a park to the west. The second small flock was observed just within the Site on a *Banksia atenuatta* tree. A small flock of Forest Red-tailed Black Cockatoos were observed flying overhead and heard within the area (not within the Site) on several occasions. Feeding evidence of both Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo were observed on Site by Tony Kirkby while conducting the specific Black Cockatoo survey.

Table 9: Bird Species Recorded within Site

Common Name	Scientific Name	Cons Sig	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6	Loc 7	Loc 8	Loc 9	Loc 10	Opp. Record	Total
Australian Magpie	*Cracticus tibicen*		1		3	1					*		3	**9**
Australian Raven	*Corvus coronoides*		1		*	*		2	*		*	^	3	**11**
Australian Ringneck	*Barnardius zonarius*				3			2	2		3	2	4	**16**
Black-faced Cuckoo-shrike	Coracina novaehollandiae						1							**1**
Brown Honeyeater	*Lichmera indistincta*										*		*	**2**
Carnaby's Black Cockatoo	*Calyptorhynchus latirostris*	Yes											4	**4**
Galah	*Eolophus roseicapillus*							3			2	^	6	**11**
Golden Whistler	*Pachycephala pectoralis*												*	**1**
Grey Butcher Bird	*Cracticus torquatus*						1	1					1	**3**
Grey Currawong	*Strepera versicolor*												*	**1**
Grey Fantail	*Rhipidura albiscapa*		1					5				2	2	**10**
Silvereye	*Zosterops lateralis*		5				6	5	4		5	2	3	**30**
Laughing Kookaburra	*Dacelo novaeguineae*						1			1			2	**4**
Little Corella	*Cacatua sanguinea*						5^						3^	**8**
Magpie-lark	*Grallina cyanoleuca*		*								1			**1**
Rainbow Lorikeet	*Trichoglossus haematodus*							^		^			*	**3**
Red Wattlebird	*Anthochaera carunculata*			1						1			2	**4**
Red-capped Parrot	*Purpureicephalus spurius*							2	1				4	**7**
Red-tailed Black Cockatoo	*Calyptorhynchus banksii*	Yes											3^	**3**
Rufous Whistler	*Pachycephala rufiventris*							1			3		1	**5**
Scarlet Robin	*Petroica boodang*							4					4	**8**
Singing Honeyeater	*Lichenostomus virescens*						1						*	**2**
Southern Boobook	*Ninox novaeseelandiae*			1										**1**
Splendid Fairy-wren	*Malurus splendens*		3					1						**4**
Stubble Quail	*Coturnix pectoralis*								2#				1#	**3**
Weebill	*Smicrornis brevirostris*		3			3		5					10	**21**
Western Gerygone	*Gerygone fusca*		2	2		2	3	1	2				3	**15**
Yellow-rump thornbill	*Acanthiza chrysorrhoa*												3	**3**
Total Per Survey Location			**17**	**4**	**7**	**7**	**18**	**33**	**12**	**3**	**17**	**8**		

* Indicates that the species was heard but not sighted

# Indicates that the species was observed briefly and therefore identification is tentative

^ Species observed overhead (not utilising Site)

3.2.2 Mammals

A total of six mammals were recorded within the Site (Table 10). Most of these records were through tracks, scats and diggings at the Site. A total of two native mammal species were observed during the survey of a potential nine (9) predicted to occur in the area. Four introduced mammal species were recorded out of a predicted five (5).

Common Brush-tail Possum (*Trichosurus vulpecula*) scat was observed within three survey locations throughout the Site. Suitable hollows for the species were also observed throughout the Site. What appeared to be Quenda (*Isoodon obesulus*) diggings were observed at location 6 and 9. These diggings differ from that of Rabbit (*Oryctolagus cuniculus*) in that the digging ends in more of a point compared to the Rabbit which is usually more rounded. In order to gain an estimate evidence of Quenda abundance trapping would be required.

Signs of introduced mammal species were obvious throughout the Site. Dog (*Canis lupus)* and potentially Red Fox (*Vulpes vulpes*) prints were common throughout the Site. Presumably the dog prints are a result of residents walking dogs throughout the track network. Several scats that appeared to be Red Fox were observed within the Site. Rabbit diggings and a warren system at Location 7 were recorded at the Site. Feral cats (*Felis catus*) were sighted on two occasions as they were flushed from underneath bushes. It is possible they could be semi domesticated but are recorded as feral as they were taking refuge within the bush.

3.2.2.1 Mammals of Conservation Significance

Although no direct observations of the species were made (only diggings), the Quenda is listed as a Priority 5 species by the DEC and appears to be present at the Site.

Table 10: Mammal species recorded within Project area

Common Name	Scientific Name	Cons Sig	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6	Loc 7	Loc 8	Loc 9	Loc 10	Opp. Record	Total
Cat	*Felis catus*												2	2
Common Brushtail Possum	*Trichosurus vulpecula*			*						*		*		3
Dog	*Canis lupus*		*	*			*	*			*	*		6
Rabbit	*Oryctolagus cuniculus*								*					1
Red Fox?	*Vulpes Vulpes*										*			1
Quenda	*Isoodon obesulus*	Yes						*			*			2
Total Per Survey Location			1	2	0	0	1	2	1	1	3	2		

* Indicates that only evidence of the species was observed (scats, tracks, diggings)

3.2.1 Herpetofauna

A total of two (2) species of reptile were observed during the survey (Table 11) of a potential 34 predicted to occur in the area. No amphibian species were recorded of a total six (6) predicted to occur in the area.

A Bobtail Lizard (*Tiliqua rugosa*) was observed within the Site at Location 8. Several small skink species were observed during the survey, these appeared to be *Menetia greyii*, however this could not be confirmed. This is expected for the Site without implementing more intensive methods such as pit and funnel trapping.

3.2.1.1 Herpetofauna of Conservation Significance

No species found on the Site were of Conservation Significance based on the protected lists under State or Commonwealth legislation or under the DEC's Priority list at the time of reporting.

Table 11: Reptile species recorded within Project area

Common Name	Scientific Name	Cons Sig	Loc 1	Loc 2	Loc 3	Loc 4	Loc 5	Loc 6	Loc 7	Loc 8	Loc 9	Loc 10	Opp. Record	Total
Bobtail Lizard	*Tiliqua rugosa*									1				1
Grey's Skink?	*Menetia greyii*?			#					#					2
Total Per Survey Location				1					1	1				

# Indicates that the species was observed briefly and therefore difficult to identify

4 Conservation Significant Fauna

Four fauna species of Conservation Significance were recorded during the survey and a further 20 may be expected to occur on the basis of DEC, EPBC and other database searches.

One of the bird species observed within the Site is of international Conservation Significance based on the IUCN Red list, and is also protected by National and State legislation.

4.1 Threatened Fauna Statutory Framework

A total of twelve (12) bird species, six (6) native mammal species and five (5) reptile species, listed under State and/or Commonwealth legislation, are predicted to occur within the Site. No amphibians of Conservation Significance are predicted to occur within the Site. One insect species of Conservation Significance was recorded in the wider area during the desktop survey.

4.1.1 Key Statutory Requirements

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the WC Act. In addition, many of these species are listed under the Commonwealth EPBC Act.

4.1.2 Federal Legislation

Fauna species are protected at a Federal level under the EPBC Act. The EPBC Act was developed to provide for the protection of the environment, with specific regard to those aspects of the environment that are matters of national environmental significance (MNES). The EPBC Act promotes the conservation of biodiversity through ecologically sustainable development practices and the ecologically sustainable use of natural resources.

The EPBC Act includes provisions to protect native species (and in particular prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species protected under international agreements (Japan-Australia Migratory Bird Agreement [JAMBA], China-Australia Migratory Bird Agreement [CAMBA], Republic of Korea-Australia Migratory Bird Agreement [RoKAMBA]).

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). Table 12 outlines the categories of significance levels.

Table 12: EPBC Act Categories of Threatened Fauna Species

CONSERVATION CODE	CATEGORY
Ex	Extinct - Taxa not defiantly located in the wild during the past 50 years.
ExW	Extinct in the Wild - Taxa known to survive only in captivity.
CE	Critically Endangered - Taxa facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered - Taxa facing a very high risk of extinction in the wild in the near future.
V	Vulnerable - Taxa facing a high risk of extinction in the wild in the medium-term.
NT	Near Threatened - Taxa that risk becoming Vulnerable in the wild.
CD	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.
DD	Data Deficient (Insufficiently Known) - Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

4.1.3 State Legislation

Western Australia's biodiversity is supported and protected by the following legislation:

- The *Conservation and Land Management Act 1984* (CALM Act);
- The *Environmental Protection Act 1986* (EP Act);
- The WC Act;
- The *Wildlife Conservation Regulations 1970*; and
- The Wildlife Conservation (Specially Protected Fauna) Notice 2010 (2).

The *Wildlife Conservation (Specially Protected Fauna) Notice 2010 (2)* describes categories for fauna classified as Specially Protected in a series of Schedules (Table 13). The DEC produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the *WC Act* but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered as potentially significant and the species need further survey and evaluation of their conservation status before consideration can be given to declaration as Threatened Fauna. Levels of Priority are described in Table 14.

Table 13: WC Act Codes for Threatened Fauna

Conservation Code	Category
Schedule 1	Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection.
Schedule 2	Fauna that is presumed to be extinct are declared to be fauna that is in need of special protection.
Schedule 3	Birds that are identified in the agreement between the governments of Australia and Japan relating to the protection of migratory birds, and birds in danger of extinction, are declared to be fauna that is in need of special protection.
Schedule 4	Fauna that is in need of special protection, otherwise than for the reasons mentioned (in Schedule 1 – 3).

Table 14: DEC Priority Fauna Conservation Codes (DEC 2010)

Conservation Code	Category
P1	**Priority One** Taxa with few, poorly known populations on threatened lands.
P2	**Priority Two** Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc.
P3	**Priority Three** Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
P4	**Priority Four** Rare taxa. Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.
P5	**Priority Five** Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

4.1.4 International Agreements

The EPBC Act also includes management of migratory species that are recognised under international treaties such as the CAMBA, the JAMBA, RoKAMBA and *The Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention). Species included in these agreements are considered to be significant at the global level.

4.2 Threatened Fauna

4.2.1 Predicted Significant Fauna

An assessment was conducted to determine the likelihood of each of the predicted Conservation Significant species listed in Table 15 occurring within the Site. This involved determining background and habitat preference for each of the fauna species, along with the likelihood of each occurring within the Site (Table 15). Based on this information it was determined that there was a total of two predicted conservation species with a moderate possibility of occurring within the site. An additional two (2) predicted Conservation Significant species were determined as having a strong likelihood of occurring in the area. In total three of these species were observed (or their sign) during the Vertebrate Fauna Survey. This included:

- Carnaby's Black Cockatoo;
- Forest Red-tailed Black Cockatoo; and
- Quenda.

There was no evidence of the 'possible' Rainbow Bee-eater being present on Site at the time of the survey.

Table 15: Likelihood of predicted Conservation Significant species occurring in Project Area

Species	Conservation Status	Preferred Habitat	Extent of Habitat in the Study Area and Region	Expected Likelihood of Occurrence
Birds				
Australian Painted Snipe (*Rostratula australis)*	IUCN: Endangered EPBC: Vulnerable WC: Schedule 1	Common in the south-west in swamps of the Swan Coastal Plain (Johnstone & Storr 1998). Inhabits shallow terrestrial freshwater wetlands (SEWPaC 2012b).	There are no swamps or water bodies present within the Site.	Unlikely
Carnaby's Black Cockatoo (*Calyptorhynchus latirostris)*	IUCN: Endangered EPBC: Endangered WC: Schedule 1	Forests, woodlands, heathlands, farms. It feeds on banksias, hakeas, dryandras (often on ground) and also exploits pine plantations (Morcombe 2003).	Banksia species are common throughout the Site. There is also the potential for breeding habitat with large Tuart, Jarrah and Marri trees throughout the Site.	Likely
Cattle Egret (*Ardea ibis)*	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Inhabits paddocks, pastures, croplands, wetlands, tidal mudflats and drains (Pizzey & Knight 1997). Occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands (SEWPaC 2012b).	The Site does not contain any of the preferred habitat of the species, therefore it is unlikely the species will be present at the Site.	Unlikely
Forest Red-Tailed Black Cockatoo (*Calyptorhynchus banksii naso)*	EPBC: Vulnerable WC: Schedule 1	Inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm of annual rainfall (SEWPaC 2012b). It feeds on the seeds of Marri and Jarrah fruits (SEWPaC 2012b)	Marri and Jarrah are common throughout the Site. There is also the potential for breeding habitat with large Tuart, Jarrah and Marri trees throughout the Site.	Likely
Fork-Tailed Swift (*Apus pacificus)*	EPBC: Migratory Marine WC: Schedule 3	This species occurs over open country, from semi-deserts to coasts. It sometimes occurs over forests (Pizzey & Knight 1997). This species most commonly occurs over inland plains (SEWPaC 2012b)	Due to its migratory nature this species could occur at the Site. However this is unlikely as the Site does not contain any of the species preferred habitat and is a significant distance from the coast.	Unlikely
Great Egret, White Egret (*Ardea alba)*	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 1997).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely

Species	Conservation Status	Preferred Habitat	Extent of Habitat in the Study Area and Region	Expected Likelihood of Occurrence
Malleefowl (*Leipoa ocellaa)*	IUCN: Vulnerable EPBC: Vulnerable, Migratory Terrestrial WC: Schedule 1	Malleefowl occur within mallee, *Acacia*, paperbark, sheoak, and other scrubs; eucalypt woodland; coastal heaths; mostly on sand or gravel soils with abundant litter and low scrub (Pizzey and Knight 1997; Morcombe 2003).	The Site does not contain the species preferred habitat. Also as the species is primarily a ground dwelling bird it is unlikely to be present a Site surrounded by residential development. Therefore it is unlikely to be present at the Site.	Unlikely
Painted Snipe (*Rostratula benghalensis s. lat.)*	EPBC: Migratory Wetland WC: Schedule 3	Marsh with moderate cover (Simpson & Day 1996). This species inhabits shallow terrestrial freshwater wetlands (SEWPaC 2012b).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely
Rainbow Bee-Eater (*Merops ornatus)*	EPBC: Migratory Terrestrial WC: Schedule 3	Occurs in open forests and woodlands, shrublands, sandridges, sandspits, riverbanks, mangroves and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999).	The Site does not contain any of the preferred habitats of the species. However due to its indifference to habitat types there is a chance it may occur within the Site. However the proposed activity at the Site is unlikely to negatively impact the species.	Possible
White-bellied Sea-Eagle (*Haliaeetus leucogaster)*	EPBC: Migratory Terrestrial WC: Schedule 3	This species occurs mainly around coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs (Pizzey and Knight 1997). This species is also found around terrestrial wetlands in tropical and temperate regions (SWEPAC 2012b).	As the Site is not located next to the coast, nor contains any significant water bodies it is unlikely the species will be present or utilising the Site.	Unlikely
Mammals				
Chuditch (*Dasyurus geoffroii)*	IUCN: Near Threatened EPBC: Vulnerable WC: Schedule 1	This species is able to exist in a variety of environments from denser eucalypt forests and open woodlands to sparser, semi-arid and low-lying scrub (Van Dyck & Strahan 2008). The only remaining habitat suitable for supporting Chuditch numbers is through the cooler south-west corner of the state, in areas with significant concentrations of prey and sufficient logs and hollows for	The Site contains the species preferred habitat and during pre-European settlement the species would likely have occurred at the Site. However due to significant threats on the species such as land clearing and predation by feral species such as the Red Fox and Feral Cat the species is likely to have become extinct at the Site. In addition the lack of	Unlikely

Species	Conservation Status	Preferred Habitat	Extent of Habitat in the Study Area and Region	Expected Likelihood of Occurrence
		nests (Van Dyck & Strahan 2008).	contiguous habitat makes it difficult for the species to survive at the Site or to re-establish at the Site. Therefore although there is a possibility the species is present at the Site it is unlikely.	
Quenda (*Isoodon obesulus subsp. Fusciventer)*	DEC: Priority 5	This species inhabits heathy forest, heath, and coastal scrub (Menkhorst & Knight 2004). The southern brown bandicoot often feeds in forest and woodland that is burnt on a regular basis and also in areas of pasture and cropland adjacent to dense cover.	The Quenda still in habitats remnant vegetation within the outer Perth suburbs. Although the habitat at the Site is not it's preferred habitat it is more than suitable for feeding. The surrounding urban properties are likely to keep Red Fox numbers down and therefore allow the species a chance to survive. Therefore there is a possibility the species is present at the Site.	Possible
Quokka (*Setonix brachyurus)*	IUCN: Vulnerable EPBC: Vulnerable WC: Schedule 1	This species requires wet ground cover in forest or swampy flats (Menkhorst & Knight 2004). The Quokka is also found in heaths and shrublands (SEWPaC 2012b).	The Site does not contain the preferred habitat for the species. In addition the lack of contiguous habitat at the Site is likely to inhibit the species survival at the Site. Therefore it is unlikely the species will be present at the Site.	Unlikely
Red-Tailed Phascogale (*Phascogale calura)*	IUCN: Near Threatened EPBC: Endangered WC: Schedule 1	This species is found in woodland habitats in south and central Australia. It is restricted to areas containing mature wandoo or rock oak woodland (Menkhorst & Knight 2004). This species requires hollow-containing eucalyptus trees for breeding (SEWPaC 2012b).	The Site does not contain the species preferred habitat. In additional the Site is well outside the species known distribution. Therefore it is unlikely the species will be present at the Site.	Unlikely
Water Rat (*Hydromys chrysogaster)*	DEC: Priority 4	The water rat inhabits a wide variety of aquatic habitats including subalpine streams, slow inland rivers, lakes and farm dams (Menkhorst & Knight 2004). This species requires the presence of water.	There are no aquatic habitats present at the Site. Therefore it is unlikely the species will be utilising the Site.	Unlikely
Western Brush Wallaby (*Macropus Irma)*	DEC: Priority 4	This species inhabits dry sclerophyll forest and woodland in the south-west of Western Australia, including some mallee areas (Menkhorst & Knight 2004). The preferred habitat type for this species is open forest or woodland.	The Site contains preferred habitat of the species. However due to the nature of the site (small Site enclosed by residential housing and roads) it is unlikely the species will be present at the Site.	Unlikely

Species	Conservation Status	Preferred Habitat	Extent of Habitat in the Study Area and Region	Expected Likelihood of Occurrence
Reptiles				
Lined Skink (*Lerista lineata)*	DEC: Priority 3	This species is found on the lower west coast of Western Australia. It inhabits areas containing white sands Storr et al. 1999). Its preferred habitat is sandy coastal heath and shrubland (Wilson & Swan 2003).	The Site does not contain any sandy coastal heath or shrublands therefore it is unlikely the species will be utilising the Site.	Unlikely
Rottnest Bobtail (*Tiliqua rugosa subsp. konowi)*	WC: Schedule 1	Tiliqua rugosa are found in dry to arid areas of southern Australia in open mallee woodlands, shrublands and coastal dunes. This subspecies is found on Rottnest Island (Wilson & Swan 2003).	As the Site is not located on Rottnest Island it is unlikely the species will be present at the Site.	Unlikely
Insects				
Graceful Sun Moth (*Synemon gratiosa)*	EPBC: Endangered WC: Schedule 1	The graceful sun moth is found in coastal heathland and *Banksia* woodland. This species is dependent on its host plants, *Lomandra hermaphrodita* and *Lomandra maritima* for survival (SEWPaC 2012b).	Lomandra species are present at the Site, therefore it is possible the species utilises the Site. A Graceful Sun Moth (GSM) survey conducted at the Site in 2010 did not record the species. Therefore it is unlikely the species is present at the Site.	Unlikely

4.2.2 Recorded Significant Fauna

Feeding evidence and sightings of both Carnaby's Black Cockatoo (Listed as Endangered/ Schedule 1) and Forest Red-tailed Black Cockatoo (Listed as Vulnerable/ Schedule 1) were made at the Site. This data was observed during a Black Cockatoo survey conducted during a similar time as the Level 1 Vertebrate Fauna Survey. Detailed findings of the Black Cockatoo Survey are presented within the Black Cockatoo report (360 Environmental 2012).

Evidence of Quenda being present at the Site was observed (diggings).

4.2.3 Migratory Species

The Cattle Egret (*Ardea ibis*), Fork-tailed Swift *(Apus pacificus),* the Great Egret *(Ardea alba),* Painted Snipe (*Rostratula australis*), the Rainbow Bee-eater *(Merops ornatus)* and White-bellied Sea-eagle (*Haliaeetus leucogaster*) are listed as Migratory species under the EPBC Act. The EPBC Database search suggested that these species or their habitat are potentially present at the Site, however inspection of the Site during the reconnaissance survey suggested there was a lack of preferred habitat making their presence at the site unlikely).

The Cattle Egret inhabits moist pastures with tall grass; shallow open wetlands and margins, mudflats (Morcombe 2003).

The Fork-tailed Swift is found over open country, from semi desert to coasts, islands, occasionally over forests and cities (Pizzey and Knight 2002).

The Great Egret has been recorded in a wide range of wetland habitats. These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 2002).

Painted Snipe inhabits surrounds and shallows of wetlands that are well vegetated and contain dense low cover (Morcombe 2003).

The Rainbow Bee-eater has been recorded in open woodlands with sandy loamy soil; sand ridges, sandpits, riverbanks, road cuttings, beaches dunes, cliffs mangroves, rainforests, woodlands and golf courses (Pizzey and Knight 2002).

White-bellied Sea Eagle usually occurs within coastal areas, over islands, reefs, headlands, beaches, bays, estuaries, mangroves, seasonally flooded inland swamps, lagoons and floodplains. It is often found far inland on large pools of major rivers (Morcombe 2003).

Based on these species' widespread distributions and aerial behaviour over a wide variety of habitats, there is potential for these species to be recorded within the Project

area. Conversely, as a result of their wide distribution and indifference to a wide variety of habitats it is considered that clearing on the Site is unlikely to have a significant impact on the species. The proposed area to be cleared is small and therefore is unlikely to impact the conservation status of these migratory species.

388000 388100 388200 388300 388400 388500 388600 388700

6431500 6431400 6431300 6431200 6431100 6431000 6430900 6430800 6430700 6430600



388000 388100 388200 388300 388400 388500 388600 388700

Legend

Carnaby's Black Cockatoo

Site Boundary

Likely Quenda Digging Locations

CODE

Sighting Location

Feeding Location

Red-tailed Black Cockatoo

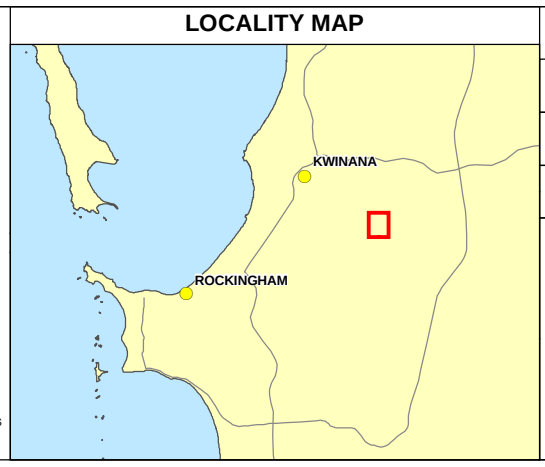
CODE

Sighting Location

Feeding Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.01	18/04/2012

HORIZONTAL DATUM AND PROJECTION

GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
TD	AH	AH	0

Department of Housing/Satterley Property Group

Level 1 Vertebrate Fauna Survey
Kwinana Town Centre
Site Location

Figure 2

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5 Conclusion and Recommendations

5.1 Fauna Summary and Discussion

Database searches for the Site revealed that a total of 23 species of Conservation Significance are predicted to occur within the Site. This was composed of twelve (12) bird species, six (6) native mammal species and five (5) reptile species, listed under State and/or Commonwealth legislation. No amphibians of Conservation Significance are predicted to occur within the area. One insect species of Conservation Significance, the Graceful Sun Moth was predicted to occur within the Site. A Graceful Sun Moth (GSM) survey conducted at the Site in 2010 did not record the species. Therefore it is unlikely the species is present at the Site and should not require further survey work.

A desktop study of the data revealed that there is a possibility that two species may occur within the Site, based on habitat and location, and that two Conservation Significant species were likely to be present at the Site. A reconnaissance Site visit revealed that the Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo where present at the Site and appeared to be utilising the location. It also appeared that Quenda were utilising the Site with two observations of diggings that appeared to be made by Quenda.

In addition to the Level 1 Vertebrate Fauna Survey a Black Cockatoo survey has also been conducted at the Site during early 2012. This revealed that both Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo are utilising the Site to an extent for feeding and were sighted within the area.

The fauna and fauna assemblage recorded at the Site was expected and generally representative for the area. No unexpected species were recorded. The current species list for this Site is not exhaustive and there are likely to be many more species present at the Site, particularly reptiles and bats. However a much higher survey intensity involving trapping techniques would need to be implemented at the Site to record many of these species. Surveying the Site in spring is also likely to yield a greater fauna records. A reconnaissance survey in spring was not essential with many of the species expected to be in the area being recorded.

Generally, the fauna habitat at the Site is in good condition and provides significant fauna value with large older growth habitat trees such as Tuart, Marri, Jarrah and Banksia being present. Levels of annual weeds within the Site were relatively high at the time of the survey; this lowered the Site's overall condition. The isolated and fragmented nature of the Site does also remove some of the fauna value, with the Site being surrounded on all sides by residential housing. This is particularly true for ground dwelling species such as mammals and reptiles, as it is difficult for some species to persist within

a Site of this size and furthermore it makes it difficult for new migrants to move into the area.

That being said it would appear Quenda still persist within the Site. It would be necessary to conduct species specific monitoring at the Site to assess the abundance of Quenda on the Site. As the Quenda is listed as Priority 5 it is only of Conservation Significance at a State level; it is not listed protected under Commonwealth legislation.

Both Carnaby's Black Cocaktoo and the Red-tailed Black Cockatoo were recorded at the Site. Both species appeared to be utilising the Site for feeding, however this appeared relatively infrequent with mostly old evidence of feeding being recorded during the Black Cockatoo Survey (360 Environmental 2012). The Red-tailed Black Cockatoo is listed as Vulnerable under Commonwealth legislation and Schedule 1 at a State level. The Carnaby's Black Cockatoo is of greater Conservation Significance being listed as Endangered under Commonwealth legislation and Schedule 1 at a State level. Therefore significant effort should be implemented to minimise or mitigate the habitat clearing at the Site, particularly of the large habitat trees considered significant for the two Black Cockatoo species.

5.2 Recommendations

In summary, the recommendations include:

- Minimise the clearing of remnant native vegetation wherever possible. For example, previously disturbed areas should be used in preference to clearing remnant vegetation wherever possible;
- It is recommended that a Fauna removal specialist be engaged to trap for Quenda at the site to confirm their presence and to relocate the species from the Site prior to vegetation clearing. Trapping at the Site will require approval from the Department of Environment and Conservation. Prior to the translocation taking place it will also be necessary to liaise with the local council to determine an appropriate location for the animals to be released;
- Implement a Flora and Fauna Management Plan for the Site for the clearing and construction period;
- Retain trees that display hollows wherever possible. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could

include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);

- Clear habitat in stages to allow fauna to disperse away from the Site; and
- Feral bee control could be implemented on Site to remove feral bees from the hollows of trees that remain on Site.
- It is suggested that no further fauna survey work will be required at the Site (with the exception of Quenda trapping and relocation). A Level 1 Vertebrate Fauna Survey should be sufficient for the Site.

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7 Report Limitations

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

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

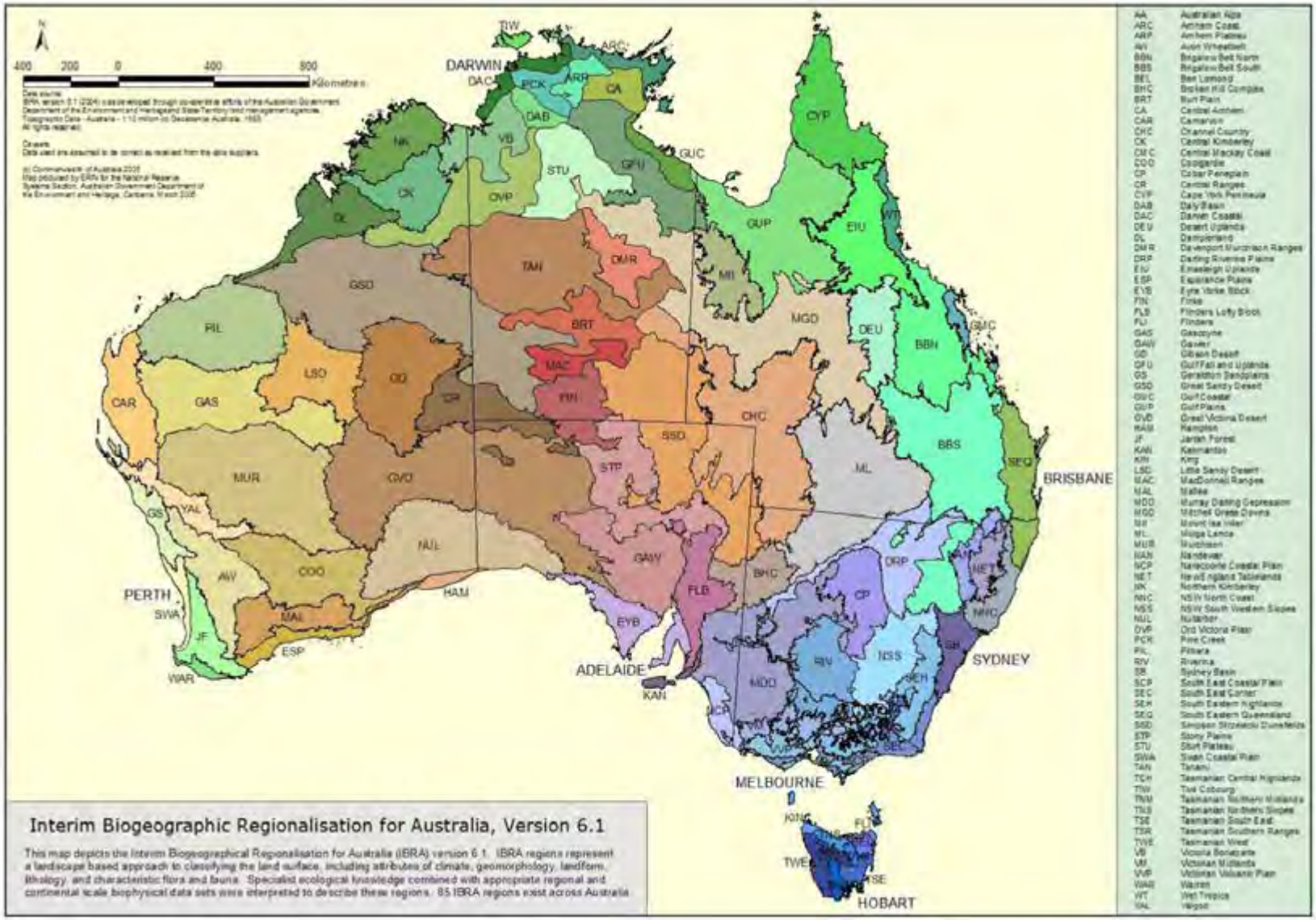
Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed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

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

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APPENDIX A: IBRA MAP

Figure 7: IBRA Bioregions



APPENDIX B: SITE LOCATION PLATES

Plate 1: Site 1

North





West



East



South

Plate 2: Site 2

North





West



East



South

Plate 3: Site 3

North





West



South



East

Plate 4: Site 4

North





West



East



South

Plate 5: Site 5

North





West



East



South

Plate 6: Site 6

North





West



East



South

Plate 7: Site 7

North





West



East



South

Plate 8: Site 8

North





West



East



South

Plate 9: Site 9

North





West



East



South

Plate 10: Site 10

North





West



East



South

APPENDIX C: EPBC SEARCH

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

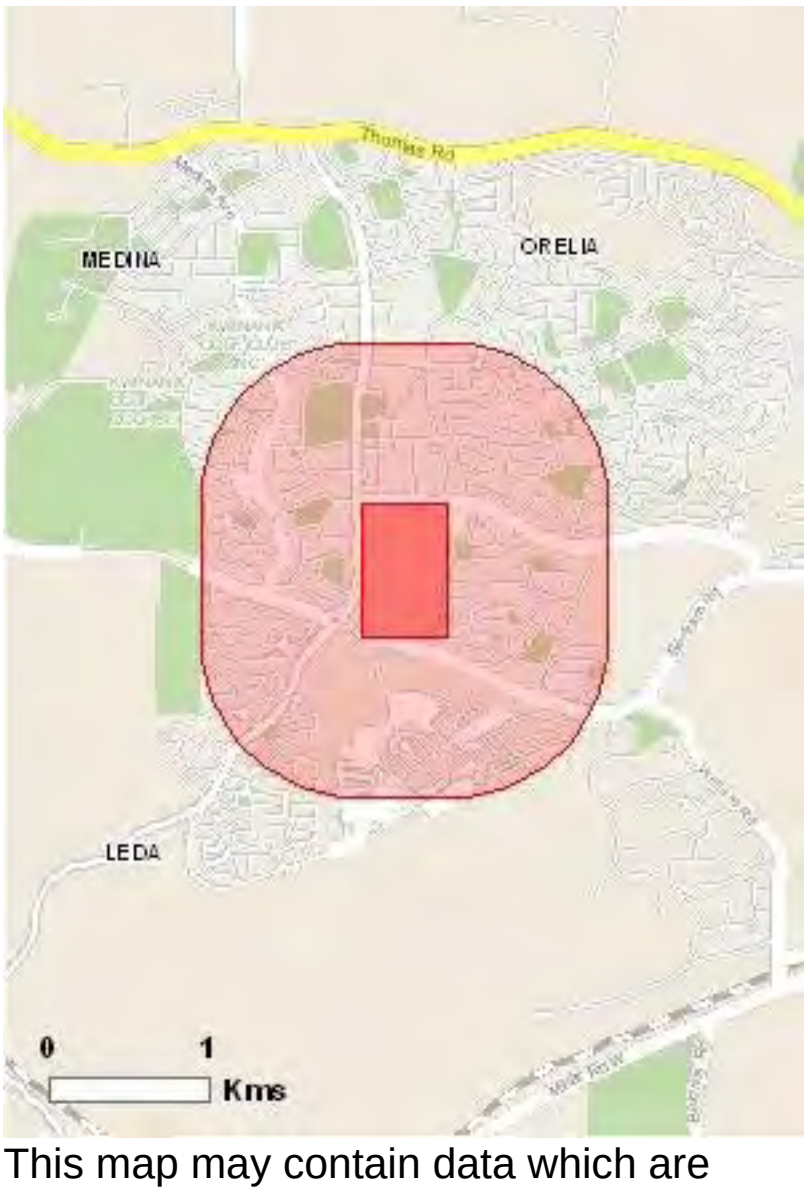
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

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 about the EPBC Act including significance guidelines, forms and application process details can be found at http://www.environment.gov.au/epbc/assessmentsapprovals/index.html

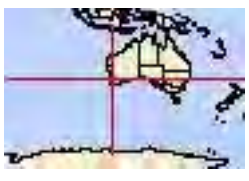
Report created: 29/02/12 17:34:07

Summary
Details
Matters of NES
Other Matters Protected by the EPBC Act
Extra Information
Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 1.0Km



Summary

Matters of National Environment 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 - see http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	10
Migratory Species:	9

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 and the heritage values of a place on the Register of the National Estate. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage/index.html

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.

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. Information on EPBC Act permit requirements and application forms can be found at http://www.environment.gov.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	6
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

Place on the RNE:	1
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR)	[Resource Information]
Name	Proximity
Becher point wetlands	Upstream from Ramsar
Forrestdale & thomsons lakes	Within 10km of Ramsar
Peel-yalgorup system	Upstream from Ramsar

Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		

Name	Status	Type of Presence
Calyptorhynchus banksii naso		
Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis		
Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
INSECTS		
Synemon gratiosa		
Graceful Sun Moth [66757]	Endangered	Species or species habitat may occur within area
MAMMALS		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura		
Red-tailed Phascogale [316]	Endangered	Species or species habitat may occur within area
Setonix brachyurus		
Quokka [229]	Vulnerable	Species or species habitat may occur within area
PLANTS		
Centrolepis caespitosa		
[6393]	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

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 may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Merops ornatus		
Rainbow Bee-eater [670]		Species or species habitat may occur within

Name	Threatened	Type of Presence
		area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [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 may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Historic		
Woodlands Cottage and Reserve 25132	WA	Indicative Place

Invasive Species

[Resource Information]

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

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
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
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 may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may 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 reichardtiji 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

Coordinates

-32.2477 115.81236,-32.2477 115.81735,-32.25537 115.81735,-32.25537 115.81236,-32.2477 115.81236

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 Heritage and Register of National Estate properties, Wetlands of International 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

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

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.

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
-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.

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Canberra ACT 2601 Australia
+61 2 6274 1111

APPENDIX D: NATUREMAP SEARCH

NatureMap Species Report

Created By Guest user on 19/03/2012

Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115°48' 53" E,32°15' 03" S
Buffer	5km
Group By	Kingdom

Kingdom	Species	Records
Animalia	148	1676
Chromista	1	1
Plantae	238	362
Protozoa	8	8
TOTAL	**395**	**2047**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Animalia					
1.	24260	*Acanthiza apicalis (Broad-tailed Thornbill)*			
2.	24261	*Acanthiza chrysorrhoa (Yellow-rumped Thornbill)*			
3.	24262	*Acanthiza inornata (Western Thornbill)*			
4.	24560	*Acanthorhynchus superciliosus (Western Spinebill)*			
5.	25535	*Accipiter cirrocephalus (Collared Sparrowhawk)*			
6.	24281	*Accipiter cirrocephalus subsp. cirrocephalus*			
7.	25536	*Accipiter fasciatus (Brown Goshawk)*			
8.	25011	*Acritoscincus trilineatum*			
9.	25755	*Acrocephalus australis (Australian Reed Warbler)*			
10.	24312	*Anas gracilis (Grey Teal)*			
11.	24315	*Anas rhynchotis (Australasian Shoveler)*			
12.	24316	*Anas superciliosa (Pacific Black Duck)*			
13.	24561	*Anthochaera carunculata (Red Wattlebird)*			
14.	24562	*Anthochaera lunulata (Western Little Wattlebird)*			
15.	24286	*Aquila morphnoides subsp. morphnoides*			
16.	25566	*Artamus cinereus (Black-faced Woodswallow)*			
17.	24353	*Artamus cyanopterus (Dusky Woodswallow)*			
18.	24318	*Aythya australis (Hardhead)*			
19.	24319	*Biziura lobata (Musk Duck)*			
20.	25716	*Cacatua sanguinea (Little Corella)*			
21.	25598	*Cacomantis flabelliformis (Fan-tailed Cuckoo)*			
22.	24779	*Calidris acuminata (Sharp-tailed Sandpiper)*			
23.	24784	*Calidris ferruginea (Curlew Sandpiper)*			
24.	24788	*Calidris ruficollis (Red-necked Stint)*			
25.	25717	*Calyptorhynchus banksii (Red-tailed Black-Cockatoo)*			
26.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo)*		T	
27.	24377	*Charadrius ruficapillus (Red-capped Plover)*			
28.	24321	*Chenonetta jubata (Australian Wood Duck)*			
29.	24431	*Chrysococcyx basalis (Horsfield's Bronze Cuckoo)*			
30.	24288	*Circus approximans (Swamp Harrier)*			
31.	24774	*Cladorhynchus leucocephalus (Banded Stilt)*			
32.	25675	*Colluricincla harmonica (Grey Shrike-thrush)*			
33.	24399	*Columba livia (Domestic Pigeon)*			
34.	25568	*Coracina novaehollandiae (Black-faced Cuckoo-shrike)*			
35.	25592	*Corvus coronoides (Australian Raven)*			
36.	25595	*Cracticus tibicen (Australian Magpie)*			
37.	24422	*Cracticus tibicen subsp. dorsalis (White-backed Magpie)*			
38.	25596	*Cracticus torquatus (Grey Butcherbird)*			
39.	25399	*Crinia glauerti (Clicking Frog)*			
40.	25400	*Crinia insignifera (Squelching Froglet)*			
41.	25027	*Ctenotus australis*			
42.	25039	*Ctenotus fallens*			
43.	25040	*Ctenotus gemmula*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
44.	24322	*Cygnus atratus (Black Swan)*			
45.	30901	*Dacelo novaeguineae (Laughing Kookaburra)*			
46.	25673	*Daphoenositta chrysoptera (Varied Sittella)*			
47.	25607	*Dicaeum hirundinaceum (Mistletoebird)*			
48.	25621	*Falco berigora (Brown Falcon)*			
49.	25622	*Falco cenchroides (Australian Kestrel)*			
50.	24472	*Falco cenchroides subsp. cenchroides*			
51.	25623	*Falco longipennis (Australian Hobby)*			
52.	24041	*Felis catus (Cat)*			
53.	25727	*Fulica atra (Eurasian Coot)*			
54.	25729	*Gallinula tenebrosa (Dusky Moorhen)*			
55.	25530	*Gerygone fusca (Western Gerygone)*			
56.	24443	*Grallina cyanoleuca (Magpie-lark)*			
57.	24293	*Haliaeetus leucogaster (White-bellied Sea-Eagle)*			
58.	24295	*Haliastur sphenurus (Whistling Kite)*			
59.	25410	*Heleioporus eyrei (Moaning Frog)*			
60.	25119	*Hemiergis quadrilineata*			
61.	25734	*Himantopus himantopus (Black-winged Stilt)*			
62.	24491	*Hirundo neoxena (Welcome Swallow)*			
63.	24215	*Hydromys chrysogaster (Water-rat)*		P4	
64.	25366	*Hydrophis elegans*			
65.	25478	*Isoodon obesulus (Southern Brown Bandicoot)*			
66.	24153	*Isoodon obesulus subsp. fusciventer (Quenda)*		P5	
67.	25133	*Lerista elegans*			
68.	25147	*Lerista lineata*		P3	
69.	24581	*Lichenostomus virescens (Singing Honeyeater)*			
70.	25661	*Lichmera indistincta (Brown Honeyeater)*			
71.	25415	*Limnodynastes dorsalis (Western Banjo Frog)*			
72.	25378	*Litoria adelaidensis (Slender Tree Frog)*			
73.	25388	*Litoria moorei (Motorbike Frog)*			
74.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
75.	24326	*Malacorhynchus membranaceus (Pink-eared Duck)*			
76.	25654	*Malurus splendens (Splendid Fairy-wren)*			
77.	24583	*Manorina flavigula (Yellow-throated Miner)*			
78.	25758	*Megalurus gramineus (Little Grassbird)*			
79.	24598	*Merops ornatus (Rainbow Bee-eater)*			
80.	25188	*Morethia adelaidensis*			
81.	25189	*Morethia boulengeri*			
82.	25190	*Morethia butleri*			
83.	25191	*Morethia lineoocellata*			
84.	25192	*Morethia obscura*			
85.	25193	*Morethia ruficauda subsp. exquisita*			
86.	25194	*Morethia ruficauda subsp. ruficauda*			
87.	24223	*Mus musculus (House Mouse)*			
88.	24738	*Neophema elegans (Elegant Parrot)*			
89.	25197	*Notoscincus ornatus subsp. ornatus*			
90.	25198	*Notoscincus ornatus subsp. wotjulum*			
91.	25564	*Nycticorax caledonicus (Rufous Night Heron)*			
92.	24407	*Ocyphaps lophotes (Crested Pigeon)*			
93.	24328	*Oxyura australis (Blue-billed Duck)*			
94.	25679	*Pachycephala pectoralis (Golden Whistler)*			
95.	25680	*Pachycephala rufiventris (Rufous Whistler)*			
96.	25681	*Pardalotus punctatus (Spotted Pardalote)*			
97.	25682	*Pardalotus striatus (Striated Pardalote)*			
98.	24630	*Pardalotus striatus subsp. westraliensis*			
99.	24648	*Pelecanus conspicillatus (Australian Pelican)*			
100.	24659	*Petroica goodenovii (Red-capped Robin)*			
101.	25697	*Phalacrocorax carbo (Great Cormorant)*			
102.	24667	*Phalacrocorax sulcirostris (Little Black Cormorant)*			
103.	25699	*Phalacrocorax varius (Pied Cormorant)*			
104.	24409	*Phaps chalcoptera (Common Bronzewing)*			
105.	24099	*Phascogale tapoatafa subsp. tapoatafa (Southern Brush-tailed Phascogale)*			
106.	24596	*Phylidonyris novaehollandiae (New Holland Honeyeater)*			
107.	24841	*Platalea flavipes (Yellow-billed Spoonbill)*			
108.	24750	*Platycercus zonarius subsp. semitorquatus (Twenty-eight Parrot)*			
109.	24843	*Plegadis falcinellus (Glossy Ibis)*			
110.	25703	*Podargus strigoides (Tawny Frogmouth)*			
111.	25704	*Podiceps cristatus (Great Crested Grebe)*			
112.	24681	*Poliocephalus poliocephalus (Hoary-headed Grebe)*			
113.	25722	*Polytelis anthopeplus (Regent Parrot)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
114.	25731	*Porphyrio porphyrio (Purple Swamphen)*			
115.	25199	*Proablepharus reginae*			
116.	25200	*Proablepharus tenuis*			
117.	25259	*Pseudonaja affinis subsp. affinis (Dugite)*			
118.	25264	*Pseudonaja nuchalis (Gwardar)*			
119.	24245	*Rattus rattus (Black Rat)*			
120.	24776	*Recurvirostra novaehollandiae (Red-necked Avocet)*			
121.	25614	*Rhipidura leucophrys (Willie Wagtail)*			
122.	25534	*Sericornis frontalis (White-browed Scrubwren)*			
123.	25266	*Simoselaps bertholdi (Jan's Banded Snake)*			
124.	25267	*Simoselaps littoralis (West Coast Banded Snake)*			
125.	30948	*Smicrornis brevirostris (Weebill)*			
126.	25597	*Strepera versicolor (Grey Currawong)*			
127.	25589	*Streptopelia chinensis (Spotted Turtle-Dove)*			
128.	30951	*Streptopelia chinensis subsp. tigrina*			
129.	25590	*Streptopelia senegalensis (Laughing Turtle-Dove)*			
130.	24942	*Strophurus spinigerus subsp. spinigerus*			
131.	25705	*Tachybaptus novaehollandiae (Australasian Grebe)*			
132.	24331	*Tadorna tadornoides (Australian Shelduck)*			
133.	24844	*Threskiornis molucca (Australian White Ibis)*			
134.	24845	*Threskiornis spinicollis (Straw-necked Ibis)*			
135.	25202	*Tiliqua multifasciata (Central Blue-tongue)*			
136.	25203	*Tiliqua occipitalis (Western Bluetongue)*			
137.	25204	*Tiliqua rugosa subsp. aspera*			
138.	25205	*Tiliqua rugosa subsp. konowi*		T	
139.	25206	*Tiliqua rugosa subsp. palarra*			
140.	25207	*Tiliqua rugosa subsp. rugosa*			
141.	25549	*Todiramphus sanctus (Sacred Kingfisher)*			
142.	25723	*Trichoglossus haematodus (Rainbow Lorikeet)*			
143.	25521	*Trichosurus vulpecula (Common Brushtail Possum)*			
144.	24808	*Tringa nebularia (Common Greenshank)*			
145.	24849	*Turnix varia subsp. varia*			
146.	24852	*Tyto alba subsp. delicatula (Barn Owl)*			
147.	25227	*Varanus tristis subsp. tristis (Racehorse Monitor)*			
148.	25765	*Zosterops lateralis (Grey-breasted White-eye)*			
Chromista					
149.		*Phytophthora cinnamomi*			
Plantae					
150.	3525	*Acacia rostellifera (Summer-scented Wattle)*			
151.	3527	*Acacia saligna (Orange Wattle)*			
152.	30032	*Acacia saligna subsp. saligna*			
153.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
154.	1208	*Acanthocarpus preissii*			
155.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
156.	1728	*Allocasuarina fraseriana (Sheoak)*			
157.	11434	*Anigozanthos humilis subsp. humilis*			
158.	11261	*Anigozanthos manglesii subsp. manglesii*			
159.	3686	*Aotus cordifolia*			
160.	6211	*Apium prostratum (Sea Celery)*			
161.	141	*Aponogeton hexatepalus (Stalked Water Ribbons)*		P4	
162.	6334	*Astroloma pallidum (Kick Bush)*			
163.	17234	*Austrostipa compressa*			
164.	37421	*Austrostipa sp. Marchagee (B.R. Maslin 1407)*			
165.	231	*Avellinia michelii*	Y		
166.	234	*Avena fatua (Wild Oat)*	Y		
167.	1800	*Banksia attenuata (Slender Banksia)*			
168.	1819	*Banksia grandis (Bull Banksia)*			
169.	1834	*Banksia menziesii (Firewood Banksia)*			
170.	740	*Baumea arthrophylla*			
171.	11381	*Boronia ramosa subsp. anethifolia*			
172.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
173.	244	*Briza maxima (Blowfly Grass)*	Y		
174.	245	*Briza minor (Shivery Grass)*	Y		
175.	249	*Bromus diandrus (Great Brome)*	Y		
176.	250	*Bromus hordeaceus (Soft Brome)*	Y		
177.	1366	*Bulbine semibarbata (Leek Lily)*			
178.	12770	*Burchardia congesta*			
179.	1276	*Caesia micrantha (Pale Grass-lily)*			
180.	1586	*Caladenia discoidea (Dancing Orchid)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
181.	15348	*Caladenia flava subsp. flava*			
182.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
183.	15361	*Caladenia longicauda subsp. calcigena*			
184.	17760	*Caladenia nobilis*			
185.	2846	*Calandrinia calyptrata (Pink Purslane)*			
186.	2854	*Calandrinia granulifera (Pygmy Purslane)*			
187.	96	*Callitris preissii (Rottnest Island Pine)*			
188.	35816	*Calothamnus quadrifidus subsp. quadrifidus*			
189.	757	*Carex preissii*			
190.	1162	*Cartonema philydroides*			
191.	2957	*Cassytha racemosa (Dodder Laurel)*			
192.	6539	*Centaurium erythraea (Common Centaury)*	Y		
193.	1125	*Centrolepis drummondiana*			
194.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
195.	1280	*Chamaescilla corymbosa (Blue Squill)*			
196.	7937	*Cirsium vulgare (Spear Thistle)*	Y		
197.	1885	*Conospermum triplinervium (Tree Smokebush)*			
198.	6348	*Conostephium pendulum (Pearl Flower)*			
199.	1418	*Conostylis aculeata (Prickly Conostylis)*			
200.	11826	*Conostylis aculeata subsp. aculeata*			
201.	11438	*Conostylis candicans subsp. candicans*			
202.	1436	*Conostylis juncea*			
203.	1455	*Conostylis setosa (White Cottonhead)*			
204.	3137	*Crassula colorata (Dense Stonecrop)*			
205.	3140	*Crassula glomerata*	Y		
206.	11345	*Crassula thunbergiana subsp. thunbergiana*	Y		
207.	6663	*Cuscuta epithymum (Lesser Dodder)*	Y		
208.	7454	*Dampiera linearis (Common Dampiera)*			
209.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
210.	3845	*Daviesia triflora*			
211.	1259	*Dianella revoluta (Blueberry Lily)*			
212.	314	*Digitaria didactyla (Queensland Blue Couch)*	Y		
213.	7054	*Dischisma arenarium*	Y		
214.	12943	*Diuris brumalis*			
215.	11049	*Diuris corymbosa*			
216.	1634	*Diuris laxiflora (Bee Orchid)*			
217.	12939	*Diuris magnifica*			
218.	12938	*Diuris micrantha*		T	
219.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
220.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
221.	13216	*Drosera menziesii subsp. penicillaris*			
222.	3131	*Drosera stolonifera (Leafy Sundew)*			
223.	11485	*Ehrharta brevifolia var. cuspidata*	Y		
224.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
225.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
226.	374	*Eragrostis cilianensis (Stinkgrass)*	Y		
227.	376	*Eragrostis curvula (African Lovegrass)*	Y		
228.	5615	*Eucalyptus decipiens*			
229.	5649	*Eucalyptus foecunda (Narrow-leaved Red Mallee)*			
230.	5659	*Eucalyptus gomphocephala (Tuart)*			
231.	5708	*Eucalyptus marginata (Jarrah)*			
232.	5763	*Eucalyptus rudis (Flooded Gum)*			
233.	29940	*Euphorbia maculata*	Y		
234.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
235.	894	*Fimbristylis velata*			
236.	8365	*Fumaria bastardii*	Y		
237.	907	*Gahnia trifida (Coast Saw-sedge)*			
238.	7323	*Galium murale (Small Goosegrass)*	Y		
239.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
240.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
241.	37500	*Grammatotheca bergiana var. bergiana*	Y		
242.	14282	*Gratiola pubescens*			
243.	15839	*Grevillea preissii subsp. preissii*			
244.	12824	*Grevillea vestita subsp. vestita*			
245.	2175	*Hakea lissocarpha (Honey Bush)*			
246.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
247.	3016	*Heliophila pusilla*	Y		
248.	6710	*Heliotropium europaeum (Common Heliotrope)*	Y		
249.	6839	*Hemiandra pungens (Snakebush)*			
250.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
251.	5154	*Hibbertia perfoliata*			
252.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
253.	6222	*Homalosciadium homalocarpum*			
254.	3968	*Hovea trisperma (Common Hovea)*			
255.	5216	*Hybanthus calycinus (Wild Violet)*			
256.	6224	*Hydrocotyle blepharocarpa*			
257.	6240	*Hydrocotyle scutellifera*			
258.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
259.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
260.	910	*Isolepis cernua (Nodding Club-rush)*			
261.	917	*Isolepis marginata (Coarse Club-rush)*	Y		
262.	7396	*Isotoma hypocrateriformis (Woodbridge Poison)*			
263.	3992	*Isotropis cuneifolia (Granny Bonnets)*			
264.	19700	*Isotropis cuneifolia subsp. cuneifolia*			
265.	8092	*Ixiolaena viscosa (Sticky Ixiolaena)*			
266.	1185	*Juncus kraussii (Sea Rush)*			
267.	1189	*Juncus pauciflorus (Loose Flower Rush)*			
268.	4044	*Kennedia prostrata (Scarlet Runner)*			
269.	5832	*Kunzea ericifolia (Spearwood)*			
270.	20019	*Lachnagrostis filiformis*			
271.	19955	*Lachnagrostis plebeia*			
272.	19956	*Lachnagrostis preissii*			
273.	18585	*Lagenophora huegelii*			
274.	467	*Lagurus ovatus (Hare's Tail Grass)*	Y		
275.	28342	*Landoltia punctata (Thin Duckweed)*			
276.	1309	*Laxmannia squarrosa*			
277.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
278.	925	*Lepidosperma angustatum*			
279.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
280.	15418	*Leptoceras menziesii*			
281.	6374	*Leucopogon conostephioides*			
282.	6427	*Leucopogon parviflorus (Coast Beard-heath)*			
283.	6436	*Leucopogon propinquus*			
284.	7677	*Levenhookia stipitata (Common Stylewort)*			
285.	36160	*Liparophyllum capitatum*			
286.	7408	*Lobelia tenuior (Slender Lobelia)*			
287.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
288.	1231	*Lomandra maritima*			
289.	1232	*Lomandra micrantha (Small-flower Mat-rush)*			
290.	1234	*Lomandra nigricans*			
291.	1239	*Lomandra preissii*			
292.	1243	*Lomandra sericea (Silky Mat Rush)*			
293.	1246	*Lomandra suaveolens*			
294.	1097	*Lyginia barbata*			
295.	85	*Macrozamia riedlei (Zamia)*			
296.	13271	*Melaleuca huegelii subsp. huegelii*			
297.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
298.	5978	*Melaleuca teretifolia (Banbar)*			
299.	5980	*Melaleuca thymoides*			
300.	13280	*Melaleuca viminea subsp. viminea*			
301.	6883	*Mentha pulegium (Pennyroyal)*	Y		
302.	955	*Mesomelaena pseudostygia*			
303.	485	*Microlaena stipoides (Weeping Grass)*			
304.	15419	*Microtis media subsp. media*			
305.	4662	*Monotaxis grandiflora (Diamond of the Desert)*			
306.	4666	*Monotaxis occidentalis*			
307.	2412	*Muehlenbeckia adpressa (Climbing Lignum)*			
308.	6140	*Oenothera mollissima*	Y		
309.	14292	*Oenothera stricta subsp. stricta*	Y		
310.	8149	*Olearia rudis (Rough Daisybush)*			
311.	12782	*Ophioglossum gramineum*			
312.	36177	*Ornduffia albiflora*			
313.	7122	*Orobanche minor (Lesser Broomrape)*	Y		
314.	1667	*Paracaleana nigrita (Flying Duck Orchid)*			
315.	516	*Parapholis incurva (Coast Barbgrass)*	Y		
316.	527	*Paspalum dilatatum*	Y		
317.	528	*Paspalum distichum (Water Couch)*	Y		
318.	1550	*Patersonia occidentalis (Purple Flag)*			
319.	2273	*Persoonia saccata (Snottygobble)*			
320.	2299	*Petrophile linearis (Pixie Mops)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
321.	18529	*Philotheca spicata (Pepper and Salt)*			
322.	1478	*Phlebocarya ciliata*			
323.	4675	*Phyllanthus calycinus (False Boronia)*			
324.	2793	*Phytolacca octandra (Red Ink Plant)*	Y		
325.	5254	*Pimelea leucantha*			
326.	18117	*Pimelea rosea subsp. rosea*			
327.	578	*Poa porphyroclados*			
328.	8175	*Podolepis gracilis (Slender Podolepis)*			
329.	8182	*Podotheca angustifolia (Sticky Longheads)*			
330.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
331.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
332.	583	*Polypogon tenellus*			
333.	4691	*Poranthera microphylla (Small Poranthera)*			
334.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
335.	1676	*Prasophyllum hians (Yawning Leek Orchid)*			
336.	10853	*Prasophyllum plumiforme*			
337.	11260	*Ptilotus drummondii var. drummondii (Pussytail)*			
338.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
339.	2578	*Rhagodia baccata (Berry Saltbush)*			
340.	18599	*Salsola tragus*			
341.	6484	*Samolus repens (Creeping Brookweed)*			
342.	7595	*Scaevola anchusifolia*			
343.	7603	*Scaevola canescens (Grey Scaevola)*			
344.	982	*Schoenus clandestinus*			
345.	25878	*Senecio condylus*			
346.	2909	*Silene gallica (French Catchfly)*	Y		
347.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
348.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
349.	7037	*Solanum symonii*			
350.	9367	*Sonchus hydrophilus (Native Sowthistle)*			
351.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
352.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
353.	635	*Sporobolus virginicus (Marine Couch)*			
354.	2918	*Stellaria media (Chickweed)*	Y		
355.	19403	*Stenopetalum gracile*			
356.	2316	*Stirlingia latifolia (Blueboy)*			
357.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
358.	17850	*Stylidium ireneae*		P4	
359.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
360.	2326	*Synaphea polymorpha (Albany Synaphea)*			
361.	2329	*Synaphea spinulosa*			
362.	15532	*Synaphea spinulosa subsp. spinulosa*			
363.	2791	*Tersonia cyathiflora (Button Creeper)*			
364.	1708	*Thelymitra fuscolutea (Leopard Orchid)*			
365.	20731	*Thelymitra vulgaris*			
366.	20728	*Thelymitra xanthotricha*			
367.	1319	*Thysanotus arenarius*			
368.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
369.	1351	*Thysanotus sparteus*			
370.	6280	*Trachymene pilosa (Native Parsnip)*			
371.	1481	*Tribonanthes australis*			
372.	4383	*Tribulus terrestris (Caltrop)*	Y		
373.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
374.	4292	*Trifolium campestre (Hop Clover)*	Y		
375.	8255	*Ursinia anthemoides (Ursinia)*	Y		
376.	7111	*Veronica persica (Creeping Speedwell)*	Y		
377.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
378.	724	*Vulpia myuros (Rat's Tail Fescue)*	Y		
379.	12052	*Vulpia myuros forma megalura*	Y		
380.	33101	*Vulpia myuros forma myuros*	Y		
381.	1394	*Wurmbea dioica (Early Nancy)*			
382.	12072	*Wurmbea dioica subsp. alba*			
383.	1398	*Wurmbea monantha*			
384.	1256	*Xanthorrhoea preissii (Grass tree)*			
385.	6289	*Xanthosia huegelii*			
386.	2331	*Xylomelum occidentale (Woody Pear)*			
387.	1049	*Zantedeschia aethiopica (Arum Lily)*	Y		

Protozoa

388.	38964	*Arcyria cinerea*			
389.	38967	*Arcyria incarnata*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
390.	39019	*Didymium clavus*			Y
391.	39048	*Lycogala epidendrum*			
392.	39071	*Physarum luteolum*			Y
393.	39079	*Physarum viride*			
394.	39085	*Stemonitis lignicola*			
395.	39087	*Stemonitis splendens*			

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 wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

APPENDIX E: DEC SEARCH

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRANAME	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
Calyptorhynchus latirostris	FAUNA SURVEY	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockato o	Animalia	T	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Calyptorhynchus latirostris	BIRD ATLAS2	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockato o	Animalia	T	BIRD	20	07	2000	MEDINA	Thomas Oval, Medina
Calyptorhynchus latirostris	BIRD ATLAS2	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockato o	Animalia	T	BIRD	19	09	2002	POSTANS	The Spectacles
Tiliqua rugosa subsp. konowi	FAUNA SURVEY	Scincidae	Tiliqua	rugosa	subsp. konowi	(Mertens)		Animalia	T	REPTI LE	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.3
Tiliqua rugosa subsp. konowi	FAUNA SURVEY	Scincidae	Tiliqua	rugosa	subsp. konowi	(Mertens)		Animalia	T	REPTI LE	09	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.5
Falco peregrinus	FAUNA SURVEY	Falconidae	Falco	peregrinus		Tunstall	Peregrin e Falcon	Animalia	S	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fuscive nter	(Gray)	Quenda	Animalia	5	MAM MAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fuscive nter	(Gray)	Quenda	Animalia	5	MAM MAL	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fuscive nter	(Gray)	Quenda	Animalia	5	MAM MAL	06	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fuscive nter	(Gray)	Quenda	Animalia	5	MAM MAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isoodon obesulus	FAUNA	Peramelidae	Isoodon	obesulus	subsp.	(Gray)	Quenda	Animalia	5	MAM	07	03	2009	EAST	East Rockingham

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRANAME	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
subsp. fusciventer	SURVEY				fusciventer					MAL				ROCKINGHAM	WWTP TS 3.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	10	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	01	11	2001	COOLOONGUP	N end of Lake Cooloongup, Cooloongup (Site 3)
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	01	12	1974	CASUARINA	Mortimer Rd, Wellard.
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	25	05	2010	LEDA	Leda Wetlands
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	01	11	2001	LEDA	Leda Reserve, Leda (Site 2)
Isoodon obesulus	WAM	Peramelidae	Isoodon	obesulus	subsp.	(Gray)	Quenda	Animalia	5	MAM	22	06	1961	MEDINA	

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRANAME	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
subsp. fusciventer	SPECIMENS				fusciventer					MAL					
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	01	11	2001	PARMELIA	Bushland opposite Sicklemore Rd, Parmelia/Bertram (Site 1)
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	06	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	03	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	04	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	09	07	2004	HOPE VALLEY	Alcoa development site on Anketell Rd, E of Abercombe Rd
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	02	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	05	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectales
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	02	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRANAME	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	06	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	04	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles
Charadrius rubricollis	TFAUNA	Charadriidae	Charadrius	rubricollis		(Gmelin)	Hooded Plover	Animalia	4	BIRD	10	01	1998	COOLOONGUP	Cooloongup Lake, City of Rockingham
Hydromys chrysogaster	TFAUNA	Muridae	Hydromys	chrysogaster		Geoffroy	Water-rat	Animalia	4	MAMMAL	10	06	1973	MEDINA	Medina
Macropus irma	TFAUNA	Macropodidae	Macropus	irma		(Jourdan)	Western Brush Wallaby	Animalia	4	MAMMAL	01	01	1989	WELLARD	Leda Nature Reserve, Town of Kwinana
Notoscincus butleri	FAUNA SURVEY	Scincidae	Notoscincus	butleri		Storr		Animalia	4	REPTILE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 1.9
Notoscincus butleri	FAUNA SURVEY	Scincidae	Notoscincus	butleri		Storr		Animalia	4	REPTILE	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 3.2
Lerista lineata	WAM SPECIMENS	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTILE	05	01	1979	MEDINA	Spectacle Swamp, near Medina
Lerista lineata	TFAUNA	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTILE	13	11	2007	THE SPECTACLES	roadside south of Anketell Rd, adjacent to the Spectacles
Lerista lineata	TFAUNA	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTILE	05	01	1979	THE SPECTACLES	Spectacle Swamp, near Medina
Neelaps	TFAUNA	Elapidae	Neelaps	calonotos		(A.M.C.	Black-	Animalia	3	REPTI				COOLOONGUP	East Rockingham

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRANAME	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
calonotos						DumΘril, Bibron & A. DumΘril)	striped Snake			LE					
Neelaps calonotos	WAM SPECIMENS	Elapidae	Neelaps	calonotos		(A.M.C. DumΘril, Bibron & A. DumΘril)	Black-striped Snake	Animalia	3	REPTILE				COOLOONGUP	East Rockingham
Pletholax gracilis subsp. edelensis	FAUNA SURVEY	Pygopodidae	Pletholax	gracilis	subsp. edelensis	Storr		Animalia	3	REPTILE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 4.3

360 environmental

Lot E26, Meares Road,
Kwinana

Level 2 Flora and Vegetation Survey Report

Prepared for:
Satterley Property Group
December 2012

people • planet • professional

360 Environmental Pty Ltd

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
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Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Level 2 Flora and Vegetation Survey at Lot E26 Meares Road, Kwinana (the Site). The Department of Housing and Satterley Property Group propose to develop the Site for residential and commercial purposes. The Site comprises approximately 36 hectares (ha) of predominately remnant bushland that is to be cleared. The survey area is located within the Perth subregion of the Swan Coastal Plain and on the western section of the Spearwood dunes, known as the Cottelsoe Complex. In the broadest sense, this area hosts woodlands of Tuart – Jarrah on shallow soils over limestone, in an area with a Mediterranean climate.

Two Threatened Ecological Communities (TECs) and two Priority Ecological Communities (PECs) occur within a five kilometre radius of the Site. Woodlands over sedgelands on Holocene dune swales of southern Swan Coastal Plain (SCP19b) and *Melaleuca huegelii – M. acerosa* (currently *M. systena*) shrublands on limestone ridges (SCP26a) occur in the vicinity of the Site. The PECs, northern Spearwood shrublands and woodlands (SCP24) and southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands (SCP25) have also been recorded in the broader area.

A total of five vegetation units were documented within the survey area. The predominant unit was a Woodland of *Eucalyptus gomphocephala* and *E. marginata* subsp. *marginata*. This unit covered approximately 60 – 70% of the survey area. The next most widespread unit was a Woodland of *Corymbia calophylla*. Both units were primarily located on shallow grey sands. The balance of the vegetation was located on shallow yellow sands over limestone. In addition to the native vegetation, extensive patches identified as being completely Degraded were noted. No TECs or PECs were recorded during the survey.

A search of the Department of Environment and Conservation (DEC) database records yielded one Threatened (Declared Rare Flora) species and four Priority flora that have been recorded within a five kilometre radius of the Site. A review of the habitat for these species was completed, resulting in the determination that the likelihood of any of these species occurring in the survey area was low.

A total of 114 angiosperms, including subspecies and variants, and two gymnosperms were recorded. The angiosperms represented 78 genera within 37 families. The two gymnosperms were from the Zamiaceae and Cupressaceae. The most speciose families recorded during the survey were Fabaceae, with 15 species from nine genera, Proteaceae, with 10 species from seven genera, and Cyperaceae, with nine species from five genera. No Threatened or Priority flora were documented on the Site during the survey.

A total of 47 weed species were recorded during the survey, including the Declared plant, *Zantedeschia aethopica*. Of the weed species recorded, *Ehrharta calycina* was

identified as the most widespread, and as having the greatest current and potential impacts including increased fire fuel load at the Site. It was noted that there were no sections of the survey area in which no weeds were observed.

The majority of the vegetation within the survey area was assessed as being in Degraded condition. The survey area was infested with the invasive grass *Ehrharta calycina*, which represented between 10% and 70% of the total vegetation cover. A range of other weed species was also recorded during the survey. The vegetation has been impacted by dumping of garden waste and rubbish, as well as by a series of tracks that dissected the Site.

The vegetation within the Site was identified as being Beard complex 6: Medium woodland: Tuart and Jarrah. Approximately 39 % of the inferred pre-European extent of this unit remains in the Town of Kwinana (Shepherd et al. 2002). It is unlikely that environmental offsets would be required for the clearing of this complex in the context of either the local government area or the Heddle complex extent. However, the state level extent of Beard complex 6 (approximately 26%) may trigger a requirement for the provision of offsets. The Cottesloe Complex – Central and South had approximately 41.1% remaining, which is unlikely to require the provision of offsets.

Lot E26 Meares Avenue in Kwinana was considered to be an urban bushland remnant of low conservation value. In its current state, the vegetation is largely Degraded and considered likely to decline further in the absence of fire and weed management. The Site was not considered to be a representative example of the vegetation of this region. No flora of conservation value, range extensions, novel species or unique forms or variants of species were recorded at the Site. The key conservation values attributed to the Site were the size of some mature trees and the potential role of the Site as a linkage for genetic flow between surrounding vegetation in the region.

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1 Introduction

1.1 Project Background

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Level 1 Vertebrate Fauna Survey at Lot E26 Meares Road, Kwinana (the Site), (Figure 1). The Department of Housing and Satterley Property Group propose to develop the Site for residential and commercial purposes.

The Site comprises approximately 36 ha of predominately remnant bushland. 360 Environmental has conducted several biological studies in the vicinity of the Site recently, including a Level 2 flora and vegetation survey at the Site in 2006.As the proposed development will require the clearing of native vegetation, the ecological value of the Site and potential impacts arising from the development require evaluation in a local and regional context.

1.2 Scope and Objectives

To determine the appropriate level of survey for the areas over which clearing was proposed, an assessment of the proposed clearing in the context of the Environmental Protection Authority (EPA) *Position Statement No 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection*, EPA *Guidance Statement No 10: Level of Assessment for Proposals Affecting Natural Areas within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region* (2006) and *Guidance Statement No 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* was completed. Based on the review of these publications, a Level 2 Flora and Vegetation survey was considered appropriate.

A Level 2 survey is comprised of:

- A desktop review to collect ecological data relevant to the survey area and surrounds. The desktop review should involve a search of all sources of literature, data and map-based information. In this report, the desktop review includes:
  - Searches of relevant DEC databases;
  - A search of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database;
  - Interrogation of relevant Geographic Information Systems (GIS) datasets;
  - Reviews of publicly-available ecological information;
- A site visit with the objectives of:
  - Verifying the information collected in the desktop review;

- Developing a preliminary delineation and description of the vegetation;
- Completing a quadrat-based survey to place the vegetation in a local and regional context;
- Assessing the condition of the vegetation;
- Completing a census of the flora, with a focus on determining the presence of any flora of conservation significance; and
- Identifying any potential impacts.

This report contains the following:

- An overview of the survey Site, which serves to place the Site in a regional context;
- The findings of the desktop review;
- A detailed description of the methods used;
- The findings of the field survey, incorporating a description of the vegetation, an assessment of the condition using the scale devised by Keighery (1994; Appendix D), and an assessment of the conservation significance of the vegetation with the specific objective of determining whether any TECs or PECs are present;
- A summary of the flora recorded, with reference to flora of conservation significance, if found;
- An assessment of the adequacy of the survey; and
- Conclusions and recommendations based on findings from the survey.

1.3 Study Site

The Site was located in the Town of Kwinana, approximately 30 km south of Perth in Western Australia (Figure 1). The survey area of 36 ha is bordered by Meares Avenue, Challenger Avenue, Gilmore Avenue and Wellard Road. It comprises a bushland remnant surrounded by urban development. An aerial photograph of the Site is presented as Figure 2.



Legend

Lot E26

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- CADASTRAL BOUNDARY SOURCED FROM LANDGATE 2008
- TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2008

SCALE

0 187.5 375 750 1,125 1,500 1,875

Metres

1:39,723 @ A4

LOCALITY MAP



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METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
TD	MH	
DATE	**REVISION**	**DRAWING ID**
11.04.12	0	EBS165-4.01

SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Location of the Survey Area (image date approximately 2002)

Figure 1

360



Legend

- Lot E26
- Cadastral Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- CADASTRAL BOUNDARY SOURCED FROM LANDGATE 2008
- TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2008

SCALE

0 25 50 100 150 200 250

Metres

1:5,302 @ A4

LOCALITY MAP



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TD	MH	
DATE	**REVISION**	**DRAWING ID**
11.04.12	0	EBS165-4.01

SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Map of the of the survey area (image date approximately 2002)

Figure 2

2 Methods

2.1 Desktop Review

A desktop review was completed prior to the field survey. The purpose of the desktop review was to collect information about the Site and surrounds that would potentially assist with the design and implementation of the field survey. The desktop review consisted of:

- A review of publicly available reports and publications containing flora, vegetation and ecological information relevant to the survey area;
- A search of the Western Australian DEC Threatened (Declared Rare) Flora (DRF) database, the Western Australian Herbarium (WAHERB) database and the Declared Rare and Priority Flora List for flora collected from the survey area and surrounds, or potentially occurring within the survey area;
- A search of the DEC TEC database for listings of TECs or PECs recorded on or in the vicinity of the survey area; and
- A search of the Federal Government EPBC Act Protected Matters database.

2.1.1 Literature and GIS Review

The literature and GIS review was used to collect information relating to the Site. Specific objectives included establishing a local and regional context for, and determination of conservation values attributable to the Site that were not likely to be addressed in the database searches.

2.1.2 Threatened (Declared Rare) and Priority Flora – DEC Database Search

In Section 23F of the *Wildlife Conservation Act 1950* (WC Act), flora that, in the opinion of the Minister, is likely to become extinct or is rare or is otherwise in need of special protection, may be declared rare by notice published in the *Government Gazette*. Once a species is declared rare, no person, whether licensed to collect flora or the owner of land or an occupier of land, is authorised to take the species without the written permission of the Minister. In the context of the Act, to take includes gathering, plucking, cutting, pulling up, destroying, digging up, removing or injuring the flora or to cause or permit the same to be done by any means.

Priority Flora are not subject to the same level of protection Declared Rare Flora, but, like all vegetation in Western Australia, are protected under the *Environmental Protection Act 1986* (EP Act) and are considered when assessing the conservation value of an area, especially in the context of clearing.

A search of the DEC *Threatened (Declared Rare) Flora* database and the WAHERB database was conducted by 360 Environmental in March 2012, based on a circle of five kilometre radius around central coordinates of 32°15'04"S, 115°48'54"E.

To ensure that listings of Priority flora presented in the database search findings were accurate, listed species were cross-referenced with WAHERB information presented on Florabase (WAHERB 2012). Changed conservation codes, and species names were documented for reporting purposes, and the results of presented in this report amended to reflect these changes. A description of the differences between the conservation codes is presented in Appendix A.

2.1.3 Threatened Ecological Communities – DEC Database Search

Within Western Australia, biological assemblages that are considered to be unique and/or restricted can be assigned a status as a TEC or a PEC. A TEC is gazetted in parliament and Ministerial approval must be sought for any disturbance. There are currently four categories of TEC recognised by the DEC (Appendix B):

1. Presumed Totally Destroyed;
2. Critically Endangered;
3. Endangered; and
4. Vulnerable.

Ecological communities that are not recognised as TECs can be listed as PECs for which there are also four categories (Appendix B). Ecological communities that are considered to be under threat, without meeting the TEC criteria can be listed as Priority Ecological Communities. It is possible that communities that are currently only considered to be PECs may be upgraded to TECs should threatening processes continue. In light of this, any assessment of vegetation that will potentially be cleared needs to consider both categories of communities and any potential impacts.

A search of the DEC TEC database was completed by 360 Environmental in March 2012, based on a circle of five kilometre radius around central coordinates of 32°15'04"S, 115°48'54"E.

2.1.4 *Environment Protection and Biodiversity Conservation Act 1999* Protected Matters Database Search

The EPBC Act is a Federal Act that facilitates a national level of protection for natural assets of conservation significance on Federal, State and private lands. The key features of the legislation are the provision of a means to:

- Protect biodiversity by identifying threatening processes and ensuring these are appropriately assessed and managed;
- Protect critical habitat;
- Ensure compliance and enforcement through auditing and legal processes;

- Conduct assessments in addition to State assessments; and
- Protect natural assets on Federal lands.

To determine whether there were potential matters of national environmental significance associated with the proposed development, a search of the Protected Matters database was undertaken. The Protected Matters database provides a summary of listings under the provisions of the Act. The search was conducted for the local government area of Kwinana.

2.2 Field Survey

2.2.1 Survey Timing and Weather

The survey was conducted over three site visits between late September and mid November 2012 (Table 1). The survey was comprised of the following:

- A preliminary reconnaissance of the areas to determine sites in which quadrats could be located and sites at which relevés were more appropriate;
- Quadrat and relevé-based survey over appropriate areas of vegetation; and
- A traverse within vegetation units to develop an inventory of flora species.

The weather across the survey days was typically dry and mild (Table 1). While below average, winter rainfall prior to the survey period totalled 286.6 mm. This was considered to be adequate to support the germination and growth of flora such that most species would be apparent.

Table 1: Weather data for the field days at the Meares Road Site.

Date	Temperature (°C)		Rainfall (mm)
	Minimum	Maximum	
10/09/2012	16.3	23.9	0
07/10/2012	13.8	21.7	0
08/11/2012	10.5	27.7	0

2.2.2 Survey Personnel

The database searches for the desktop portion of the survey were completed by Melissa Hobson of 360 Environmental. The field surveys were completed by Brett Neasham of Niche Environmental Services.

2.2.3 Preliminary Reconnaissance

The purpose of the preliminary reconnaissance was to develop familiarity with the areas to be surveyed and to identify probable quadrat locations. The reconnaissance was also used to ensure that all sites were accessible.

2.2.4 Relevé-based Survey

A total of eight relevés were assessed during the survey. At each relevé, the following was recorded:

- The location of the relevé using a Garmin GPS, with the location recorded in WGS84, UTM;
- The geographical location of the relevé site, with slope, topography and soil type;
- A photograph of the vegetation was taken using a Canon ixus60 digital camera;
- All key structural species;
- A brief description of the vegetation, based on key structural species;
- The condition of the vegetation and any disturbances; and
- The extent and nature of litter cover.

2.2.5 Detailed Quadrat-based Survey

Quadrats used for assessing vegetation on the Swan Coastal Plain are typically a size of 10 m by 10 m. Where quadrats of this dimension could not be used, the quadrat was modified as required. Irrespective of shape, the area for quadrats was maintained at 100 m^2. A total of four quadrats were surveyed during the assessment. Within each quadrat, the following information was collected:

- The location of the quadrat using a Garmin GPS, with the location recorded in WGS84, UTM;
- The geographical location of the Site, with slope, topography and soil type;
- A photograph of the vegetation within the quadrat was taken using a Canon ixus60 digital camera;
- All flora present, with estimates of height and cover made to assist with describing the vegetation;
- The condition of the vegetation and any disturbances; and
- The extent and nature of litter cover.

2.2.6 Traverse to Develop Flora Inventory

In addition to the information collected during the survey of quadrats and relevés, a traverse was undertaken to further develop the flora species inventory. Where

specimens could not be identified in the field, a specimen was collected for identification at the WAHERB samples.

2.3 Data Analysis and Interpretation

2.3.1 Taxonomy

Taxonomic identification was completed using relevant taxonomic keys, manuscripts and herbarium specimens. Nomenclature was based on that used for Florabase (WAHERB 2012).

2.3.2 Vegetation Description and Mapping

Vegetation was described using the Vegetation Structural Classes (Keighery 1994) (Appendix C) within Volume 2: Directory of Bush Forever Sites (Government of Western Australia 2000). Vegetation mapping was based on a combination of data collected during the survey, field notes and interpretations of aerial photography. The vegetation was mapped using transparency overlays on A4 aerial images, which were then converted into polygons using MapInfo software. Maps were produced showing the spatial distribution of vegetation types and condition, DRF locations, Priority Flora or Declared Plants as well as Heddle et al. (1980) vegetation complexes and the locations of geomorphic wetlands.

2.3.3 Statistical Analysis

Species data collected during the survey was converted to a binary representation of presence/absence. Quadrats from vegetation units in the Gibson et al. (1994) survey of the Swan Coastal Plain that represent the vegetation units found on the Spearwood dune system were incorporated in the presence/absence matrix. The presence/absence matrix was analysed using the multivariate statistical analysis package, PRIMER v6 (Clarke and Gorley 2006). Data was analysed using non-metric multi-dimensional scaling and applying Bray Curtis similarity. The degree of similarity between the vegetation units of the Gibson *et al*. (1994) survey and the vegetation recorded in the current survey was determined by interpretation of both a dendrogram and a cluster ordination.

3 Results and Discussion - Desktop Review

3.1 Environmental Setting

3.1.1 IBRA Bioregion

The Site is located within the Perth subregion (SWA2) of the Swan Coastal Plain Bioregion of the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway & Creswell 1995). The SWA2 subregion occupies a narrow strip between the Indian Ocean and the Darling Scarp, extending from Cape Naturaliste in the south to north of Jurien Bay (Mitchell *et al*. 2002). The SWA2 subregion is a low lying coastal plain dominated by *Banksia* and Tuart woodlands on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas (Mitchell et al. 2002). Outwash plains vegetation and paperbark swamps are now extensive only in the south (Mitchell et al., 2002).

3.1.2 Beard Vegetation

The study site was located within the Drummond subdistrict (Darling district) of the Southwest Botanical Province of Western Australia (Beard 1990). The Southwest Botanical Province extends from west of Hamelin Bay, to the north of Perth and east of Esperance in the south of Western Australia. The Southwest Botanical Province is recognised as an area of comparatively high floristic biodiversity and is recognised as such globally. The region is characterised by a high number of endemic species and complex, biogeographically-influenced flora and vegetation.

The Drummond subdistrict is analogous to the SWA2 (IBRA) bioregion and occupies the same general location within Western Australia. This region hosts a myriad of vegetation, from Kwongan heath north of Perth, to *Eucalpytus* woodlands and forests in the southwest and to sedgelands and in permanent and seasonal wetlands.

The SWA2 subregion is under high ecological stress due to extensive clearing for agriculture and residential development. The area was mapped by Beard (1980) at the 1:250,000 scale as part of the Vegetation Survey of Western Australia. The survey area is mapped as *Eucalyptus gomphocephala* or *E. gomphocephala* and *E. marginata* medium tall trees to 30 m with a projected foliar canopy of 10 – 30% (Beard 1980). The *E. gomphocephala* woodlands of the Swan region were described by Beard (1980) as forming stands on coastal limestone, with tree heights to 25 m and boles of 60 – 90 cm diameter. The midstorey sclerophyll shrubs in this unit were up to 10 m in height, generally over *Xanthorrhoea preissii* and *Macrozamia riedlei* (Beard 1980).

3.1.3 Site Geology

The Site was located in Spearwood dune systems, which comprise Tamala limestone, with a hard capping of secondary calcite overlain by sand to variable depths (McArthur 2004). The Spearwood dune systems cover approximately 61,000 ha of the Swan Coastal Plain and are divided into the western Cottesloe soils and the eastern Karrakatta soils (Bettenay et al. 1960). The Cottesloe soils are described as having shallow yellow or brown neutral soils over limestone, some of which is exposed (Bettenay et al.1960). The soils are generally infertile due to soil pH and lack of colloidal properties, but are recognised as a source of water held at shallow depths in limestone (Bettenay et al.1960).

3.1.4 Heddle *et al*. Vegetation

The survey area has been mapped by Heddle *et al*. (1980) at a 1:250,000 scale, producing broad landform-vegetation descriptions. These provide for a generalized overview based on interpretations of landforms and associated vegetation.

The survey area was located on the Cottesloe Complex - Central and South, which supports heaths on shallow sands over limestone. The deeper sands support a mosaic of Tuart woodlands and Tuart-Jarrah-Marri open forests, distinguished in the south by the dominance of Tuart (Heddle et al. 1980). This complex is located in the northern and the southern sections of the region and has a similar understorey across the range (Heddle et al. 1980). This vegetation unit is restricted to the Cottesloe landform complex and as such has the same orientation; parallel to the coast.

3.1.5 Gibson *et al*. Vegetation (1994)

Gibson et al. (1994) have completed a detailed floristic survey programme to better define the vegetative characteristics of the region, and to identify vegetation units in need of protection and those that were well-reserved or well-represented. The Spearwood dunes incorporate six vegetation units, including (Gibson et al. 1994):

- Northern Spearwood shrublands and woodlands (SCP24);
- Southern *Eucalyptus gomphocephala – Agonis flexuosa* woodlands (SCP25);
- *Melaleuca huegelii – M. acerosa* shrublands on limestone ridges (SCP26a);
- Woodlands and mallees on limestone (SCP26b);
- Species poor mallees and shrublands on limestone (SCP27); and
- Spearwood *Banksia attenuata* or *B. attenuata – Eucalyptus* spp. woodlands (SCP28).

3.1.6 360 Environmental (2006)

360 Environmental completed a site-specific flora and vegetation survey in 2006 (360 Environmental 2006). The flora species inventory compiled during this survey included

112 native species and 37 weed species (360 Environmental 2006). No conservation significance flora taxa of were recorded during the survey (360 Environmental 2006).

The vegetation at the Site was broadly defined as *Eucalyptus* or *Corymbia* woodlands and low shrublands on sands and limestone. The vegetation was noted as being highly impacted by invasive weeds and as having a low level of conservation significance.

3.1.7 Climate

The study sites were located within an area that is classified as having a warm Mediterranean climate characterised by hot, dry summers and cool, wet winters. Mean annual rainfall in the region is typically in the range of 600 – 800 mm missing from references). Peak rainfall is recorded between May – August (Figure 3). The highest mean daily maximum temperature is typically recorded during February within the lowest mean daily maximum temperatures typically recorded during July.

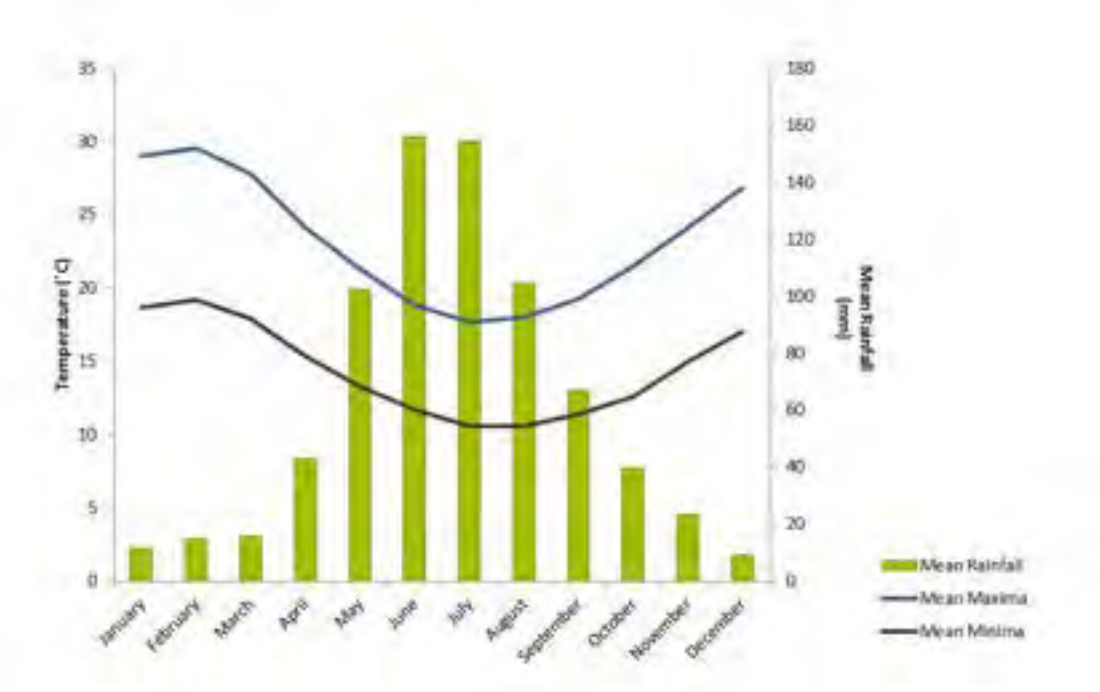


Figure 3: Long-term climatic data recorded at BP Kwinana from 1955 to 2012.

In the 12 months prior to the commencement of the survey, a total of 626.3 mm of rain was recorded at the Kwinana BP refinery, the closest Bureau recording station, well below the long-term average of 703 mm. The amount received was however considered sufficient to promote the emergence of annual species, the re-emergence of senescent perennial species and to promote flowering and fruiting of perennial species.

3.1.8 National Parks, Nature Reserves and Conservation Areas

The DEC-managed Leda Reserve is approximately 1.5 km to the south of the survey area.

3.2 Threatened (Declared Rare) and Priority Flora – DEC Database Search

According to DEC records (reference 08 – 0412FL; DEC, 2012a), one DRF and four Priority Flora species have been recorded in the area surrounding the Site. A brief summary and assessment of these species is presented below:

- *Diuris micrantha* (Orchidaceae) – this Threatened species is typically found in winter-wet areas, such as swamps, where it grows amongst dense native sedges (Hoffman & Brown 2011). There were no dense stands of sedges at the Site and no areas subject to seasonal inundation. It is therefore highly unlikely that this species would be found in the area;
- *Cyathochaeta teretifolia* (Cyperaceae) – this Priority 3 species is generally observed in grey sand and sandy clay, usually in association with swamps and creek edges (WAHERB, 2012). This type of habitat is not within the Site. The species is unlikely to occur in the area;
- *Aponogeton hexatepalus* (Aponogetonaceae) – this Priority 4 species is typically found in mud associated with freshwater ponds, rivers and claypans (WAHERB, 2012). Given the absence of this habitat within the survey area, it is considered highly unlikely that this species will occur;
- *Dodonaea hackettiana* (Sapindaceae) – this Priority 4 species is noted as occurring on outcropping limestone (WAHERB, 2012). Outcropping limestone has not been observed in the Site, and as such, it is considered that this species would not be in the area; and
- *Stylidium ireneae* (Stylidaceae) – this Priority 4 species is found on sandy loams near creeklines and in woodlands. The Site includes woodlands, although the species is often found growing with *Agonis* species (WAHERB, 2012), which have not been observed in the area. The species is therefore considered unlikely to occur.

3.3 Threatened Ecological Communities – DEC Database Search

Two TECs and two PECs were identified as occurring within the database search area (reference 08 – 04121EC; DEC 2012b). The TECs included:

- SCP19b – Woodlands over sedgelands in Holocene dunes swales of the southern Swan Coastal Plain; and

- SCP26a – *M. huegelii - M. acerosa* (currently *M. systena*) shrublands on limestone ridges (Gibson et al. 1994 type 26a). The two PECs recorded in the database search were:
- SCP24 – Northern Spearwood shrublands and woodlands; and
- SCP25 – Southern *E. gomphocephala – A. flexuosa* woodlands

3.4 EPBC Act Protected Matters Database Search

Nine flora species were listed in the EPBC Protected Matters database search, of which *Diuris micrantha* has been recorded in close proximity to the survey area. No other flora or vegetation community related matters have been recorded in the vicinity of the Site, and none have been recorded from within the Site.

3.5 Survey Limitations

The EPA survey guidelines outline a number of potential limitations that may reduce the completeness of surveys (EPA 2002, 2004). An assessment of the current survey in this context indicates that there were no limitations likely to compromise the findings of the work. The limitations were evaluated as follows:

- Competency of botanist - this survey was completed by a botanist with over five years of relevant experience in the design and implementation of flora and vegetation surveys across Western Australia;
- Scope - the scope for this work was clearly defined as a Level 2 flora and vegetation survey over a well-defined area. The scope was considered to be realistically achievable within the allocated timeframe and resource availability;
- Proportion of flora identified - All flora specimens collected during the survey were identified;
- Survey timing - the survey was conducted during spring, which is the appropriate time to conduct surveys in this region;
- Access to land - there were no access-related issues associated with the survey area;
- Completeness and further work - the survey and report are considered to meet the underlying requirements of a Level 2 survey; and
- Disturbances – parts of the survey area included a number of access tracks, historic clearing, dumping of rubbish and high levels of weed infestation. There are no records of fire at the Site in the preceding 10 years.

4 Results and Discussion

4.1 Vegetation Descriptions and Condition Assessment

A total of five vegetation units were delineated within the survey area. In addition to this, several areas within the Site were described as being completely Degraded (Figure 4). The vegetation units recorded from the Site included:

- Tuart and Jarrah woodland on shallow grey – brown sands;
- Marri woodland on shallow light grey – brown sands;
- Tuart woodland on shallow light grey sands and occasional exposed limestone;
- Sheoak low woodland on light yellow sands; and
- *Grevillea* shrubland on light yellow sands.

Descriptions of each vegetation unit recorded during the survey are presented in the following subsections. An image of each vegetation unit is presented in Appendix F and a species association matrix is presented in Appendix G.

4.1.1 Tuart and Jarrah Woodland on Shallow Grey – Brown Sands (WEgEm) (Appendix F; Plate 1)

This vegetation unit was the main vegetation recorded within the survey and was characterised by a canopy comprised of *E. gomphocephala* and *E. marginata* subsp. *marginata* to 25 m, with occasional *C. calophylla*. Distribution of the canopy species within this unit was somewhat variable, with some areas containing more *E. gomphocephala* and other areas containing more *E. marginata* subsp. *marginata*. This variability was considered to be a product of the historic and current disturbances at the Site, and the distribution of the mature species within the survey areas. The midstorey to 10 m was comprised of *B. grandis* and *B. attenuata*, with *A. fraseriana* as a co-occurring species. The lower storey was dominated by *X. preissii*, *M. riedlei* and *J. furcellata*, generally growing to a maximum height of two metres. There were. occasional records of *Acacia pulchella* and *Allocasuarina humilis* in this stratum. The understorey was comparatively species rich, with a number of sedges, peas and herbs observed. A full list of the species recorded in this unit is provided in Appendix G.

The vegetation in this unit was assessed as being in Good to Degraded condition. The vegetation within this unit had been clearly impacted by the presence of invasive weeds and alteration to natural fire cycles. The invasive weed *E. calycina* was recorded in all occurrences of this unit, with coverage ranging from approximately 10% in good condition vegetation up to 70% in areas in Degraded condition. In addition to the presence of *E. calycina*, there was a range of other weeds species recorded in the unit. The abundance



Jarrah-Banksia woodlands

Em *Eucalyptus marginata* subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, Acacia pulchella scattered shrubs over *Gompholobium tomentosum*, *Hibbertia hypericoides* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* very open grassland with *Conostylis aculeata* very open herbland.

EmBa (*Eucalyptus gomphocephala* scattered trees over) *Eucalyptus marginata* subsp *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmocladus aspera*, *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* (perennial veldt grass) open grassland to grassland.

EmAf *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over Acacia pulchella, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre*, *Lupinus blue very open herbland.

EgEm *Eucalyptus gomphosephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* (=KM2-10) scattered tall shrubs over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladus aspera* very open sedgeland and *Conostylis aculeata* very open herbland.

Tuart woodlands

Eg *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preisii* high open shrubland over *Macrozamia riedlei* and *Acacia pulchella* open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* open herbland.

Marri woodlands

Cc *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon* ? prop scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Limestone shrublands

Gv *Grevillea vestita* subsp. *vestita* heath over *Desmocladus aspera* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

EgDs *Eucalyptus gomphocephala* scattered trees over Dryandra sessilis high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

AfDs (*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, Dryandra sessilis scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over Acacia pulchella, Pimelea rosea, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* very open herbland.

Legend

Lot E26

Vegetation Units

- Jarrah-Banksia woodlands
- Limestone shrublands
- Marri woodlands
- Tuart woodlands
- Completely Degraded

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
-TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2006

SCALE

0 25 50 100 150 200

Metres

1:5,000 @ A4

LOCALITY MAP



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METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
TD	MH	
DATE	**REVISION**	**DRAWING ID**
11.04.12	0	EBS165-4.02

SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Vegetation units within the survey area

Figure 4

of weed species in this unit was attributed to a lack of management, post-fire invasion and dumping of garden waste.

In addition to the infestation by weed species, there were a number of tracks within this unit, ranging from narrow foot tracks to some wide enough to drive a vehicle down. The vehicle tracks were considered to be in place to assist with fire management, but the presence of these and the smaller tracks serve to fragment the vegetation and assists with the movement of weeds through the area. The tracks appeared to be used by walkers and by people on trailbikes. The presence of either of these could help to spread weeds, start fires or introduce and move propagules of weeds or pathogens.

While this vegetation unit was clearly impacted by disturbances and weeds, the ecological value of this unit was still evident. Each stratum contained individuals that were clearly mature and would potentially serve as habitat for fauna. In addition to this, the vegetation within this unit would potentially serve as a linkage to other areas of native vegetation in the region, and may have a role in promoting genetic flow between these areas.

4.1.2 Marri Woodland on Shallow Light Grey – Brown Sands (WCc) (Appendix F; Plate 2)

This vegetation unit was characterised by a canopy to 30 m of *C. calophylla*, with occasional records of *E. gomphocephala* and *E. marginata* subsp. *marginata*. The midstorey was comprised of *B. grandis* and *B. attenuata*, with occasional records of *A. fraseriana*. The understorey was comprised of *J. furcellata*, *M. riedlei* and infrequent patches of *X. preissii*. The lower storey was largely similar in structure and composition to that found in WEgEm. A full list of the species recorded in this unit is provided in Appendix G.

As with vegetation unit WEgEm, the condition of this vegetation ranged from good to Degraded, with the condition changing as a consequence of the degree of weed infestation s and evidence of other disturbance. Grass weeds, dominated by *E. calycina*, were the main weed species in this unit with cover up to 70% in some sections. The absence of weed management and dumping of garden waste on the edges of this unit have contributed to the spread of weeds and an increase in the diversity of weeds recorded. The condition of this vegetation is unlikely to improve without an aggressive weed management programme, and in the absence of this, the concomitant risk of fires associated with fuel load from grasses is high. This vegetation unit was also noted as being fragmented by walking tracks, vehicle access tracks and dumping of rubbish.

4.1.3 Tuart Woodland on Shallow Light Grey Sands and Limestone (WEgOSBs) (Appendix F; Plate 3)

This vegetation unit was characterised by a canopy to 20 m of *E. gomphocephala* over a Shrubland to approximately three metres dominated by *B. sessilis* var. *cygnorum*, with *A. fraseriana* as a co-occurring species. The understorey in this unit was poorly developed. It is unclear whether this vegetation unit may have been either more extensive than its current extent, or whether it represents an intergrade between the vegetation on shallow soils that dominate the survey area and those on very shallow light sands closer to the limestone of this region. Species recorded in this unit were observed in adjacent vegetation, with the main distinction being the relative densities. A full list of the species recorded in this unit is provided in Appendix G.

The vegetation in unit WEgOSBs was assessed as being in Degraded condition, with the main cause of degradation being associated with a series of tracks running through the area. As with the other vegetation in the survey area, the level of weed infestation was high.

4.1.4 Sheoak Low Woodland on Light Yellow Sands (LWAf) (Appendix F; Plate 4)

This vegetation unit was characterised by an upper storey to approximately 10 m dominated by *A. fraseriana* over *B. sessilis* var. *cygnorum* to four metres. The understorey of this unit was comparatively species poor, with low herbs and sedges the main contributing species. A full list of the species recorded in this unit is provided in Appendix G.

The vegetation in this unit was assessed as being in Degraded condition. The cover of *E. calycina* in this unit was as high as 70%, with a number of other weed species also observed. In addition to this, there were a number of small tracks dissecting the unit.

4.1.5 *Grevillea* Shrubland on Light Yellow Sands (SGv) (Appendix F; Plate 5)

This vegetation unit was comprised of a shrubland to approximately one metre of *G. vestita* subsp. *vestita* over a poorly developed understorey, featuring *Lomandra* species as the dominant species. This vegetation unit was restricted to two areas adjacent to a completely Degraded area on a higher point within the survey area. A full summary of the species recorded in this unit is presented in Appendix G.

The vegetation in this unit was assessed as being in Degraded condition. The area was infested by *E. calycina*, which was effectively the dominant species in the area. There was also a track within this unit. It was not clear whether the area had been subject to logging or some other form of clearing in the past, but it is proposed that this vegetation unit is a relic or very poor remnant of the vegetation that predated the disturbance.

4.1.6 Completely Degraded (CD).

There were four sections of the survey area that were defined as being Completely Degraded. One of these, located on the eastern side of the survey area, contained a drainage sump and small associated infrastructure pad. The vegetation in this section had been completely removed, with some non-native species planted in the infrastructure pad. This section was noted as being heavily infested by grass weeds. The section of Degraded vegetation in the north east corner was associated with a small drainage sump and was infested with weeds. The section of completely Degraded vegetation in the south west corner was associated with loss of understorey vegetation. There were canopy species in this section, but they were over an understorey that was largely comprised of weed species or mowed verges. The Completely Degraded section toward the centre of the survey area appeared to have been subject to extensive clearing at some stage.

4.2 Extent of Vegetation

4.2.1 Beard Vegetation

The Shepherd et al. (2007) dataset estimating the extent of remaining native vegetation for the Town of Kwinana was reviewed in relation to the vegetation within the survey area. It was determined that Beard vegetation type 6: Medium woodland: Tuart and Jarrah, was most likely to be the indigenous vegetation type of the survey area. The inferred pre-European extent of this unit within the Town of Kwinana was 1477 ha, of which 587 ha or approximately 39.74% remains (Shepherd et al. 1997). It was noted that there no examples of this unit occur within DEC managed lands within the Town of Kwinana. It was also noted that the extent of this vegetation remaining across the Western Australia is approximately 26%, of which approximately 34% was within the DEC estate. The survey area, at 36 ha, represents 6% of this vegetation extent within the Town of Kwinana, and 0.2% across Western Australia. On this basis, the impacts associated with clearing this vegetation are considerably higher at the local spatial level than at the state level. However, the proposed clearing would not result in the vegetation unit falling below 30%, and as such, would not necessarily trigger a requirement for environmental offsetting.

4.2.2 Heddle et al. (1980)

EPA Guidance Statement No. 10 (EPA 2006) provides a summary of the remaining extent of native vegetation within the System 6 area in which the survey area is located. The Cottesloe Complex – Central and South had an inferred pre-European vegetation extent of 44,995 ha, of which approximately 18 474 ha or 41.1% remains (EPA 2006). Of the remaining extent, approximately 8.8% is considered as being in secure tenure (EPA 2006). The proposed clearing of 36 ha within this complex represents the loss of approximately 1.9% of the remaining extent. On this basis, the proposed clearing would not trigger a requirement for the provision of environmental offsets.

4.3 Statistical Analysis

Vegetation data incorporated into the statistical analysis originated from within the four quadrats surveyed. Three of these were located in WEmEg and one within WCc. Based on a review of the output from PRIMER, it would appear that these units are all closely related to SCP28. The quadrats were noted as not being closely related to any of the known TECs or PECs within the region. No statistical analysis was completed for the vegetation defined by relevés, including units WEgOSBs, SGv and LWAf. However, a side by side comparison of these species and those recorded within the TECs and PECs was completed. The units within the survey area did not contain key species from within the TECs or PECs.

4.4 Conservation Significance of Vegetation

To determine whether vegetation was considered to have conservation significance, an assessment was made against the following factors:

- Presence of flora of conservation significance;
- Presence of new flora records;
- Vegetation units with potentially restricted distributions;
- Vegetation in better condition than that of the surrounding landscape;
- Vegetation containing a unique assemblage of species; and/or
- Vegetation identified by a recognised authority as being a unit with conservation significance.

No flora species of conservation significance were recorded during the survey, nor were there any collections considered to represent novel species, range extensions or substantial variations from known species. The species documented within the survey area were all well-known across the Swan Coastal Plain and were known to be recorded in association at other sites. On this basis, the Site was not considered to have conservation value in relation to either specific species or combinations of species.

The vegetation units within the survey area were not considered to have restricted distributions. An example of a restricted unit in this region would be the Holocene sedgelands, which require a specific substrate and hydrology to exist. If a broader definition of this concept was applied, a vegetation unit that is restricted in distribution could be considered to be vegetation that is either being, or has already been, highly fragmented, or is located within a highly-modified ecological matrix, such as an urbanised area. The alteration or loss of the matrix and the fragmentation of remaining vegetation can have an effect analogous to that associated with restricted habitat. Key pressures can include loss of gene flow and the introduction of invasive species. It was noted that the survey area was located within a highly-modified matrix and had been impacted by invasive species.

As a consequence of the invasion by weed species, the condition of the vegetation in the context of displacement of species and alteration of ecosystem processes. This served to reduce the vegetation condition and therefore the underlying ecological value across the Site. These effects are likely to have been further accentuated through alteration of the fire frequency, largely through the absence of fire, and a clear absence of weed management.

The underlying value of the Site is proposed to be a combination of the size of the remnant, its potential as a site promoting gene flow and the underlying ecological value of the Site. While the vegetation across the Site is recognized as a Beard complex that is heavily cleared and poorly reserved in the area, it does not include either TECs or a PECs, and is not in a condition that would be considered to be representative of this vegetation within the region. As a consequence of its current state therefore, the Site is not considered to have a high level of conservation value.

4.5 Native Flora

During the survey, a total of 114 angiosperms, including subspecies and variants, and two gymnosperms were recorded. The angiosperms represented 78 genera within 37 families, while the two gymnosperms represented the Zamiaceae and Cupressaceae. The most speciose families recorded during the survey belonged to the Fabaceae, with 15 species representing nine genera. The Proteaceae were represented by 10 species from seven genera and the Cyperaceae by nine species from five genera. No flora taxa of conservation significance were recorded during the survey. A full summary of the species recorded during the survey is presented in Appendix H.

The flora recorded from the Site was considered to be comparatively low in the context of good condition vegetation on the Swan Coastal Plain where species diversity can be as high as 100 species in 100 m^2. The low species number was considered to be a consequence of the level of disturbance due to the presence of invasive weed species and the reduced fire frequencies (see Section 7.2). Given that surveys have been conducted three times during spring in 2012 and twice during 2006, it is considered highly unlikely that additional survey work would result in a substantial change to the inventory.

4.6 Weeds

There were a total of 47 weed species recorded during the survey, none of which are listed as Weeds of National Significance. One declared taxon that was recorded *Zantedeschia aethopica,* is a P1 and P4 species for the whole state (refer to Appendix E for definitions). A full summary of the weeds recorded during the survey, including their environmental weed ranking is presented in Appendix I. Of the remaining weed species identified in the survey, *E. calycina* was the most widespread, and presents the greatest

current and potential threat in terms of impact. The current impacts associated with *E. calycina* are related to the extent and density of infestation within the survey area.

The majority of the survey area was occupied by *E. calycina*, which subsequently was the most widespread of the understorey species. It is hypothesised that the infestation density within the survey area is a significant contributor to the relatively low flora species inventory, particularly with regard to annual and ephemeral taxa that would typically occur in the same stratum. The high level of infestation of *E. calycina* and other grass weeds additionally increases the fuel load at the Site. It is well documented that grasses create a fine fuel load that once ignited results in fires that spread faster and burn hotter than fires with a low fuel load.

The majority of the remaining weed species were scattered throughout the Site, with higher diversity levels noted towards the Site boundary. This increased weed diversity on the periphery is a clear example of an edge effect through which species have a high potential to become significant problems at the Site. Key amongst these are *Euphorbia terracina*, *Solanum nigrum*, *Pelargonium capitatum*, *Zantedeschia aethopica* and *Foeniculum vulgare*.

5 Conclusion

Lot E26 Meares Road, Kwinana was subject to a Level 2 survey during spring 2012. The survey area was a 36 ha remnant vegetation block located within the Town of Kwinana, in the Perth subregion of the Swan Coastal Plain. The survey area was within the Cottesloe Complex Central and South, which forms part of the western section of the Spearwood dunes. Three site visits were undertaken in September, October and November.

During the survey, a total of 114 native flora species and 47 alien species were recorded in five vegetation units. The flora recorded were predominantly common species, with no flora of conservation significance, novel species or range extensions recorded. The census of weed species was considered to reflect the underlying level of disturbance at the Site, including the effects of displacement of native taxa due to the presence of weeds and the apparent reduction in fire frequencies at the Site in the last ten years.

The vegetation at the Site was dominated by *E. marginata* subsp. *marginata* and *E. gomphocephala*, with several areas having a canopy defined by the presence of *C. calophylla*. The understorey structure in the vegetation units with either the *Eucalyptus* or *Corymbia* overstorey was structurally and floristically very similar. The minor units within the survey area were noted as occurring on higher points in the Site, and were within areas that appeared to have been highly disturbed. None of the vegetation within the Site was identified as being a TEC or PEC.

The majority of the survey area was assessed as being in Degraded condition, with the key factor in reducing the condition of the vegetation being infestation by weed species. The invasive grass *E. calycina* was recorded over the entirety of the Site, with cover in some areas exceeding 70%. It was noted that there were no sections of the survey area that were free of weeds. Additional disturbance due to the proliferation of tracks, dumping of household waste and lack of fire at appropriate intervals was also apparent. The absence of weed management and absence of appropriate burning regimes at the Site are likely to lead to further degradation in the future.

The Site was noted as providing potential ecological linkages to surrounding vegetation in the local area and region. The Site also contained a number of mature *Eucalyptus*, *Corymbia* and *Banksia* trees that may be of value to fauna.

While the Site was assessed as being largely in a Degraded condition, the value of remnant vegetation on the Swan Coastal Plain is high.

6 Limitations

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

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

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

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

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APPENDIX A

Definitions of Threatened (Declared Rare) and Priority Flora

CONSERVATION CODE	CATEGORY DESCRIPTION
T	*Threatened – (Declared Rare Flora – Extant)* Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such (Schedule 1 under the Wildlife Conservation Act, 1950). Threatened Flora (Schedule 1) are further ranked by the DEC according to their level of threat using IUCN Red List Criteria: 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
X	*X: Presumed Extinct Flora (Declared Rare Flora — Extinct)* Taxa which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such (Schedule 2 under the Wildlife Conservation Act 1950)
Species that have not been adequately surveyed for listing under Schedule 1 or 2 can be added to the Priority Flora List under Priorities. These three categories are ranked in order of priority for survey and evaluation of conservation status 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 are placed in Priority 5.	
P1	*Priority One – Poorly-known Species* Species that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2	*Priority Two – Poorly Known Species* Species that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

CONSERVATION CODE	CATEGORY DESCRIPTION
P3	*Priority Three – Poorly Known Species* Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities 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 localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4	*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.
P5	*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.

APPENDIX B

Definitions of Threatened and Priority Ecological Communities

CATEGORY	CATEGORY DESCRIPTION
Presumably Totally Destroyed (PD)	An ecological community that has been adequately searched for but for which no representative occurrences are known. The community has been completely destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the forseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant AND EITHER of the following applies: A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or B) All occurrences within the last 50 years have been destroyed.
Critically Endangered (CR)	An ecological community will be listed as critically endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This is determined on the basis of the best available information, by it meeting ANY ONE OR MORE of the following criteria (A, D, or G): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (B or C): B) Geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); C) Modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated; D) Current distribution is limited, and one or more of the following apply (E or F): E) Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); F) There may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes; and/ or G) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).
Endangered	An ecological community will be listed as endangered when it has been adequately surveyed and is not critically endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting ANY ONE OR MORE of the following (A, D or H): A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (B or C):

CATEGORY	CATEGORY DESCRIPTION
	B) The estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years); C) Modification throughout its range is continuing such that in the short term future (within approximately 20 years); D) Current distribution is limited, and one or more of the following apply (E, F or G): E) Geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years); F) There are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes; G) There may be many occurrences but the total area is small and/or isolated and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes; and/ or H) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).
Vulnerable	An ecological community will be listed as vulnerable when it has been adequately surveyed and is not critically endangered or endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by meeting any one or more of the following criteria (A, B or C): A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated; B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations; and/ or C) The ecological community may be still widespread but is believed to move into a category of higher threat in the medium to long-term future because of existing or impending threatening processes.
Priority 1	Poorly-known ecological communities Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤ 5 occurrences or a total area of ≤ 100 ha). Occurrences are believed to be under threat due to limited extent, or being on lands under which immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but

CATEGORY	CATEGORY DESCRIPTION
	do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
Priority 2	Poorly-known ecological communities Communities that are known from few occurrences with a restricted distribution (generally ≤ 10 occurrences or a total area of ≤ 200 ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
Priority 3	Poorly-known ecological communities Communities that are known from several to many occurrences, a significance number or area of which are not under threat of habitat destruction or degradation; or Communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat; or Communities made up of large, and/or widespread occurrences that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect.
Priority 4	Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring. Rare – Ecological communities known from few occurrences 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 communities are usually represented on conservation lands. Near Threatened – Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. Ecological communities that have been removed from the list of threatened communities during the past five years.
Priority 5	Conservation-Dependent ecological communities Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

APPENDIX C

Classification of Vegetation Structural Formation and Height Classes (Keighery 1994)

LIFE FORM/HEIGHT CLASS	CANOPY COVER			
	100-70%	70-30%	30-10%	10-2%
Trees > 30m Trees 10-30m Trees < 10m	Tall Closed Forest Closed Forest Low Closed Forest	Tall Open Forest Open Forest Low Open Forest	Tall Woodland Woodland Low Woodland	Tall Open Woodland Open Woodland Low Open Woodland
Mallee Tree Form	Closed Tree Mallee	Tree Mallee	Open Tree Mallee	Very Open Tree Mallee
Mallee Shrub Form	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m Shrubs 1-2m Shrubs < 1m	Closed Tall Shrub Closed Heath Closed Low Heath	Tall Open Shrub Open Heath Open Low Heath	Tall Shrubland Shrubland Low Shrubland	Tall Open Shrubland Open Shrubland Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

APPENDIX D

Vegetation Condition Scale (Keighery 1994)

CODE	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 areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

APPENDIX E

Definitions of Declared Plant Classes

CLASS	DEFINITION
P1	Introduction of the plant into, or movement of the plant within, an area is prohibited.
P2	Plant to be eradicated in the area.
P3	Plant to be controlled by reduction in number or distribution of the plant or both.
P4	Spread of plant beyond where it currently occurs to be prevented.
P5	Particular action to be taken on public land or land under the control of a local government.

APPENDIX F

Vegetation Photographs



Vegetation Complex LWAf



Vegetation Complex SGv



Vegetation Complex WCc



Vegetation Complex WEgEm



Vegetation Complex WEgOSBs

APPENDIX G

Species-Association Matrix

APPENDIX H

Native Species Summary

FAMILY	GENUS	SPECIES
Amaranthaceae	*Ptilotus*	*drummondii* var. *drummondii*
	Ptilotus	*polystachyus*
Anarthriaceae	*Lyginia*	*imberbis*
Anthericaceae	*Chamaescilla*	*corymbosa* var. *corymbosa*
	Dichopogon	*capillipes*
	Sowerbaea	*laxiflora*
	Thysanotus	*arenarius*
	Thysanotus	*manglesianus*
	Tricoryne	*elatior*
Apiaceae	*Eryngium*	*pinnatifidum*
	Trachymene	*pilosa*
	Xanthosia	*huegelii*
Asparagaceae	*Acanthocarpus*	*preissii*
	Lomandra	*caespitosa*
	Lomandra	*hermaphrodita*
	Lomandra	*maritima*
	Lomandra	*micrantha*
	Lomandra	*preisii*
	Lomandra	*suaveolens*
	Brachyscome	*iberidifolia*
	Lagenophera	*huegelii*
	Ozothamnus	*cordatus*
	Podolepis	*gracilis*
	Podolepis	*lessonii*
	Senecio	*hispidulus*
Campanulaceae	*Lobelia*	*tenuis*
Casuarinaceae	*Allocasuarina*	*fraseriana*
	Allocasuarina	*humilis*
Colchicaceae	*Burchardia*	*congesta*
Crassulaceae	*Crassula*	*colorata* var. *acuminata*
	Crassula	*colorata* var. *colorata*
	Crassula	*decumbens* var. *decumbens*
Cupressaceae	*Callitris*	*?canescens*
Cyperaceae	*Ficinia*	*nodosa*
	Isolepis	*cernua* var. *setiformis*
	Lepidosperma	*pubisquameum*
	Lepidosperma	*scabrum*
	Lepidosperma	*squamatum*
	Mesomelaena	*pseudostygia*
	Schoenus	*clandestinus*
	Schoenus	*curvifolius*
	Schoenus	*grandiflorus*
Dilleniaceae	*Hibbertia*	*hypericoides*

FAMILY	GENUS	SPECIES
	Hibbertia	*racemosa*
Droseraceae	*Drosera*	*erythrorhiza* subsp. *erythrorhiza*
	Drosera	*pallida*
	Drosera	*porrecta*
Ericaceae	*Astroloma*	*pallidum*
	Leucopogon	*propinquus*
Euphorbiaceae	*Poranthera*	*microphylla*
Fabaceae	*Acacia*	*applanata*
	Acacia	*cochlearis*
	Acacia	*pulchella* var. *glaberrima*
	Acacia	*saligna*
	Acacia	*stenoptera*
	Bossiaea	*eriocarpa*
	Gastrolobium	*capitatum*
	Gompholobium	*tomentosum*
	Hardenbergia	*comptoniana*
	Hovea	*trisperma*
	Isotropis	*cuneifolia* subsp. *cuneifolia*
	Jacksonia	*furcellata*
	Jacksonia	*sternbergia*
	Kennedia	*coccinea*
	Kennedia	*prostrata*
Geraniaceae	*Geranium*	*solanderi*
Goodeniaceae	*Scaevola*	*canescens*
Haemodoraceae	*Anigozanthos*	*manglesii*
	Conostylis	*aculeata*
	Haemodorum	*paniculatum*
Hemerocallidaceae	*Caesia*	*micrantha*
	Corynotheca	*micrantha*
	Dianella	*revoluta* var. *divaricata*
Iridaceae	*Patersonia*	*occidentalis*
Juncaceae	*Juncus*	*pallidus*
	Luzula	*meridionalis*
Lamiaceae	*Hemiandra*	*glabra* subsp. *glabra*
Myrtaceae	*Corymbia*	*calophylla*
	Eucalyptus	*gomphocephala*
	Eucalyptus	*marginata* subsp. *marginata*
Orchidaceae	*Caladenia*	*discoidea*
	Caladenia	*flava* subsp. *flava*
	Caladenia	*latifolia*
	Caladenia	*longicauda* subsp. *calcigena*
	Diuris	*magnifica*
	Microtis	*media* subsp. *media*

FAMILY	GENUS	SPECIES
	Pterostylis	*sanguinea*
Poaceae	*Rytidopsperma*	*occidentale*
	Austrostipa	*flavescens*
	Poa	*porphyoclados*
Polygonaceae	*Muehlenbeckia*	*adpressa*
Proteaceae	*Banksia*	*attenuata*
	Banksia	*grandis*
	Banksia	*sessilis* var. *cygnorum*
	Banksia	*dallanneyi*
	Grevillea	*vestita* subsp. *vestita*
	Hakea	*prostrata*
	Persoonia	*saccata*
	Petrophile	*linearis*
	Synaphea	*spinulosa* subsp. *spinulosa*
	Xylomelum	*occidentale*
Ranunculaceae	*Clematis*	*pubescens*
Restionaceae	*Desmocladus*	*asper*
	Desmocladus	*flexuosus*
Rhamnaceae	*Crytpandra*	*arbutiflora*
Rubiaceae	*Opercularia*	*hispidula*
	Opercularia	*vaginata*
Rutaceae	*Philotheca*	*spicata*
Stylidaceae	*Stylidium*	*saxifragoides*
	Stylidium	*schoenoides*
	Stylidium	*striatum*
Thymelaeaceae	*Pimelea*	*rosea* subsp. *rosea*
Violaceae	*Hybanthus*	*calycinus*
Xanthorrhoeaceae	*Xanthorrhoea*	*brunonis*
	Xanthorrhoea	*preisii*
Zamiaceae	*Macrozamia*	*riedlei*

APPENDIX I

Invasive Species Summary

FAMILY	GENUS	SPECIES	DECLARED	ENV. WEED RATING
Anacardiaceae	*Schinus*	*terebinthifolius*		VH
Araceae	*Zantedeschia*	*aethiopica*	P1, P4	VH
Asclepiadaceae	*Gomphocarpus*	*fruticosus*		M
Asparagaceae	*Asparagus*	*officinalis*		L
Asteraceae	*Arctotheca*	*calendula*		H
	Conyza	*bonariensis*		L
	Dimorphotheca	*ecklonis*		L
	Gazania	*linearis*		U
	Hypochaeris	*glabra*		H
	Sonchus	*oleraceus*		FAR
	Ursinia	*anthemoides*		M
Brassicaceae	*Brassica*	*tournefortii*		H
Campanulaceae	*Wahlenbergia*	*capensis*		FAR
Caprifoliaceae	*Centranthus*	*macrosiphon*		
Caryophyllaceae	*Petrorhagia*	*dubia*		M
	Stellaria	*media*		U
Euphorbiaceae	*Euphorbia*	*peplus*		H
	Euphorbia	*terracina*		VH
Fabaceae	*Acacia*	*iteaphylla*		FAR
	Acacia	*longifolia*		VH
	Lupinus	*angustifolius*		U
	Lupinus	*cosentinii*		U
	Lupinus	*luteus*		L
	Trifolium	*arvense* var. *arvense*		FAR
	Trifolium	*campestre* var. *campestre*		FAR
Fumariaceae	*Fumaria*	*capreolata*		M/H
Geraniaceae	*Geranium*	*molle*		M
	Pelargonium	*capitatum*		M/H
Iridaceae	*Freesia*	*alba x leichtlinii*		VH
	Gladiolus	*caryophyllaceus*		FAR/H
	Romulea	*rosea*		FAR
Lamiaceae	*Lavendula*	*stoechas*		FAR
Orchidaceae	*Disa*	*bracteata*		U
Orobanchaceae	*Orobanche*	*minor*		FAR
Oxalidaceae	*Oxalis*	*pes-caprae*		H
Poaceae	*Avena*	*barbata*		VH
	Briza	*maxima*		FAR
	Briza	*minor*		FAR
	Bromus	*diandrus*		VH
	Cynodon	*dactylon*		VH
	Ehrharta	*calycina*		VH
	Eragrostis	*curvula*		H

FAMILY	GENUS	SPECIES	DECLARED	ENV. WEED RATING
	Lagurus	*ovatus*		H
Primulaceae	*Lysimachia*	*arvensis*		FAR
Scrophulariaceae	*Misopates*	*orontium*		U
Solanaceae	*Solanum*	*nigrum*		M

360 environmental

Black Cockatoo Survey – Kwinana Town Centre

Prepared for:

Department of Housing/
Satterley Property Group

May 2012

people • planet • professional

360 Environmental Pty Ltd

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Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing (DoH) to undertake a Black Cockatoo Survey at Lot 26 Meares Avenue, Kwinana (the site), known as Kwinana Town Centre (Figure 1). The survey involved a Black Cockatoo Foraging Assessment, Black Cockatoo Breeding Assessment and Black Cockatoo Significant Tree Survey (the survey). The DoH has proposed the area be utilised for residential development. The site comprises an area of approximately 36 hectares (ha) and is located in the Town of Kwinana, approximately 33 kilometres (km) south of Perth. The site is composed of uncleared bushland with Tuart, Jarrah, Marri and Banksia species present throughout.

A search of the Environment Protection and Biodiversity Conservation (EPBC) database and past site assessments revealed that the Vulnerable Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo, and the Endangered Carnaby's Black Cockatoo are likely to occur within the area. A survey conducted in 2009 at the site found evidence of Black Cockatoo foraging (360 Environmental, 2009). This consisted of feeding debris from Carnaby's Black Cockatoo and Red-tailed Black Cockatoo. Three potential breeding hollows were also identified. No evidence of Black Cockatoo breeding was recorded on site at the time of the survey (360 Environmental, 2009).

The current survey identified only one potentially suitable nesting hollow for Black Cockatoo within the Kwinana Town Centre. No evidence of Black Cockatoo breeding was recorded. Suitable feeding species (Banksia and Jarrah) and sparse evidence of feeding debris were recorded at the site. The majority of the feeding evidence was old foraging evidence on seeds. There were three locations which showed evidence of Carnaby's Black Cockatoo feeding and ten locations which showed evidence of Forest Red-Tailed Black Cockatoo feeding. Of these, only one location showed recent evidence of Black Cockatoo feeding (Forest Red-tailed Black Cockatoo). Tail feathers and scats were recorded, which indicates the presence of a small roost site within the study area. This suggests that although not extensively utilised, both Carnaby's Black Cockatoo and Red-tailed Black Cockatoo do at least occasionally utilise the survey area for foraging, feeding, to some extent roosting but there was no evidence of breeding.

The suggestion that Black Cockatoo's occasionally utilise the site is supported by a sighting of at least three Red-tailed Black Cockatoos flying over the site, thirty Carnaby's Black Cockatoo's observed within the garden just outside the site on Meares Avenue and seven Carnaby's Black Cockatoo observed on *Banksia attenuata* trees along Meares Avenue.

From the outcomes of this report the following are recommended:

- Retain as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater. The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) considers that trees over 500 mm could provide

breeding and foraging habitat for Black Cockatoo species. Trees with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees. It is recommended that emphasis be placed on retaining potential breeding and foraging trees to minimise impacts. Should offsets be required for vegetation clearing they are likely to be greater for the clearing of breeding habitat; and

- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use.
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site;
- Feral bee control could be implemented on site to remove feral bees from the hollows of trees that remain on site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cocktoo and Baudin's Black Cockatoo breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Red-tailed Black Cockatoos breed within a period from September to April. This will reduce the likelihood of Black Cockatoos using the site during clearing.

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1 Introduction

1.1 Background

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Black Cockatoo Breeding and Foraging Survey and Black Cockatoo Significant Tree Survey at Lot 26 Meares Avenue, Kwinana (the site), known as Kwinana Town Centre (Figure 1). The site is approximately 36 hectares in size and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The site is composed of uncleared bushland. The vegetation within the survey area can be classified into four broad vegetation groups (360 Environmental, 2006). These groups are Jarrah-Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands.

The Department of Housing/ Satterley Property Group has proposed the area be utilised for residential development.

1.2 Objectives

The objectives of the Black Cockatoo Survey were to:

- Identify significant habitat trees (breeding and feeding) suitable for Black Cockatoo and evidence of Black Cockatoo breeding and feeding at the site with reference to SEWPaC's (2011) draft referral guidelines for Black Cockatoos; and
- Determine the extent of the use of the site by Black Cockatoos.

1.3 Scope of the Study

In order to determine what areas of the survey area would be considered foraging or breeding habitat for Black Cockatoos, a survey of suitable trees within the proposed development area was undertaken. The Black Cockatoo Survey included:

- Background Research;
- On site Black Cockatoo Breeding Assessment;
- On site Black Cockatoo Foraging Assessment; and
- On site Black Cockatoo Significant Tree Assessment.

2 Site Description

2.1 Site Location

The survey site is approximately 36 ha and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The majority of the site is uncleared bushland.

2.2 Broad Habitat Assessment

In 2006, 360 Environmental conducted a site assessment of the area. The vegetation consists of Tuart (*Eucalyptus gomphocephalla)* and Jarrah (*Eucalyptus marginata*) with sections of Marri (*Corymbia calophylia*) and *Banksia* species (360 Environmental, 2006). The vegetation within the survey area can be classified into four broad vegetation groups. These groups are Tuart woodlands, Jarrah-Banksia woodlands, Marri woodlands and shallow limestone shrublands (360 Environmental, 2006). The Jarrah-Banksia vegetation units covered the largest part of the study area. The condition of the vegetation in the survey area was mostly in the range of 'Good' to 'Very Poor'. Some physical disturbance has occurred in various places in the survey area.

3 Black Cockatoo Species

Three species of Black Cockatoo occur in the south-west of Western Australia. All three species are protected under the following State and Federal legislation:

- The *Wildlife Conservation Act 1950* (WC Act), Western Australia; and
- The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act. The Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are classified as Vulnerable.

Under the WC Act both Carnaby's Black Cockatoo and Baudin's Black Cockatoo are listed as Endangered. The Forest Red-tailed Black Cockatoo is listed as Vulnerable.

3.1 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is a large, Black cockatoo with a white patch on its cheek, white bands on its tail, and a strong curved bill. Carnaby's Black Cockatoo is also known as the Short-billed Cockatoo. In males, the bill is black and the eye-ring dark-pink. Females have a light grey bill, grey eye-ring, and the cheek patch is less distinctive.

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DEC, 2009). There is evidence the species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, 2006).

Carnaby's Black Cockatoos are believed to breed mostly in the wheatbelt region of Western Australia (DEC, 2009). After breeding, Carnaby's Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July (DEC, 2009).

Carnaby's Black Cockatoo display strong pair bonds. They occur in uncleared or remnant areas of Eucalypt woodland, principally Salmon gum (*Eucalyptus salmonophloia*) or Wandoo (*E. wandoo*), and shrubland or kwongan heath dominated by Hakea and Banksia species. Carnaby's Black Cockatoo nest in the hollows of live or dead smooth-barked Eucalypts (Salmon Gum and Wandoo) but also in Red Morrell (*E. longicornis*), York Gum (*E. loxophleba*), Marri and Tuart (Johnstone and Storr, 1998). Nest hollows range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr, 1998). Eggs are laid between July to mid-October and incubation is 29 days (Johnstone and Storr, 1998).

On the Swan Coastal Plain, the birds feed on a large variety of plants including the *Proteaceae* (Banksia and Grevillea), Marri nuts and introduced species – notably Pines (DEC, 2009).

Carnaby's Black Cockatoo has undergone a dramatic decline in recent years, declining by 50 percent in the past 45 years, one of the main contributing factors being land clearing (DEC, 2009). The long-term survival and recovery of this species is linked to the survival of its habitat – both in breeding areas in the Wheatbelt and non-breeding areas such as the Swan Coastal Plain (DEC, 2009). In addition, clearing of heathland near breeding sites has reduced the availability of food for breeding pairs and their young (DEC, 2009).

3.2 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is a large Black Cockatoo with a pair of black central tail feathers and a bright red, orange or yellow barring on the tail (SEWPaC, 2012). This species is endemic to the south-west humid and semi-humid zones of Western Australia. It inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm average annual rainfall (SEWPaC, 2012). Forest Red-tailed Black Cockatoos feed predominantly on the seeds of Jarrah and Marri fruits.

3.3 Baudin's Black Cockatoo

Baudin's Black Cockatoo is a large black cockatoo with rectangular white patches in the tail. This species is only found in the extreme south-west of Western Australia. It occurs in areas of high rainfall and usually in heavily forested locations dominated by Marri, Karri or Jarrah. The diet of Baudin's Black Cockatoo consists mostly of *Eucalyptus* seeds (e.g. Marri and Jarrah) and occasionally insect larvae (SEWPaC, 2012).

4 Methods

4.1 Background Research

The background research is designed to gather existing data on known locations of breeding and feeding for Black Cockatoo. The background research and desktop study included review of the following websites and documents:

- DEC's website on Black Cockatoos;
- SEWPaC's EPBC Act draft referral guidelines; and
- Reports of previous studies undertaken in the area.

4.2 Black Cockatoo Foraging and Breeding Assessment Methodology

4.2.1 Survey Personnel

The Black Cockatoo Foraging and Breeding Survey was undertaken by Black Cockatoo specialist Tony Kirkby. Tony Kirkby was a technical officer at the WA Museum and has had significant field experience with Black Cockatoos in Western Australia. He is considered an expert in the area of protected Black Cockatoos and has authored a number of papers on the subject. Over the last seven years Tony has collected, recorded and photographed most of the food taken by the three south-west Black Cockatoos and has to date a database of over 20,000 records and an image library of over 3,000 cockatoo and cockatoo food related photographs.

4.2.2 Black Cockatoo Breeding Site Assessment

Tony Kirkby undertook a one day site visit during the 21 March 2012 to assess trees considered to be suitable for breeding. The trees were assessed based on the following criteria:

- Native trees (Jarrah, Tuart, Marri etc.);
- Diameter at breast height > 500 millimetres (mm); and
- Hollows > 12 centimetres (cm) diameter.

The survey area was walked and all trees meeting the criteria for potential breeding habitat (species, girth and hollow diameter) were recorded and electronically logged using a hand held Differential Global Positioning System (DGPS) unit (Appendix B).

4.2.3 Black Cockatoo Foraging Site Assessment

Tony Kirkby undertook a one day site visit to conduct an observational site survey and feeding assessment to determine the extent of foraging habitat for Black Cockatoos at

the same time as the breeding assessment was undertaken. The observational and foraging assessment included:

- Analysis of dentition marks in seed and nut material; and
- Opportunistic observations of Carnaby's Black Cockatoos within the proposed development area.

Feeding trees and opportunistic observations were recorded and located using a hand held DGPS unit (Appendix B).

4.3 Black Cockatoo Significant Tree Survey Methodology

4.3.1 Survey Personnel

The Black Cockatoo Significant Tree Survey was conducted by two Environmental Scientists from 360 Environmental. The survey was conducted over a period of four days during April and early may.

4.3.2 Site Survey

The survey comprised of recording the location, species, tree diameter at breast height and any other important descriptive information about each tree located within the site boundary.

Roughly 40 m wide walking transects were designed across the site. Every tree within a survey transect was assessed based on the Black Cockatoo significant tree criteria (below). Each transect ran parallel or perpendicular to another transect to ensure all trees within the site were included within a transect line. Tree details were individually recorded electronically using a DGPS.

4.3.3 Black Cockatoo Significant Tree Criteria

Trees exceeding 400 mm trunk diameter at breast height (DBH) (~1.5 m above ground level) were considered environmentally significant for the purposes of this survey based on criteria used by the Town of Kwinana (Town of Kwinana, pers. comm., 9 February 2010). This is a more conservative measure of tree significance than the standard 500 mm used by SEWPaC. Trees with a trunk DBH less than 400 mm were not recorded for the purposes of this survey.

4.3.3.1 Tree Location (using DGPS)

Each significant tree was individually recorded using a DGPS to get the Universal Transverse Mercator (UTM GDA 94 Zone 50) coordinates.

4.3.3.2 Tree Species

Each significant tree was individually recorded according to its species, as either:

- Jarrah (*Eucalyptus marginata*);
- Marri (*Corymbia calophylla*);
- Tuart (*Eucalyptus gomphocephala*);
- Sheoak (*Allocasuarina fraseriana*);
- Banksia (*Banksia attenuata* or *Banksia grandis*); or
- Stag (standing dead tree).

4.3.3.3 Trunk Diameter at Breast Height

Each significant tree was individually recorded according to its trunk DBH, as either:

- Small: 400 mm to 500 mm;
- Medium: 500 mm to 800 mm;
- Large: 800 mm to 1,200 mm; and
- Very Large: 1,200 mm+.

5 Results

The breeding and foraging survey was undertaken on 21 March 2012 by Tony Kirkby. The Significant Tree Survey was undertaken throughout April and early May by Environmental Scientists at 360 Environmental. The following summarises the results of the Black Cockatoo breeding, foraging and significant tree assessments.

5.1 Black Cockatoo Breeding Assessment

Tree hollows were assessed by Tony Kirkby to determine if they were being utilised by Black Cockatoos, and if not to determine if they were suitable or have the potential to be suitable for use by Black Cockatoos.

- One Tuart tree was found to contain a hollow of suitable size for Black Cockatoos, however, it contained feral bees which would preclude current use by Black Cockatoos – 388213E 6431257N;
- Tail feathers and scats were observed in one Marri tree which indicate a small roost site located - 388583E 6431216N;
- A slightly chewed hollow in a Marri tree was observed, however, this was too low and slightly small to be a Black Cockatoo hollow – 388486E 6431012N; and
- A hollow in Marri which showed no signs of use – 388238E 6431118N.

Feral bees were observed in 8 locations within the site.

Figure 2 provides a map illustrating the locations where possible suitable hollows were located. Appendix B provides a summary of data results for the foraging assessment. Data from the 2009 Breeding Assessment (360 Environmental, 2009) was included in Figure 2 and Appendix B.

5.2 Black Cockatoo Foraging Assessment

There was a relatively large amount of old feeding evidence on the seeds of Marri and *Banksia attenuata*. Recent feeding evidence was also observed on Marri seeds. The following provides a summary of feeding evidence observed during the foraging assessment.

- Old evidence of feeding on seeds from *Banksia attenuata* – 388435E 6430749N;
- Old evidence of feeding on seeds from *Banksia attenuata* – 388427E 6430945N;
- Old evidence of feeding on seeds from *Banksia attenuata* – 388473E 6430927N;
- Old evidence of feeding on seeds from Marri – 388319E 6430725N;
- Recent evidence of feeding on seeds from Marri – 388275E 6430680N;

- Old evidence of feeding on seeds from Marri – 388131E 6430839N;
- Old evidence of feeding on seeds from Marri – 388486E 6431012N;
- Old evidence of feeding on seeds from Marri – 388507E 6431043N;
- Old evidence of feeding on seeds from Marri – 388552E 6431110N;
- Old evidence of feeding on seeds from Marri – 388481E 6431118N;
- Old evidence of feeding on seeds from Marri – 388422E 6431125N;
- Old evidence of feeding on seeds from Marri – 388583E 6431447N; and
- Old evidence of feeding on seeds from Marri – 388608E 6431251N.

Figure 2 provides a map illustrating the locations where feeding evidence was found. Appendix B provides a summary of data results for the foraging assessment. Data from the 2009 Foraging Assessment (360 Environmental, 2009) was included in Figure 2 and Appendix B.

5.3 Black Cockatoo Opportunistic Observations

Thirty Carnaby's Black Cockatoos were seen milling around in gardens along Meares Avenue on the 21 March 2012. In early May at least three Red-tailed Black Cockatoos were sighted flying overhead while within the site. These birds did not utilise any trees within the site at the time of the observation. On 7 May 2012 five birds were sighted within a *Banksia attenuata* on the edge of the site along Meares Avenue. The location of these observations is displayed in Figure 2.

5.4 Black Cockatoo Significant Tree Assessment

A summary of the results of the Black Cockatoo significant Tree Survey are presented in Table 1 and Figure 3. The raw survey data is located in Appendix C.

In total, 1,063 trees were recorded on site with a trunk DBH greater than 400 mm. A total of 574 (54%) of these trees were recorded with a trunk DBH >500 mm. A total of 35 (3.3%) extra large trees were recorded within the site. These included primarily Marri, Jarrah and Tuart. An example of an extra large tree is displayed in Plate 1. The most commonly recorded tree species were Jarrah, Marri, Tuart and to a lesser extent Banksia. Sheoak and dead Stags were recorded less frequently. Jarrah and Tuart trees were located throughout the site. Marri occurs in clumps throughout the site usually replacing Tuart and to a lesser extend Jarrah (Figure 3).

Table 1: Black Cockatoo Significant Tree Survey Results

Trunk Size (DBH)	Jarrah	Marri	Tuart	Sheoak	Banksia	Stag	Total
Small: 400mm – 500mm	194	114	72	20	89	0	489
Medium: 500mm – 800mm	135	97	165	8	17	5	427
Large: 800mm – 1200mm	38	13	50	1	1	9	112
Extra Large: >1200mm	12	10	10	0	0	3	35
TOTAL	379	234	297	29	107	17	1,063



Plate 1: An example of an extra large tree (>1,200mm DBH)

It is evident that fires have recently occurred at the site and the majority of significant trees displayed various degrees of fire scaring. Recent fire damage was recorded while conducting the tree survey (Figure 4; Appendix C). In general most trees survived the recent fire events, giving the impression it was a cool burn. The fire appears to have caused little to no permanent damage.

6 Discussion

Potential nesting hollows were identified in a Tuart tree (388213E 6431257N) and two Marri trees (338486E 6431012N and 388238E 6431118N). One of the hollows located in the Marri trees was too low and small for use by Black Cockatoos. The other hollow in Marri showed no signs of use. The hollow located in the Tuart tree was occupied with feral bees and therefore not suitable for Black Cockatoos. Invasion of tree hollows by feral bees leads to a reduction in the number of suitable hollows left for Black Cockatoos (WAM, 2011). A number of Black Cockatoo chicks have been found dead in such hollows as a result of being stung by feral bees (WAM, 2011). Based on this, it is considered unlikely that a Black Cockatoo would utilise or pursue the invaded tree hollow/s as a nest hollow suitable for breeding. Consequently, only one suitable nesting hollow for Black Cockatoos was identified within the site area during this survey.

The occurrence of suitable feeding species (Banksia and Jarrah) and the sparse evidence of feeding debris recorded during the field survey suggests that although not extensively utilised, Carnaby's Black Cockatoo do at least occasionally utilise the survey area for foraging and feeding. The majority of the feeding evidence was old feeding evidence on seeds. There were three locations which showed evidence of Carnaby's Black Cockatoo feeding and ten locations which showed evidence of Forest Red-Tailed Black Cockatoo feeding. Of these, only one location showed recent evidence of Black Cockatoo feeding. This suggests that the survey area is used to some extent by Carnaby's and Forest Red-Tailed Black Cockatoos. Tail feathers and scats were recorded, which indicates the presence of a small roost site within the study area. The evidence recorded during this survey suggests that the study area is used by Carnaby's and Forest Red-Tailed Black Cockatoos for feeding and to some extent roosting but not currently for breeding.

The Black Cockatoo Significant Tree Survey revealed that a large proportion of the site contains old trees, many of which have reached a size that SEWPaC would consider a potential breeding tree. In total 574 trees were recorded which met SEWPaC's criteria of >500 mm DBH. This suggests that the site has the potential to be of significance to Black Cockatoo species in the future.

7 Summary and Recommendations

The evidence recorded during this survey suggests that the study area is used by Carnaby's and Forest Red-Tailed Black Cockatoos for feeding and to some extent roosting, but not breeding. Therefore in order to reduce the impacts of the proposed development on Black Cockatoos, the following are recommended:

- Retain as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater. The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) considers that trees over 500 mm could provide breeding and foraging habitat for Black Cockatoo species. Trees with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees. It is recommended that emphasis be placed on retaining potential breeding and foraging trees to minimise impacts. Should offsets be required for vegetation clearing they are likely to be greater for the clearing of breeding habitat; and
- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use.
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site;
- Feral bee control could be implemented on site to remove feral bees from the hollows of trees that remain on site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cocktoo and Baudin's Black Cockatoo breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Red-tailed Black Cockatoos breed within a period from September to April. This will reduce the likelihood of Black Cockatoos using the site during clearing.

8 Limitations

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

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

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

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

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APPENDIX A

Figures

388000 388100 388200 388300 388400 388500 388600 388700

6431500 6431400 6431300 6431200 6431100 6431000 6430900 6430800 6430700 6430600

N

Legend

Site Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.01	18/04/2012

HORIZONTAL DATUM AND PROJECTION

GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
TD	AH	AH	0

Satterley Property Group

Black Cockatoo Survey
Kwinana Town Centre
Site Location

Figure 1

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K:\Projects\1.0 EBS\EBS165-1 KTC Black Cockatoo Survey\Figures

388000 388100 388200 388300 388400 388500 388600 388700

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Legend

- Site Boundary
- Possible Cockatoo Nesting Hollow

Carnaby's Black Cockatoo

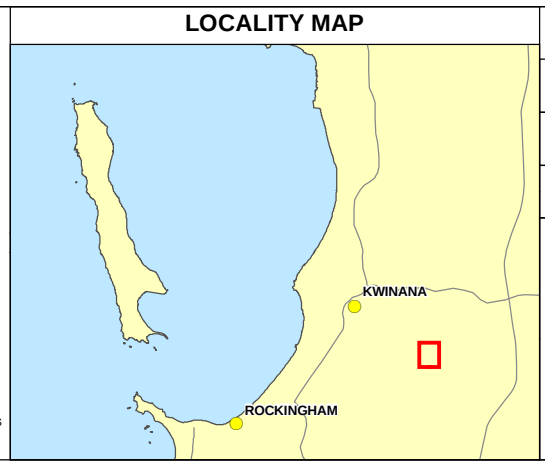
- Sighting Location
- Feeding Location

Red-tailed Black Cockatoo

- Sighting Location
- Feeding Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.02	10/05/2012

HORIZONTAL DATUM AND PROJECTION

GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	AH	AH	0

Satterley Property Group

Black Cockatoo Survey
Kwinana Town Centre
Black Cockatoo Sighting and Feeding Sites

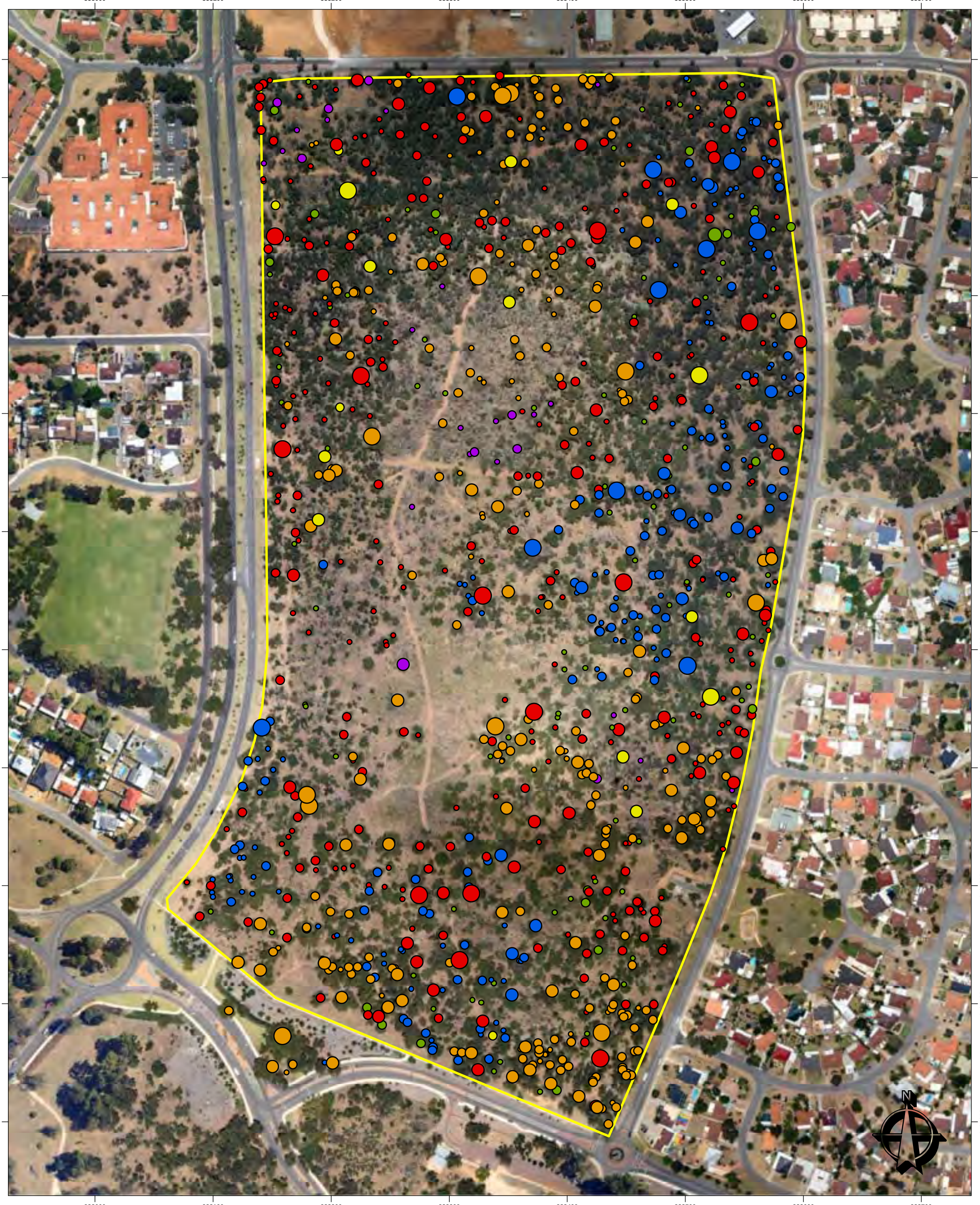
Figure 2

COPYRIGHT: THIS DOCUMENT IS AND SHALL REMAIN THE PROPERTY OF 360 ENVIRONMENTAL. THIS DOCUMENT MAY ONLY BE USED FOR THE PURPOSE FOR WHICH IT WAS COMMISSIONED AND IN ACCORDANCE WITH THE TERMS OF ENGAGEMENT FOR THE COMMISSION. 360 ENVIRONMENTAL DOES NOT HOLD ANY RESPONSIBILITY FOR THE MISUSE OF THIS DOCUMENT.

K:\Projects\1.0 EBS\EBS165-1 KTC Black Cockatoo Survey\Figures\EBS165-1 Figure 3 - Tree Diameter (9.5.12)

388000 388100 388200 388300 388400 388500 388600 388700

6431500 6431400 6431300 6431200 6431100 6431000 6430900 6430800 6430700 6430600



388000 388100 388200 388300 388400 388500 388600 388700

Legend

Site Boundary

Trunk Diameter (mm)

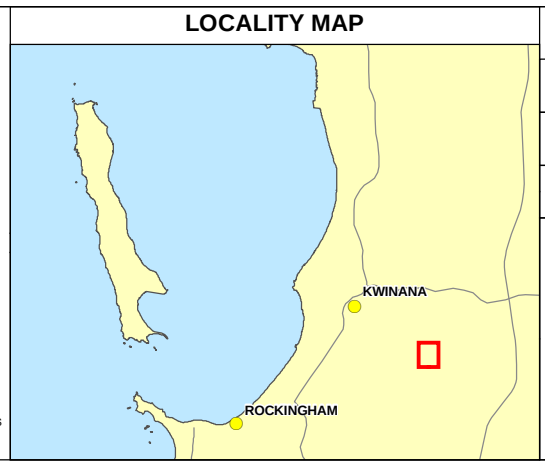
- 400 - 500
- 500 - 800
- 800 - 1200
- >1200

Species

- Banksia
- Jarrah
- Marri
- Sheoak
- Stag
- Tuart

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.03	10/05/2012

HORIZONTAL DATUM AND PROJECTION

GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	AH	AH	0

Satterley Property Group

Black Cockatoo Survey
Kwinana Town Centre
Black Cockatoo Significant Tree Survey

Figure 3

360 environmental

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K:\Projects\1.0 EBS\EBS165-1 KTC Black Cockatoo Survey\Figures\EBS165-1 Figure 3 - Tree Diameter (9.5.12)

388000 388100 388200 388300 388400 388500 388600 388700

6431500 6431400 6431300 6431200 6431100 6431000 6430900 6430800 6430700 6430600

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Legend

Site Boundary

Trunk Diameter (mm)

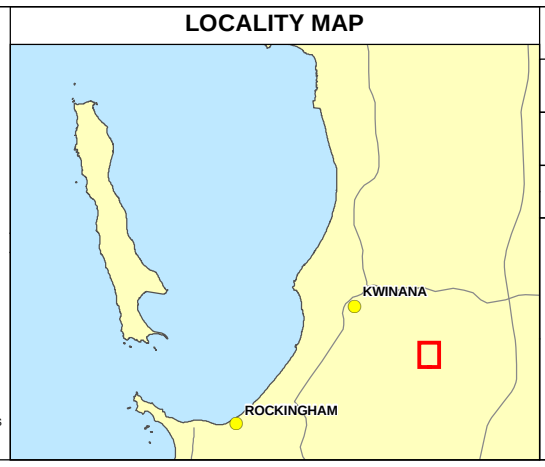
- 400 - 500
- 500 - 800
- 800 - 1200
- >1200

Evidence of Fire

- Evidence of Fire
- No Evidence of Fire

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

LOCALITY MAP



1:3,000 @ A3

0 15 30 60 90 120 Metres

DRAWING ID	DATE
EBS165-1.04	10/05/2012

HORIZONTAL DATUM AND PROJECTION

GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JJ	AH	AH	0

Satterley Property Group

Black Cockatoo Survey
Kwinana Town Centre
Significant Trees with Evidence of Fire
Figure 4

360 environmental

K:\Projects\1.0 EBS\EBS165-1 KTC Black Cockatoo Survey\Figures\EBS165-1 Figure 3 - Tree Diameter (9.5.12)

APPENDIX B

Black Cockatoo Breeding, Foraging and Sighting Data

Date	Species	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	Comments
19/03/2009	Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* (Evidence of feeding on Marri was at all stages from grey to fairly recent (up to a month old). Generally fairly extensive and well used area)	388379	6430632	Two calling
		388461	6430684	16 heading west at 08:00
		388527	6430922	Recent evidence of feeding on Jarrah
		388574	6431324	Evidence of feeding on the seeds of Marri
		388554	6431760	Evidence of feeding on the seeds of Marri
		388581	6431392	Evidence of feeding on the seeds of Marri
		388495	6431197	Evidence of feeding on the seeds of Marri
		388452	6431138	Recent evidence of feeding on the seeds of Marri
		388495	6431043	Evidence of feeding on the seeds of Marri
		388495	6431043	Two heading east at 12:15
		388435	6430987	Evidence of feeding on the seeds of Marri
		388338	6430718	Evidence of feeding on the seeds of Marri
		388471	6431030	Evidence of feeding on the seeds of Marri
		388481	6431055	Evidence of feeding on the seeds of Marri
		388455	6431216	Evidence of feeding on the seeds of Marri
		388332	6430812	Old grey evidence of feeding on the seeds of Marri
		388283	6430778	Evidence of feeding on the seeds of Marri
		388253	6430742	Evidence of feeding on the seeds of Marri
		388325	6431325	Three heading east at 13:30
		388249	6431208	Recent evidence of feeding on the seeds of Sheoak
		388251	6430750	Evidence of feeding on the seeds of Marri

Date	Species	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	Comments
		388264	6430731	Evidence of feeding on the seeds of Marri
		388259	6430712	Recent evidence of feeding on the seeds of Jarrah, several trees
	Carnaby's Cockatoo *Calyptorhychus latirostris* (Evidence of feeding was old and fairly recent. Most were small amounts only)	388531	6430906	Clippings from *Banksia attenuata*
		388559	6431012	Evidence of feeding on the seeds of *Banksia attenuata*, several trees
		388516	6431076	Evidence of feeding on the seeds of Banksia attenuata
		388585	6431748	Evidence of feeding on the seeds of Banksia attenuata
		388516	6431435	Clippings from *Banksia attenuata*
		388501	6431174	Evidence of feeding on the seeds of Banksia attenuata
		388324	6430708	Evidence of feeding on the seeds of Banksia attenuata
		388338	6430718	Three calling from west at 11:30
		388337	6431311	Evidence of feeding on the seeds of Banksia attenuata
		388325	6431325	Clippings from *Banksia attenuata*
		388305	6431298	Evidence of feeding from nectar of *Banksia attenuata*
		388143	6431051	Evidence of feeding on the seeds of Banksia attenuata
		388154	6431310	- Carnaby's Cockatoo feeding debris from *Banksia attenuata* nectar. Small amount
		388140	6431330	- Carnaby's Cockatoo feeding debris from *Banksia attenuata* seeds. Small amount
		388161	6431036	- Carnaby's Cockatoo feeding debris from *Banksia attenuata*
	Possible Cockatoo	388357	6431342	Chewed hollow in Tuart

Date	Species	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	Comments
	nest hollows	388373	6430943	Well Chewed hollow in Jarrah
		388203	6431260	Chewed hollow in Tuart
	Carnaby's Cockatoo *Calyptorhychus latirostris*	388539	6430772	07:00. 30 birds milling around in gardens along Meares Ave.
		388435	6430749	Old evidence of feeding on seeds from *Banksia attenuata*.
		388427	6430945	Old evidence of feeding on seeds from *Banksia attenuata*.
		388473	6430927	Old evidence of feeding on seeds from *Banksia attenuata*.
	Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*	388319	6430725	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388275	6430680	Redent evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388131	6430839	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388486	6431012	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388507	6431043	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388552	6431110	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388481	6431118	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388422	6431125	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
		388583	6431447	Old evidence of feeding on seeds from Marri *Corymbia calophyla*.
3/21/2012		388608	6431251	Old evidence of feeding on

Date	Species	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	Comments
				seeds from Marri *Corymbia calophyla*.
		388583	6431216	Tail feather and scats located indicating small roost site in Marri *Corymbia calophyla.*
	Possible Cockatoo nest hollows	388486	6431012	Slightly chewed hollow in Marri *Corymbia calophyla*. Too low and sightly small to be a black cockatoo hollow.
		388238	6431118	Hollow in Marri *Corymbia calophyla*, shows no signs of use.
	Feral honey bees *Apis mellifera*	388460	6430815	Hive in Tuart *Eucalyptus gomphocephala.*
		388434	6430677	Hive in Tuart *Eucalyptus gomphocephala.*
		388451	6430904	Hive in Jarrah *Eucalyptus marginata.*
		388486	6431012	Hive in Marri *Corymbia calophyla*.
		388507	6431043	2 hives in Marri *Corymbia calophyla.*
		388238	6431118	2 hives in Marri *Corymbia calophyla.*
		388213	6431257	Hollow in Tuart *Eucalyptus gomphocephala*which looks a suitable size for Black Cockatoos but contains feral honey bees *Apis mellifera*.
		388503	6431365	Hive in Tuart *Eucalyptus gomphocephala.*
4/5/2012	Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso*	388495	6431235	At least three Red-tailed Black Cockatoo flew overhead
7/5/2012	Carnaby's Cockatoo *Calyptorhychus*	388483	6430746	Carnaby foraging in tree. *Banksia attenuata*

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS
	latirostris			

APPENDIX C

Black Cockatoo Significant Tree Data

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
1	388479.83909	6430789.49889	358	Jarrah	401.070457	2	Y
2	388474.40584	6430778.13016	359	Jarrah	509.295818	3	Y
3	388429.46980	6430675.30079	360	Tuart	1823.915648	5	
4	388428.10813	6430653.55511	361	Jarrah	1209.577567	5	Y
5	388410.18664	6430621.31570	362	Tuart	1031.324031	4	
6	388424.69605	6430612.71704	363	Jarrah	974.028252	4	Y
7	388425.55365	6430611.83954	364	Tuart	1117.267701	4	
8	388429.52355	6430610.66376	365	Tuart	741.662035	3	
9	388434.94192	6430597.75168	366	Tuart	792.591617	3	
10	388441.47240	6430612.12606	367	Tuart	550.676103	3	
11	388440.99651	6430612.56429	368	Tuart	474.28173	2	
12	388438.51181	6430615.75212	369	Tuart	445.633841	2	
13	388422.02051	6430633.19859	370	Tuart	798.957814	3	
14	388421.72567	6430634.30405	371	Tuart	630.253575	3	
15	388424.51623	6430637.55009	372	Tuart	544.309905	3	
16	388450.03255	6430638.94034	373	Tuart	776.676122	3	
17	388454.55055	6430639.32279	374	Tuart	773.811333	3	
18	388451.99488	6430640.40331	375	Tuart	550.676103	3	
19	388451.41255	6430641.94907	376	Tuart	416.985951	2	
20	388446.96430	6430643.78480	377	Tuart	665.267662	3	
21	388447.03893	6430645.55955	378	Tuart	592.056388	3	
22	388446.46763	6430654.64465	379	Tuart	537.943708	3	
23	388457.34119	6430659.64292	380	Tuart	588.873289	3	
24	388460.07181	6430659.78391	381	Tuart	611.154981	3	
25	388457.12718	6430679.04293	382	Tuart	751.211331	3	
26	388472.78182	6430686.20046	383	Tuart	735.295837	3	
27	388467.23008	6430694.12191	384	Tuart	630.253575	3	
28	388460.51729	6430696.26528	385	Tuart	458.366236	2	
29	388473.48535	6430699.29096	386	Jarrah	582.507092	3	Y
30	388449.64984	6430699.24977	387	Jarrah	588.873289	3	

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
31	388446.62557	6430691.56633	388	Tuart	531.57751	3	
32	388451.35400	6430689.95544	389	Tuart	690.732453	3	
33	388447.97741	6430688.58774	390	Tuart	757.577529	3	
34	388480.89825	6430744.71883	391	Jarrah	541.126807	3	
35	388482.45934	6430748.39478	392	Jarrah	490.197225	2	
36	388415.05083	6430667.15899	393	Jarrah	665.267662	3	
37	388417.04375	6430674.38758	394	Banksia	426.535247	2	
38	388434.83811	6430692.54498	395	Tuart	436.084544	2	
39	388437.81465	6430696.01482	396	Tuart	512.478917	3	
40	388439.38428	6430698.91477	397	Tuart	541.126807	3	
41	388439.19592	6430715.98678	398	Tuart	904.000077	4	
42	388441.15092	6430718.11489	399	Tuart	452.000038	2	
43	388448.14267	6430716.30723	400	Banksia	429.718346	2	
44	388455.31310	6430732.46258	401	Tuart	537.943708	3	
45	388455.81350	6430738.34425	402	Banksia	442.450742	2	
46	388446.98298	6430744.56646	403	Jarrah	623.887377	3	
47	388465.32435	6430755.85586	404	Jarrah	623.887377	3	
48	388474.87313	6430769.93089	405	Jarrah	958.431067	4	Y
49	388462.79569	6430780.10864	406	Jarrah	439.267643	2	
50	388459.33714	6430786.16838	407	Jarrah	525.211312	3	
51	388446.99295	6430794.90186	408	Banksia	432.901445	2	
52	388377.07430	6430625.27416	409	Banksia	401.070457	2	
53	388386.13839	6430632.02647	410	Tuart	846.704297	4	
54	388391.19102	6430626.64958	411	Banksia	525.211312	3	
55	388394.68255	6430643.20785	412	Tuart	732.112738	3	
56	388401.14696	6430646.49446	413	Tuart	681.183156	3	
57	388395.99645	6430652.20288	414	Tuart	754.39443	3	
58	388386.34021	6430647.88321	415	Tuart	474.28173	2	
59	388385.39942	6430647.76195	416	Tuart	636.619772	3	
60	388381.62521	6430656.81169	417	Tuart	445.633841	2	

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
61	388382.56600	6430656.93294	418	Tuart	436.084544	2	
62	388377.24789	6430660.75471	419	Tuart	423.352149	2	
63	388385.81900	6430660.96020	420	Tuart	426.535247	2	
64	388389.39864	6430669.53676	421	Tuart	646.169069	3	
65	388403.55335	6430667.47558	422	Tuart	655.718366	3	
66	388403.19856	6430674.01304	423	Tuart	436.084544	2	
67	388416.46509	6430692.67486	424	Jarrah	401.070457	2	
68	388418.97184	6430696.02864	425	Tuart	544.309905	3	
69	388406.78186	6430707.86815	426	Tuart	655.718366	3	
70	388414.64223	6430721.25938	427	Jarrah	754.39443	3	
71	388431.88121	6430721.44961	428	Tuart	738.478936	3	
72	388416.57644	6430742.34616	429	Jarrah	630.253575	3	
73	388426.71970	6430745.22985	430	Banksia	547.493004	3	
74	388427.79632	6430758.65709	431	Jarrah	585.690191	3	Y
75	388432.35599	6430772.34449	432	Banksia	442.450742	2	
76	388439.10555	6430775.41247	433	Jarrah	490.197225	2	Y
77	388453.10627	6430778.78218	434	Jarrah	732.112738	3	Y
78	388460.57156	6430785.29503	435	Jarrah	506.112719	3	Y
79	388464.80574	6430777.24818	436	Jarrah	436.084544	2	Y
80	388449.29037	6430757.45291	437	Tuart	674.816959	3	
81	388440.95411	6430770.11107	438	Jarrah	407.436654	2	Y
82	388360.47267	6430661.23473	439	Tuart	477.464829	2	Y
83	388354.04019	6430637.99172	440	Tuart	846.704297	4	
84	388368.39425	6430643.47200	441	Tuart	932.647967	4	
85	388370.98660	6430647.60284	442	Tuart	709.831046	3	
86	388377.07053	6430651.21787	443	Tuart	420.16905	2	
87	388376.42944	6430658.08478	444	Tuart	592.056388	3	
88	388376.40007	6430660.74535	445	Tuart	722.563442	3	
89	388364.50253	6430663.16403	446	Tuart	888.084582	4	
90	388362.53903	6430653.27485	447	Tuart	763.943727	3	

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
91	388375.20601	6430666.49745	448	Tuart	709.831046	3	
92	388387.15482	6430710.64503	449	Tuart	868.985989	4	
93	388407.33727	6430751.44646	450	Tuart	993.126845	4	
94	388400.94863	6430758.36081	451	Jarrah	432.901445	2	
95	388415.63199	6430785.24269	452	Banksia	569.774696	3	Y
96	388417.49281	6430795.90681	453	Banksia	522.028213	3	Y
97	388418.54616	6430794.36625	454	Jarrah	620.704278	3	Y
98	388423.72366	6430803.29303	455	Banksia	467.915533	2	Y
99	388422.74371	6430806.71921	456	Jarrah	407.436654	2	Y
100	388434.08106	6430795.31376	457	Jarrah	502.92962	3	Y
101	388449.44107	6430812.11382	458	Jarrah	627.070476	3	Y
102	388427.24836	6430825.39519	459	Tuart	1177.746579	4	
103	388432.23013	6430834.98503	460	Tuart	623.887377	3	Y
104	388432.88591	6430843.86192	461	Tuart	636.619772	3	Y
105	388432.85533	6430846.63335	462	Tuart	722.563442	3	
106	388433.13671	6430846.74733	463	Tuart	776.676122	3	
107	388435.45999	6430849.65560	464	Tuart	496.563422	2	
108	388452.75785	6430835.98760	465	Jarrah	477.464829	2	Y
109	388420.18074	6430868.22415	466	Tuart	770.309925	3	
110	388401.79027	6430861.36897	467	Jarrah	1040.873328	4	
111	388337.90303	6430717.19697	468	Banksia	429.718346	2	
112	388327.34520	6430700.67151	470	Banksia	401.070457	2	
113	388328.55527	6430684.94122	471	Jarrah	881.718385	4	
114	388333.80881	6430652.84673	473	Marri	728.929639	3	
115	388324.48661	6430643.87411	474	Jarrah	1200.028271	4	
116	388338.25715	6430642.47401	475	Banksia	452.000038	2	
117	388343.25711	6430650.40105	476	Banksia	436.084544	2	
118	388347.55599	6430670.62699	477	Marri	518.845114	3	
119	388337.26230	6430672.84160	478	Stag	528.394411	3	
120	388346.07196	6430677.04111	479	Marri	477.464829	2	

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
121	388339.87417	6430683.73578	480	Marri	490.197225	2	
122	388353.18095	6430707.27644	481	Marri	824.422605	4	
123	388346.26743	6430719.06327	482	Marri	464.732434	2	
124	388359.55105	6430736.17316	483	Marri	420.16905	2	
125	388360.96653	6430735.96705	484	Marri	445.633841	2	
126	388353.36059	6430742.20270	485	Marri	818.056407	4	
127	388363.57237	6430738.87846	486	Marri	588.873289	3	
128	388375.25954	6430746.99018	487	Jarrah	537.943708	3	
129	388374.27952	6430767.49044	488	Marri	598.422586	3	
130	388389.62473	6430777.08384	489	Banksia	452.000038	2	
131	388403.15808	6430788.65289	490	Banksia	416.985951	2	Y
132	388394.97098	6430813.39757	491	Jarrah	725.74654	3	Y
133	388417.89045	6430828.17457	492	Jarrah	572.957795	3	Y
134	388531.95570	6430830.76307	128	Jarrah	429.718346	2	
135	388513.30611	6430847.40980	129	Tuart	690.732453	3	
136	388510.70029	6430853.03548	130	Tuart	569.774696	3	
137	388507.65034	6430856.21710	131	Tuart	878.535286	4	
138	388510.16694	6430858.68400	132	Tuart	588.873289	3	
139	388521.91180	6430861.58525	133	Tuart	553.859202	3	
140	388521.61340	6430871.56032	134	Tuart	993.126845	4	
141	388536.77394	6430863.74476	135	Jarrah	464.732434	2	
142	388541.44745	6430867.12239	136	Jarrah	407.436654	2	
143	388539.88654	6430880.52053	137	Sheoak	458.366236	2	
144	388541.13085	6430887.29735	138	Jarrah	821.239506	4	
145	388534.76056	6430892.54893	139	Tuart	576.140894	3	
146	388543.67959	6430912.49308	140	Jarrah	907.183176	4	
147	388527.59029	6430910.54180	141	Tuart	674.816959	3	
148	388523.11250	6430906.50109	142	Tuart	709.831046	3	
149	388513.86831	6430907.50788	143	Tuart	639.802871	3	
150	388508.82653	6430903.35008	144	Jarrah	452.000038	2	

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
151	388512.39763	6430895.62851	145	Jarrah	1002.676141	4	
152	388505.45833	6430892.66936	146	Jarrah	432.901445	2	
153	388488.71468	6430907.34140	147	Jarrah	588.873289	3	
154	388498.41286	6430916.42886	148	Tuart	849.887396	4	
155	388511.68244	6430943.40586	149	Jarrah	464.732434	2	
156	388529.17608	6430929.07467	150	Jarrah	442.450742	2	
157	388550.27900	6430929.19641	151	Jarrah	585.690191	3	
158	388545.82820	6430931.25389	152	Jarrah	512.478917	3	
159	388536.80550	6430937.80668	153	Jarrah	464.732434	2	
160	388531.45542	6430935.97377	154	Jarrah	404.253555	2	
161	388542.90200	6430948.85007	155	Jarrah	636.619772	3	
162	388557.30791	6430949.67406	156	Banksia	572.957795	3	
163	388556.51505	6430944.67615	157	Jarrah	515.662016	3	
164	388548.09069	6430956.77907	158	Banksia	432.901445	2	
165	388543.93360	6430966.37899	159	Banksia	490.197225	2	
166	388543.10531	6430964.59593	160	Tuart	531.57751	3	
167	388553.89727	6430968.48448	161	Banksia	429.718346	2	
168	388557.17270	6430987.59032	162	Jarrah	426.535247	2	
169	388555.66067	6430996.55417	163	Jarrah	467.915533	2	
170	388549.07149	6431013.11214	164	Jarrah	1050.422624	4	
171	388557.20242	6431010.54086	165	Banksia	455.183137	2	
172	388565.15471	6431007.08063	166	Jarrah	477.464829	2	
173	388570.61262	6431016.23216	167	Jarrah	436.084544	2	
174	388567.33880	6431022.62658	168	Jarrah	413.802852	2	
175	388568.11702	6431028.95478	169	Jarrah	837.155001	4	
176	388567.83074	6431029.28424	170	Jarrah	493.380324	2	
178	388569.01143	6431033.28859	172	Jarrah	604.788784	3	
179	388560.27250	6431039.73365	173	Tuart	1356.000115	5	
180	388540.64755	6431059.36320	174	Jarrah	490.197225	2	
181	388533.08303	6431061.82985	175	Marri	732.112738	3	

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
182	388527.87119	6431064.54416	176	Marri	487.014126	2	
183	388537.02108	6431046.46224	177	Banksia	471.098632	2	
184	388538.76383	6430999.47232	178	Jarrah	401.070457	2	
185	388539.79996	6430990.94670	179	Jarrah	413.802852	2	
186	388532.24238	6430958.60005	180	Jarrah	439.267643	2	
187	388521.77104	6430959.81507	181	Stag	1276.422644	5	
188	388514.96379	6430953.42040	182	Jarrah	413.802852	2	
189	388506.94901	6430945.46022	183	Jarrah	416.985951	2	
190	388490.23813	6430940.06504	184	Banksia	442.450742	2	
191	388482.20144	6430942.63731	185	Jarrah	1034.50713	4	
192	388479.04862	6430938.05684	186	Tuart	649.352168	3	
193	388474.35676	6430936.34204	187	Tuart	728.929639	3	
194	388484.91855	6430926.92364	188	Jarrah	410.619753	2	
195	388497.17773	6430840.46886	189	Tuart	837.155001	4	
196	388497.48249	6430855.55063	190	Tuart	553.859202	3	
197	388485.50149	6430848.43366	191	Tuart	783.04232	3	
198	388460.84587	6430837.29640	192	Banksia	439.267643	2	
199	388449.74702	6430835.62177	193	Jarrah	487.014126	2	Y
200	388455.53992	6430840.00963	194	Tuart	598.422586	3	
201	388441.24189	6430855.04118	195	Banksia	404.253555	2	
202	388458.77476	6430862.77380	196	Stag	1196.845172	4	
203	388449.79127	6430882.85316	197	Tuart	448.81694	2	
204	388460.82781	6430890.18150	198	Jarrah	397.887358	2	
205	388447.52438	6430908.99363	199	Stag	1005.85924	4	
206	388462.53947	6430905.83314	200	Sheoak	416.985951	2	
207	388483.35966	6430897.41486	201	Tuart	407.436654	2	
208	388488.35110	6430880.50670	202	Tuart	989.943746	4	
209	388474.12947	6430974.03554	203	Marri	658.901464	3	
210	388474.37663	6430977.25352	204	Jarrah	579.323993	3	
211	388475.91337	6430991.68365	205	Marri	496.563422	2	

Tree Number	Eastings (UTM GDA 94 Zone 50)	Northings (UTM GDA 94 Zone 50)	DGPS Reference Number	Species	DBH	Size Category	Fire
212	388473.26471	6431001.18931	206	Marri	499.746521	2	
213	388475.91357	6431017.29476	207	Marri	576.140894	3	
214	388483.95751	6430996.98328	208	Marri	509.295818	3	
215	388502.07160	6430986.20683	209	Marri	1604.281826	5	
216	388505.85491	6431027.60328	210	Stag	967.980364	4	
217	388508.87294	6431010.22987	211	Jarrah	738.478936	3	
218	388513.07417	6431005.17614	212	Jarrah	407.436654	2	
219	388500.47423	6431028.54179	213	Marri	404.253555	2	
220	388503.23333	6431051.74417	214	Marri	436.084544	2	
221	388515.02374	6431059.08075	215	Jarrah	445.633841	2	
222	388570.47136	6431054.70270	216	Marri	420.16905	2	
223	388515.20359	6431059.85882	216	Banksia	416.985951	2	
224	388576.56904	6431057.09817	217	Jarrah	436.084544	2	
225	388570.47395	6431063.01802	218	Banksia	429.718346	2	
226	388566.47472	6431075.39145	219	Tuart	849.887396	4	Y
227	388573.52424	6431076.91045	220	Tuart	1088.619811	4	
228	388572.67517	6431077.01196	221	Tuart	827.605704	4	
229	388572.79640	6431083.11118	222	Jarrah	537.943708	3	
230	388556.32905	6431098.34073	223	Marri	725.74654	3	
231	388544.31363	6431102.86488	224	Marri	954.929659	4	
232	388506.86352	6431072.84961	225	Jarrah	531.57751	3	Y
233	388507.53189	6431106.22903	226	Marri	525.211312	3	
234	388560.81916	6431101.27285	227	Jarrah	579.323993	3	
235	388571.64211	6431119.46401	228	Marri	703.464848	3	
236	388583.11827	6431129.67967	229	Marri	557.042301	3	
237	388573.15337	6431136.22212	230	Marri	563.408499	3	
238	388583.82217	6431151.30719	231	Marri	786.225419	3	Y
239	388578.76834	6431165.33207	232	Jarrah	1107.718404	4	
240	388573.60670	6431172.03830	233	Tuart	442.450742	2	
241	388565.99813	6431178.49583	234	Marri	725.74654	3	

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Fauna and Vegetation Management Plan- Kwinana Town Centre

Prepared for:

Department of Housing/ Satterley Property Group

March 2014

people planet professional

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Appendix A Summary of Mitigation Measures

1 Introduction

1.1 Background

The Department of Housing and Satterley Property Group proposes to develop the portion of land known as E26 (Challenger Precinct) Kwinana Town Centre (the site). The site is approximately 36 hectares (ha) and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road (Figure 1). The majority of the site is uncleared bushland. The site is proposed to be developed to a mix of residential densities with some commercial sites in the northern portion.

Town of Kwinana require a Fauna and Vegetation Management Plan as part of the implementation requirements for the Local Structure Plan (LSP) report.

1.2 Objectives

The objective of the Fauna and Vegetation Management Plan is to protect and minimse impacts to fauna and vegetation during the development of the site.

1.3 Scope

This plan is required to outline appropriate fauna and vegetation management including timing and minimal acceptable requirements to be implemented during development of the site. The scope of the plan includes:

- A review of relevant legislation;
- An outline of Flora and Vegetation Management Strategies;
- An outline of Fauna Management Strategies.

1.4 Report Format

This Report has been structured in the following format:

- Section 1. Introduction;
- Section 2. Existing Environment;
- Section 3. Legislative Requirements;
- Section 4. Flora and Vegetation Management;
- Section 5. Fauna Management;
- Section 6. Implementation;
- Section 7. Limitations; and
- Section 8. References.

2 Existing Environment

2.1 Regional Context

The Project area lies within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion. The Swan Coastal Plain subregion is classified as a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on outwashed plains and paperbark in swampy areas.

2.2 Climate

The climate is classified as warm Mediterranean and rainfall ranges between 600 and 1000 millimetres (mm) annually. The closest official Bureau of Meteorology (BoM) weather station currently operating is Medina Research Station where climate data is available between 1983 and 2012. The annual average rainfall at the site is approximately 762.2 mm per annum.

2.3 Geology

The site is located on the Bassendean Dune and Sandplain System. This consists of leached grey, siliceous Pleistocene sand dunes with well drained grey sands (Gozzard 1983). The sediment is composed of Quaternary deposits which are unconsolidated or lithified. The area occurs within the Quindalup soil unit, which consists of calcareous sands (Gozzard 1983). The predominant geology of the project site is limestone and calcrete (Department of Water 2012).

2.4 Hydrology

The Perth Groundwater Atlas indicates that the ground water below the site ranges between approximately 5 and 10 m below the ground surface (Department of Water 2012b). The sandy nature of the soils of this area result in good drainage of surface waters into the groundwater table (Department of Water 2012). The major aquifers in the area which have influences on the project area are Yarragadee north, Leederville, Superficial Swan and Rockingham Sand.

3 Relevant Guidance and Legislative Requirements

Fauna, flora and vegetation on the site is protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the State *Wildlife Conservation Act 1950* (WC Act).

3.1 Commonwealth Legislation

The EPBC Act is the primary commonwealth environmental legislation affecting the development. The EPBC Act facilitates the protection and management of nationally and internationally important fauna, flora, ecological communities and heritage places. It aims to facilitate the protection of the environment, particularly with regard to Matters of National Environmental Significance including:

- World Heritage sites;
- National Heritage places;
- Wetlands of international importance (Ramsar wetlands);
- Threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas;
- The Great Barrier Reef Marine Park; and
- Nuclear actions.

3.2 State Legislation

The WC Act was developed for the conservation and protection of wildlife in Western Australia. Under Section 14 of the Act, all native fauna and flora within Western Australia is protected. The Minister may, declare a list of taxa that are in need of special protection. The current listing was gazetted on the 17 February 2012 (Government of Western Australia 2012).

The following other environmental legislation and regulations will apply and will be adhered to at the Site:

- *Environmental Protection Regulations 1987;*
- *Environmental Protection (Noise) Regulations 1997;*
- *Environmental Protection (Unauthorised Discharges) Regulations 2004;*
- *Environmental Protection Act 1986;*
- *Contaminated Sites Act 2003;*

- *Contaminated Sites Regulations 2006;*
- *Bush Fires Act 1954;*
- *Conservation and Land Management Act 1984;*
- *Local Government Act 1995;*
- *Rights in Water and Irrigation Act 1914*; and
- *Aboriginal Heritage Act 1972.*

4 Flora and Vegetation Management

4.1 Flora and Vegetation

A flora and vegetation survey was undertaken on 20 September and 9 October, 2006. 110 species of native flowering plants and two native Gymnosperms (one native cycad (the Zamia Palm, *Macrozamia riedlei*) and one native pine (*Callitris canescens*) were recorded from the survey area. In addition, a high number of weed species (37) were recorded from the survey area. A relatively low number of annual or ephemeral native plants (particularly herbs) were recorded during the survey.

No Declared Rare Flora (DRF) species were recorded in the survey area during the survey work carried out for this report. No Priority species were recorded during the survey. No other species recorded in the survey area were considered of special conservation significance.

Nine vegetation units were defined and mapped for the survey area (Figure 2). These could be classified into four broader vegetation groups: Jarrah Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands. The Tuart woodlands included Jarrah and Banksia elements and are therefore closely related to the Jarrah Banksia woodlands group. The Jarrah-Banksia vegetation units covered the largest part of the survey area. The vegetation communities are not Threatened Ecological Communities (TEC) or Priority Ecological Communities (PEC).

The condition of vegetation in the survey area was mostly in the range of 'Good' to 'Very Poor'. Some 'Completely Degraded' areas were also recorded. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover. Perennial veldt grass (**Ehrharta calycina*) formed a grassland and sometimes a closed grassland over most of the survey area and was the most dominant and widespread weed.

Further flora and vegetation surveys will be undertaken in 2012 to update the 2006 results.

4.2 Impacts and Mitigation Measures

There are a number of mitigation measures relating to flora that will be undertaken in order to protect native vegetation. A full list of flora mitigation measures are outlined in Appendix A. They include;

- Identification of flora and vegetation though surveys;
- Design of LSP to minimise clearing;
- Soil management;
- Development and implementation of clearing protocols;

- Landscaping and Revegetation; and
- Provision of offsets.

4.2.1 Design of LSP

The LSP has been designed to minimise habitat losses associated with clearing of native vegetation and remnant trees in particular potential Black Cockatoo habitat. In development of the LSP, larger habitat trees and densities were considered to enable stands to be retained in Public Open space (POS).

4.2.2 Soil Management

Appropriate soil management for weeds and pathogens is required to prevent the spread of disease and protect the vegetation retained on site. Dieback is fatal disease found in soils caused by the pathogen *Phytophthora cinnamomi*. It attacks at least 25% of flora species in the south-west. The site has indications of the occurrence of Phytophthora dieback. There is also a large amount of weed cover recorded at the site (360 Environmental 2011). Therefore the following management strategies will be implemented for dieback and weeds;

- Any soil, mulch or fill to be imported will be certified as dieback and weed free prior to its delivery to site;
- Bulk earthworks activities will be scheduled for dry soil conditions where possible will reduce the spread of pathogens such as Phytophthora dieback;
- Earth moving machinery should be inspected upon arrival to ensure it is free from excessive vegetative matter and soil;
- Topsoil movement between sites will be restricted with sites with significant weeds or pathogens;
- Topsoil from areas of high weed density will be isolated and will remain at the source location;
- Phosphite is a chemical that can be used in the management of *P*hytophthora dieback. It is a biodegradable fungicide that protects plants against *Phytophthora cinnamomi.* It can be injected or sprayed and works by boosting the plant's natural defence. Phosphite may be used if required.

4.2.3 Clearing Protocols

Clearing protocols will be implemented to minimise the impacts of vegetation clearing on fauna in the area. Staged clearing will be considered and utilised if appropriate. During this process, all vegetation with the exception of habitat trees (which will be flagged for retention) will be removed. Habitat trees will be left overnight before being disturbed. This will allow any tree-dwelling fauna to escape to surrounding bushland overnight.

Vegetation to be retained shall be in accordance with AS 4970 retention of trees on development sites.

Road reserves and POS shall remain vegetated (shall not be cleared) until the City of Kwinana has had opportunity to identify trees and vegetation worthy of retention. Trees identified for retention throughout the LSP area will be protected from trunk and root damage in accordance with AS 4970 – 2009. Significant trees identified for retention that are damaged and need to be removed shall be replaced with a similar species of appropriate size.

Table 1 outlines the procedure in detail.

Table 1: Vegetation Clearing Procedure

STEP 1: DELINEATE VEGETATION TO BE CLEARED
A survey will be conducted to define the area of vegetation that will be cleared with the use of pegs, fencing or flagging tape.
STEP 2: PRE-CLEARING INSPECTION OF VEGETATION
• Within two days prior to clearing, habitat trees and potential hollow-bearing trees and other fauna containing habitat trees will be clearly marked to allow for staged clearing. • Prior to clearing, an appropriately trained/experienced staff member will check for the presence of fauna or active nests within the clearing area. • Fauna trapping programme to be documented and implemented to the satisfaction of the City of Kwinana. • Where possible, any animals found will be relocated to a suitable offsite location, in particular mammals and nesting birds.
STEP 3: REMOVE VEGETATION
• Clearing must only occur within the delineated area. • Habitat trees should be retained wherever possible. • Staged clearing will be considered such that trees other than habitat trees are cleared and habitat trees are left overnight before being cleared (as described above). • As a matter of best practice, to minimise disturbance to black cockatoos and other breeding birds, clearing should be undertaken outside of the spring months where practical (September, October and November) and any identified active nests should be relocated to a suitable location. • Any injured fauna encountered during clearing should be managed according to the fauna handling and rescue procedure (Table 4). • Felled hollow bearing trees will be inspected by a qualified person. • Where possible, habitat components of felled trees will be salvaged. • No cleared vegetation will be burnt. • Cleared native vegetation will be chipped and retained on site for rehabilitation and

landscaping.
STEP 4: POST-CLEARING INSPECTION
Post-clearing inspections will be carried out.

4.2.4 Landscaping and revegetation

Appropriate landscaping and revegetation methods will be used to ensure remaining native vegetation on site is enhanced. Landscaping will be undertaken on site in accordance with the Landscaping strategy. A number of Black Cockatoo habitat species will be included in the plantings.

During the rehabilitation process, topsoil removed during the clearing process will be stockpiled and replaced in the area from which it was removed where possible.

Prior to bulk earth works, seeds will be collected from native species within the project site. These seeds can then be used by the Department of Environment and Conservation (DEC) or the Town of Kwinana (TOK) for use in revegetation/rehabilitation projects in nearby parks and reserve areas.

5 Fauna Management

5.1 Fauna

A search of the DEC's (2012c) *Threatened and Priority Fauna database* has indicated several threatened or priority fauna have been recorded within a 5 km radius of the site, as follows:

- *Calyptorhynchus latirostris* (Carnaby's Black-Cockatoo) –Threatened;
- *Charadrius rubricollis* (Hooded Plover) – Priority 4;
- *Falco peregrines* (Peregrine Falcon) – Specially Protected;
- *Hydromys chrysogaster* (Water rat) – Prirority 4;
- *Isoodon obesulus subsp. fusciventer* (Quenda) – Priority 5;
- *Lerista lineata* (Lined Skink / Perth Slider) – Priority 3;
- *Macropus Irma* (Western Brush Wallaby) – Priority 4;
- *Neelaps calonotos* (Black-striped Snake) – Priority 3;
- *Notoscincus butleri* (Lined Soil Crevice Skink) – Priority 3; and
- *Tiliqua rugosa subsp. konowi* – Threatened.

A search of SEWPAC's (2012) *Protected Matters Search Tool* was undertaken and identified five vulnerable, three endangered and five migratory species listed under the EPBC Act as potentially occurring within three kilometres of the site:

- *Calyptorhynchus banksii naso* (Forest Red Tailed Black Cockatoo) – Vulnerable – species or species habitat likely to occur within area;
- *Calyptorhynchus latirostris* (Carnaby's Black Cockatoo) – Endangered – species or species habitat likely to occur within area;
- *Leipoa ocellata* (Malleefowl) – Vulnerable/Migratory – Species or species habitat may occur within area;
- *Rostratula australis* (Australian Painted Snipe) – Vulnerable/Migratory – Species or species habitat may occur within area;
- *Sternula nereis nereis* (Fairy Tern) – Vulnerable – Species or species habitat known to occur within area;
- *Synemon gratiosa* (Graceful Sun Moth) – Endangered – species or species habitat likely to occur within area;
- *Dasyurus geoffroii* (Chuditch, Western Quoll) – Vulnerable – Species or species habitat likely to occur within area;

- *Phascogale calura* (Red-tailed Phascogale) – Endangered – Species or species habitat may occur within area;
- *Setonix brachyurus* (Quokka) – Vulnerable – Species or species habitat may occur within area;
- *Apus pacificus* (Fork-tailed Swift) – Migratory – species or species habitat likely to occur within area;
- *Ardea alba* (Great Egret) – Migratory – species or species habitat likely to occur within area;
- *Ardea ibis* (Cattle Egret) – Migratory – species or species habitat likely to occur within area;
- *Haliaeetus leucogaster* (White-Bellied Sea Eagle) – Migratory – species or species habitat likely to occur within area; and
- *Merops ornatus* (Rainbow Bee-eater) – Migratory – species or species habitat likely to occur within area.

Due to the modified environment it is considered unlikely that many of these species rely on the site for habitat or feeding.

Of the bird species listed, the cockatoo species are the most likely to be present as there are mature eucalypts and banksias present on the site. These trees are utilised by cockatoo species for nesting and feeding habitat.

The flora and vegetation survey observed at least six native flora species that are known to be utilised by Carnaby's Cockatoo as a food source. The flora species observed are:

- *Xanthorrhoea preisssii* (seed);
- *Allocasuarina fraseriana* (seed);
- *Banksia attenuata* (seed, flower, invertebrates associated with flora species);
- *Banksia grandis* (seed, flower);
- *Hakea prostrate* (seed); and
- *Acacia salinga* (bark, invertebrates associated with flora species).

During a Level 1 Fauna Survey Conducted by 360 Environmental in 2012 (360 Environmental 2012a), three species of conservation significance were recorded at the Site. These were:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris);*
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso); and*
- Quenda *(Isoodon obesulus)*

Due to the likely presence of Quenda (see Figure 2 360 Environmental 2012a) it is recommended that a species specific monitoring program be conducted to assess the abundance of Quenda at the site. It is also recommended that a fauna removal specialist relocate all Quenda present prior to clearing.

5.1.1 Targeted Black Cockatoo Survey

A targeted black cockatoo survey was undertaken across the site in March 2009 (360 Environmental 2009). The survey included traversing the site to identify and confirm the presence/absence of site usage by black cockatoos. The results indicate the site is utilised by both Carnaby's Black Cockatoo and the Forest Red-Tailed Black Cockatoo for feeding and potentially also for nesting. There was evidence of extensive Red-tailed Black Cockatoo feeding on Marri and there were also several records of Carnaby's Black Cockatoo feeding on *Banksia*. An unoccupied hollow was found in a Marri tree, and another Marri tree showed signs of use as a roost site. Three possible breeding hollows were located at the site (360 Environmental 2009).

A more recent Black Cockatoo survey was undertaken in 2012 (360 Environmental 2012b). This survey recorded only one suitable nesting hollow for Black Cockatoos and no evidence of Black Cockatoo breeding was found. Suitable feeding species and sparse evidence of feeding debris was recorded at the site. Evidence of a small roost site was also found. During the survey, three Red-tailed Black Cockatoos were observed flying over the site, thirty Carnaby's Black Cockatoo were observed in a garden just outside the site and seven Carnaby's Black Cockatoos were observed on *Banksia attenuata* trees along Meares Avenue (see Figure 2 - 360 Environmental 2012b).

The survey also recorded a number of habitat trees for Black Cockatoos and it is recommended that as many of these are retained as possible (see Figure 2 - 360 Environmental 2012b).

5.1.2 Graceful Sun Moth Survey

A survey methodology following DEC Graceful Sun Moth Information Kit and Survey Methods Version 1.2 (Nov 2010) was undertaken at the site in 2010 and no Graceful Sun Moths were recorded (360 Environmental, 2010).

5.2 Impacts and Mitigation Measures

The development of the site will result in some loss of fauna habitat which may be used for foraging, breeding, roosting or dispersal. This impact to fauna can be reduced by minimising the project's footprint where possible. A full list of fauna mitigation measures are outlined in Appendix A. There are a number of measures that have been undertaken in order to minimise the impacts to fauna from the development. They include;

- Identification of fauna species through surveys;
- Removal or relocation of fauna;

- Design of LSP to minimise clearing of habitat;
- Development and Implementation of clearing protocols;
- Landscaping and revegetation; and
- Provision of offsets through the purchase of land containing appropriate habitat.

5.2.1 Design of LSP to minimise clearing of habitat

Following fauna surveys design of the LSP considered the quality of habitat and breeding hollows on the site. Design of several ecological linkages though the site will enable fauna to move though portions of the site and to adjacent bushlands. The design of the site and bulk earthworks plan was developed to minimise clearing of Black Cockatoo habitat on site.

5.2.2 Removal or relocation of fauna

Prior to clearing, each large tree should be inspected for the presence of hollows and fauna such as birds occupying them. Any fauna present will be removed and relocated by authorised personnel. Whenever possible, a suitable qualified person will be employed to conduct trapping and relocation of any fauna caught. Any fauna relocated, should be monitored by trapping to ensure survival in their new habitat.

5.2.3 Development and Implementation of clearing protocols

Clearing protocols will be implemented to minimise the impacts of vegetation clearing on fauna in the area. Staged clearing will be considered were appropriate. During this process, all vegetation with the exception of habitat trees will be removed. Habitat trees will be left overnight before being disturbed. This will allow any tree-dwelling fauna to escape to surrounding bushland overnight. Table 3 outlines the procedure in detail.

5.2.4 Fauna Handling and Rescue

During clearing, if injured or shocked animals are encountered, the process applying in Table 2 should be taken.

Table 2: Fauna Handling and Rescue Procedure

STEP 1: STOP WORKS	
Stop all work in the immediate vicinity of the animal and notify the relevant environmental staff. A relevant and qualified person should attend the site to undertake any necessary fauna handling and advice from this person will be followed. The location of the animal should be recorded and provided to the appropriate rescue agency. Any animals encountered should be relocated to a suitable offsite location.	
STEP 2: RELOCATE FAUNA	
Small uninjured animals	The animal should be removed by a qualified person and relocated to a suitable area with a similar habitat as close as

	possible to where it was found.
Small injured animals	The animal should be removed by a qualified person and placed in an enclosed box. Environmental Staff should be present during clearing and any injured fauna should be treated by veterinarian.
Large uninjured animals	Large native animals are unlikely to occur on site. However, large fauna should be relocated to a suitable offsite location prior to any clearing.
Large injured animals	Large injured animals will need to be dealt with on a case to case basis. If the animal is safe to approach, it should be placed in appropriate coverings and relevant and qualified environmental staff should be contacted to remove the animal. Critically injured animals may be euthanized on site under the advice of DEC.
STEP 3: THREATENED SPECIES	
If the animal encountered is identified as a species of conservation significance, all work likely to affect the species should cease. Relevant environmental staff should be contacted to determine appropriate corrective actions and additional safeguards that need to be implemented.	

5.2.5 Landscaping and Revegetation

Appropriate landscaping and revegetation methods will be implemented to enhance remaining native vegetation and habitat. Local native provenance seedlings to be preferentially used in landscaping. Landscaping will be undertaken on site in accordance with the Landscaping Strategy. A number of Black Cockatoo habitat species will be included in the plantings. Appropriate weed control to be undertaken by a suitable weed control contractor to prevent off target spray impacts.

5.2.6 Provision of offsets through the purchase of land containing appropriate habitat

Offset are being developed for the clearing of Black Cockatoo habitat in accordance with SEWPAC requirements.

6 Plan Implementation

The success of the Fauna and Vegetation Management Plan requires leadership to continuously promote best practice environmental management and to make the people and resources available to achieve the plan's objectives. Management will ensure the continuing suitability, adequacy and effectiveness of the Fauna and Vegetation Management Plan requires by reviewing it at regular intervals throughout the project.

An important component of the overall site management is the integration and communication of the requirements of this Fauna and Vegetation Management Plan to the wider workforce. The following process tools and management controls outline this communication.

6.1 Roles and Responsibilities

The Project Manager is responsible to ensure the vegetation management plan is implemented in accordance with commitments. Table 3 outlines the role and responsibilities.

The HSE Manager will be responsible for ensuring that all staff undergo an environmental training and awareness program and are aware of the Fauna and Vegetation Management Plan before commencing work. Staff will also be aware of the significance of remnant vegetation and methods to minimise impacts to it. All personnel handling fauna must have the appropriate training and authorisation. A Regulation 17 licence must also be obtained for the capture of fauna.

Records must be kept and presented as part of the compliance and monitoring reporting for the Fauna and Vegetation Monitoring Plan.

Table 3: Roles and Responsibilities

POSITION	RESPONSIBILITY
Project Manager	Ensuring all the requirements of the Fauna and Vegetation Management Plan are met.
Site HSE Manager	Maintain site records of surveys/trapping and arrange monitoring programs as required.
Authorised Fauna Relocator	Trapping, capture and relocation of fauna prior to clearing.
Employees, contractors and visitors	Reduce any impacts on fauna resulting from the operation of the project and report sightings of any fauna in need of relocation.

6.2 Training and Inductions

The site manager for Ace Nominees will be responsible for ensuring that environmental training and awareness programs are provided to all staff and contractors Awareness training will cover the key components of this Fauna and Vegetation Management Plan to ensure all personnel are aware of their obligations with respect to environmental responsibilities, any significant environmental risks, and of their requirements under relevant legislation and regulations.

A site induction shall be provided by the Site Manager to all contractor personnel and other personnel involved in construction activities prior to commencing work on site. Records of environmental training undertaken for all employees will be kept on site, detailing the type and purpose of the training.

7 Limitations

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

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

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

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

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8 References

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FIGURES



Legend

- Lot E26
- Cadastral Boundary

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- CADASTRAL BOUNDARY SOURCED FROM LANDGATE 2008
- TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2008

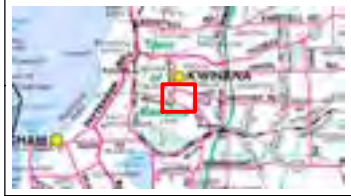
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LOCALITY MAP



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SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Kwinana Town Centre Fauna and Vegetation Management Plan
Site Location

Figure 1



Jarrah-Banksia woodlands

Em *Eucalyptus marginata* subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, Acacia pulchella scattered shrubs over *Gompholobium tomentosum*, *Hibbertia hypericoides* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* very open grassland with *Conostylis aculeata* very open herbland.

EmBa (*Eucalyptus gomphocephala* scattered trees over) *Eucalyptus marginata* subsp *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmocladus aspera*, *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* (perennial veldt grass) open grassland to grassland.

EmAf *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over Acacia pulchella, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre*, *Lupinus blue very open herbland.

EgEm *Eucalyptus gomphosephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* (=KM2-10) scattered tall shrubs over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladus aspera* very open sedgeland and *Conostylis aculeata* very open herbland.

Tuart woodlands

Eg *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preisii* high open shrubland over *Macrozamia riedlei* and *Acacia pulchella* open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* open herbland.

Marri woodlands

Cc *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon* ? prop scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Limestone shrublands

Gv *Grevillea vestita* subsp. *vestita* heath over *Desmocladus aspera* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

EgDs *Eucalyptus gomphocephala* scattered trees over Dryandra sessilis high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

AfDs (*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, Dryandra sessilis scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over Acacia pulchella, Pimelea rosea, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* very open herbland.

Legend

Lot E26

Vegetation Units

- Jarrah-Banksia woodlands
- Limestone shrublands
- Marri woodlands
- Tuart woodlands
- Completely Degraded

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
-TRAVELLER'S ATLAS SOURCED FROM LANDGATE 2006

SCALE

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Metres

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LOCALITY MAP



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SATTERLEY PROPERTY GROUP
LOT E26, KWINANA

Kwinana Town Centre Fauna and Vegetation Management Plan
Vegetation Communities

Figure 2

APPENDIX A

Summary of Mitigation Measures

Summary of Flora and Fauna Management Strategies

MANAGEMENT STRATEGY	PURPOSE	MINIMUM STANDARD	TIMING
Flora			
Undertake flora surveys.	Identification of conservation relevant flora or vegetation.	In accordance with EPA Guidance Notes.	Prior to LSP design.
Design of LSP.	Incorporate survey information to minimise clearing of flora and vegetation.	Town of Kwinana Biodiversity Strategy.	Design Phase.
Implement clearing protocol.	Ensure clearing is conducted in an appropriate manner.	Clearing protocol. As 4970 retention of trees on development sites must be adhered to.	During bulk earthworks.
Soil or fill to be certified as dieback and weed free.	Prevent spread of weed and phytophthora dieback.		Prior to bulk earthworks.
Earthworks to be conducted in dry soil conditions where possible.	Prevent spread of phytophthora dieback in runoff.		During bulk earthworks.
Earth moving machinery should be inspected upon arrival.	Prevent introduction of weeds in area.	Inspect when any new machinery is bought on site.	Prior to and during bulk earthworks.
Isolate weed infested top soil.	Prevent reinfestation of weeds in area.	All weeds on the Kwinana Pest Plants local Law shall be removed from the area of	During bulk earthworks.

MANAGEMENT STRATEGY	PURPOSE	MINIMUM STANDARD	TIMING
		works.	
Restriction of topsoil movement between sites.	Prevent spread of phytophthora dieback to other sites.		During bulk earthworks.
Implement ongoing weed control.	Prevent reinfestation of weeds in area.	Appropriate weed control to be undertaken by a suitable weed control contractor to prevent off target spray impacts. Off target impacts will be required to be revegetated and assessed as part of practical completion of works.	Post construction.
Select use of phosphite in POS areas.	Improve natural plant defence to Phytophthora dieback in POS areas.		During bulk earthworks.
Replace topsoil in landscaping/ rehabilitation where practicable.	Improve soil health and seed bank.		Post bulk earthworks.
Allow seed collection prior to clearing.	To use seeds in rehabilitation efforts by Town of Kwinana or DEC.	Seed collect guidelines.	Prior to clearing.
Fauna			
Undertake fauna surveys.	Identify absence or presence.	In accordance with EPA Guidance Notes.	Prior to LSP design.
Design of LSP.	Incorporate survey information to minimise clearing of habitat.	Town of Kwinana Biodiversity Strategy.	Design Phase.
Removal or relocation of fauna.	Minimise impact to fauna.	A detailed relocation plan will be developed for terrestrial	Prior to clearing.

MANAGEMENT STRATEGY	PURPOSE	MINIMUM STANDARD	TIMING
		fauna. The plan will outline the trapping methods to be used, timing of trapping, and species to be targeted. The results of the relocation plan will include the number of individuals for each species relocated and where they were moved to. And a monitoring programme for relocated species will be included.	
Implement clearing protocol.	Ensure clearing is conducted in an appropriate manner.	Clearing protocol.	During bulk earthworks.
Appropriate management of injured fauna.	To minimise impact to native fauna.	Fauna handling and rescue procedure.	Construction.
Plant Black Cockatoo appropriate habitat species in landscaping.	Increase remaining habitat.	In accordance with SEWPAC Guidance.	Following earthworks.
Develop offsets.	Preserve Black Cockatoo habitat.	Agreement with regulator.	Prior to construction.

30 May 2011

Satterley Property Group
PO Box 429
Joondalup WA 6919

Attention: **Paul Easthope**
Cc: **Shane Caddy (Emerge)**

RE: **Tree Survey Assessment; Areas proposed for POS; Kwinana E26**

Dear Paul,

Further to your request, please find enclosed a copy of the report of my findings from the inspection of the trees found in the areas proposed for public open space of the Kwinana E26 development.

I look forward to continuing to aid the design team as the development process continues and should you have any queries regarding the findings of this report, or if I can be of any further assistance, please do not hesitate to contact me.

Yours sincerely



Jason Royal

Dip. Arboriculture (UK)
Tech. Arbor A

Preliminary Tree Survey Assessment

Areas proposed for Public Open Space; Kwinana E26

Prepared For

Satterley Property Group

ARBOR logic

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3. Tree Risk/Hazard Assessment Page 3

4. Tree Assessment Methodology Page 4

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   POS 2 Pages 21 - 35
   POS 3 Pages 36 - 61
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   POS 5 Pages 68 - 80
   POS 6 Pages 81 - 101

6. Summary of Findings and Overall Opinion Pages 102 - 103

7. Company Information

8. Disclaimer Section

Executive Summary

Background

As part of the ongoing design of the development of the area known as E26, this consultant has been commissioned to undertake an inspection of the tree vegetation found in the six areas designated for public open space ("POS").

The main purposes of the inspection were to:

1. Identify any trees with a main stem calliper of 300mm or greater in diameter on the areas of proposed POS;
2. Provide information on the general physical condition (height, trunk calliper, canopy spread, current health, structural properties), and any comments considered pertinent to each of the identified trees;
3. Provide further broad-brush information on any design and/or construction implications that would likely be required to ensure that the retention and inclusion of any trees selected remains successful in the long term.

Key Findings

The key findings of the inspection show:

1. The areas of proposed POS are clearly dense areas of native tree vegetation and a total of 789 trees were identified in the six areas inspected.

   There are an equal number of smaller sized (younger) trees in the various areas of POS; particularly in POS 1 and POS 2.

2. The age, health and structural condition of the vegetation varies throughout the various POS areas, and many have clearly been affected by recent bushfire activity.

   However most show good signs of canopy/health recovery, and most should recover fully; albeit slowly over the next couple of years. Full recovery will however be very much dependent on seasonal rainfalls, if any further bushfire activity occurs, and what impact occurs as a result of development.

3. The majority of the identified trees were considered to be suitable for inclusion into POS, and a number of good quality mature tree specimens were identified in the various areas.

   Retention of as many of these better quality trees as possible is highly recommended.

4. However retention of all of the trees is not likely going to be a viable or achievable unless landscape in various areas of POS is proposed to be minimal; if any at all.

5. In some instances retention of some of the trees even in an area of POS may still be considered to be questionable; primarily due to their structural condition.

   However their retention will be very much dependent on detailed landscape design, and more specifically if any potential Targets (people, structures etc.) are proposed to be introduced into their projected fall zone by way of the landscape and development.

6. Whilst there are a number of what would be considered to be remnant vegetation trees in the various areas of proposed POS (i.e. trees in excess of 100 – 150 years of age), the retention of some of these trees will be very much dependent on the design of the POS not only minimising disturbance to their designated tree protection zone ("TPZ") areas, but also minimising the introduction or encouragement of potential Targets within their projected fall zones (primarily due to their structural condition).

7. To further aid in the design of the various POS areas, it is recommended that as a minimum the location of these trees, along with the better quality trees and the poor quality trees be surveyed and along with their designated TPZ area and overlayed onto all relevant detailed design plans.

   From this better management decisions on the various trees can be made as part of detailed design.

8. Any encroachment that is proposed to occur into the TPZ of any tree highlighted for retention must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines.

   In specific, further arboricultural input will likely be required during detailed design to discuss:

   8.1 Current existing ground levels and resulting levels of the area within the TPZ of any given tree. Note: Retaining and maintaining current existing ground levels within the designated TPZ of any tree is of paramount importance to the success of tree retention.

   8.2 Delineation of any underground services pipework; specifically should they pass through any designated TPZ.

   8.3 Final landscape of the area around any tree selected for retention (including the introduction of any potential Targets, delineation of any irrigation pipework or underground services, location of any hardscape structures, or softscape landscaping).

   8.4 In some instances Lot boundary treatment, and/or detailed design of any adjoining road may also have some bearing and impact on some of the trees in this POS.

9. Protection of the TPZ of any tree selected for retention during the construction of the POS areas will also still be a vital part of successful tree retention.

   TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical development works to ensure protection of trees selected for retention occurs.

   The details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

10. Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

    Extent of pruning for each tree will however be very much dependent on final detailed designs; specifically the introduction of any areas of potential Target in the fall zone of any given tree.

1. Purpose of the Report

Background/Scope

At the request Paul Easthope from Satterley Property Group I can confirm that I have been commissioned to undertake an inspection of six areas proposed for public open space ("POS") in the area currently known as E26 Kwinana ("Site").

The purpose of the inspection was to:

4. Identify any trees with a main stem calliper of 300mm or greater in diameter on the areas of proposed POS;
5. Provide information on the general physical condition (height, trunk calliper, canopy spread, current health, structural properties), and any comments considered pertinent to each of the identified trees;
6. Provide further broad-brush information on any design and/or construction implications that would likely be required to ensure that the retention and inclusion of any trees selected remains successful in the long term.

Limitations of the Assessment

The information and opinions provided in this document is based on the findings from the inspection of the Site during May 2011 and the interpretation of the plans provided; namely the landscape masterplan; a copy of which can be seen below.



The opinion provided on the future retention/management of each of the identified trees has been taken with the extent of progression of the development already undertaken in mind.

During the assessment it was noted that there are a large number of other smaller juvenile and semi-mature trees throughout the areas of proposed POS. These trees were not included into this survey assessment due to their small size/stature (as these trees would be considered to be relatively readily replaceable).

Trees that either look to be clearly situated outside of the boundary's of the areas of proposed POS, or were dead (i.e. had either no live tissue remaining) were adjudged to have <5% live tissue remaining in their canopy were also not included as part of this assessment.

2. Tree Preservation and Protection as part of Development; an Overview

Tree preservation is an important part of responsible urban development, and protection often becomes a requirement where trees are found to be situated in an area proposed for development; even if it is an area of public open space where development is often far less than other areas.

As part of the protection of trees, it is of critical importance to understand their basic requirements.

It is important to note that it is the tree's absorbing root zone that is primarily responsible for the health, vigour, and overall aesthetic appearance of the trees canopy.

It is also important to note that this absorbing root zone is generally found in the initial 300 – 500 mm of the soil profile, where soil oxygen, water, and nutrient levels are at their highest. It is therefore essential that the retention of a suitable volume/area of this section of the soil profile becomes the primary concern when designing and constructing an area of development adjacent to existing trees desired to be retained. There must be a focus towards protecting an appropriate amount of a tree's root mass.

Through the advances of research it is also now known that there is also a wide variation in the tolerance of the various tree species to root disturbance, root loss or changes to the soil chemistry and is an area often misunderstood or ignored during a development process; often to the detriment of the tree.

Each individual tree must be allocated a 'zone of protection' or Tree Protection Zone ("TPZ") during all phases of the design and construction of the development.

Australian Standard Guidelines are available; AS 4970; Protection of Trees on Development Sites ("Standard"), and provide a good basis from which to work from.

However as is stated within Standard variations and encroachments in a tree's TPZ can occur; providing arboricultural input and further investigation has been undertaken to ascertain the level of encroachment, the potential impact on the tree, and what remedial measures need to be implemented if the tree is desired or required to be retained.

As such input from an arboricultural consultant is an integral and critical part of any successful tree preservation process; even if it is to be situated in an area where on landscape works are proposed to occur.

It is common occurrence for tree preservation strategies to be implemented once root zone damage has already occurred. However remedial efforts are often of little to no value (depending on the extent of damage that has been caused), and have proven to become a difficult, potentially expensive, and time consuming exercise to implement once the damage has occurred.

Successful preservation of trees on a development site must therefore begin at the design and planning stages of any development.

3. Tree Risk Assessment

Whilst the preservations of trees and the inclusion of existing trees into a development is of great importance, in view of the relevant legal and risk management responsibilities that are generally associated with tree 'ownership' tree risk and hazard assessment must become a primary deciding factor for the future of any tree if the development will result in the introduction of potential targets such as people, structures etc ("Target") within the fall range of any given tree.

All tree risk assessment should start with the identification of a potential Target within any given tree's likely fall range.

With the absence of any 'significant' potential Target, the tree is typically recommended to be left alone and/or managed in accordance with any best environmental practices adopted for the given area.

However, in areas where a large number of potential targets are found, or are likely to be introduced by way of the development of the area in which the tree is situated, then unless the tree is of particular note for its species and/or has significance with the history/heritage of the local area, site safety must become the primary deciding criteria for its future management.

The level of risk that is acceptable with any given tree will ultimately be governed by the tree 'owner', and their willingness to accept any foreseeable risks associated with any given tree[1].

There are also many variables that require consideration as part of this process including; the structure of the given specimen, its health, known species traits and environmental factors such as prevailing and storm winds and how they would affect the subject specimen tree, the occurrence (or likely occurrence) of potential Targets within the projected fall range, the size of part considered most likely to fail, the time that failure is considered most likely to occur, the presence of potential Targets when failure is most likely to occur, and what the consequences of failure would be if it were to occur.

[1] Note: It has been documented that the level of acceptance in terms of risk can be defined as 1:10,000, and systems are available to quantify the level of risk associated with any given tree. However this form of detail is generally considered beyond the need or scope of tree assessment in the context of a development; unless it is specifically requested by the local governing authority and or is required to resolve a dispute about the removal of a particular tree (in view of risk) on the site.

4. Tree Assessment Methodology

Methodology of the Assessment

Each of the identified trees within the various POS areas was visually inspected from ground level.

Health Condition

The overall health of each tree was adjudged from an inspection of its leaf, overall percentage of leaf mass present in the canopy of the tree, and the presence (or absence) of any pest or disease factor that could have an affect on the overall health of the tree.

Structural Condition

The structural integrity of each tree was determined from a visual inspection of its main stem, primary (and secondary) branch unions, and its root plate area.

The presence of cavities, decay, and/or any pathogen that could have an effect on the structural integrity of the tree is also taken into consideration as part of the assessment process.

Where considered necessary further investigation by way of the use of sounding techniques was utilised to determine the presence and general extent of any areas of cavity or associated decay within a tree's main stem structure.

Known Species Traits

Species suitability for use an urban area (particularly for use in a high density accommodation area) and if the identified specimen is of a species that can be subject to the sudden branch failure phenomenon was also considered as part of the assessment process.

With regards to any future development the known natural species traits of the given tree and its ability to cope with disturbances to its root zone that typically occur as part of a development process, as well as its ability to cope with the new parameters that are commonly created by an urban development (i.e. decreased soil oxygen due to compaction, increased un-seasonal watering from irrigation, increased pollution, increased radiated heat/light from urban infrastructure (roads, walls, buildings etc.) are all also taken into consideration.

The known root zone morphology of the species was taken into consideration when allocating the recommended TPZ for each of the identified trees. Note: Whilst some reference to the guidelines set down in AS 4970 is given, TPZ for each tree has been based on the known typical root zone morphology for specimens of their species, the condition of the given tree, and the known tolerance to root zone disturbance of the given species.

5. Key Findings of the Assessment

5. Key Findings of the Assessment; POS 1







General Comments

A total of 107 trees that met the specification criteria were identified in this area, and includes tree tag number 1 – 43, 45 – 62, 64 - 82, 879 - 885, and 896 - 915.

Age Class

Most of the trees identified in this area were adjudged to be semi-mature – 'young' mature trees; i.e. between 20-35 years old.

However there were an equal if not larger number of smaller sized trees in this POS, most of which may only be around the 10 – 20 years old.

There were some larger Tuarts that may be in the order of 60 - 80 years, and one very old tree; considered to be well in excess of 100 years of age, and so would probably be classed as 'remnant vegetation'.

Species Identified

The dominant species in this area included, Jarrah (*Eucalyptus marginata*), Tuart (*Eucalyptus gomphocephala*), Marri (*Corymbia calophylla*), Coastal Banksia (*Banksia attenuata*), Bull Banksia (*Banksia grandis*), and Common Sheoak (*Allocasuarina fraseriana*).

Jarrah was noted to be the dominant tree species in this POS.

5. Key Findings of the Assessment; POS 1

Health Condition

The majority of the trees in this area showed varying indications of canopy stress/ trauma typically associated with impact from bushfire activity and/or environmental issues such as poor seasonal rainfalls.

However a reasonably good volume of new foliage was noted on the majority of the trees, and given time most (if not all) could be expected to make a full recovery; albeit slowly over a number of years. Full extent of recovery and time frame taken will however be very much dependent on seasonal rainfalls, if any further bushfire activity occurs, and any impact from development.

There were no noticeable major pest/disease pathogens (i.e. *Phytophthora*) visible at the time of my inspection.

Structural Form

The majority of the trees in this POS showed to have what is considered to be typical structural form for specimens of their given species.

Whilst a few of the trees showed to have what are considered to be structural defects such as bi-furcated unions with some associated swelling, and/or areas of cavity within their main stem structures, the majority of the identified trees looked to be within the realms of management to mitigate any associated risks; particularly considering they are to be situated in an area of POS where Targets are likely to be either transitional or only in the potential Target area for relatively short periods of time, and not necessarily during the periods of higher risk of failure (i.e. during a storm).

Suitability for Inclusion

The majority of the trees inspected were considered suitable for inclusion into an area of POS.

In saying this, the retention of some of the trees may still yet become questionable pending detailed design of the landscape area around them and the introduction of any potential Targets within their likely fall zone; primarily due to their structural condition and in view of risk management responsibilities.

In general based on my observations and findings of the trees in POS 1:

1. The better quality trees on this site included the trees numbered 11, 50, 60, and 61.

   Retention of as many of these trees as possible as part of the development of this POS is encouraged.

2. There are a number of trees in this area that may be considered 'questionable' for retention and inclusion into a POS; either due to their current health condition and/or structural form.

   This includes tree numbers; 3, 7, 15, 18, 26, 32, 33, 34, 38, 46, 53, 62, 64, 66, 72, 74, 78, 81 (which would possibly be considered to be remnant vegetation), 881, 884, 901, 904, 908, 911, and 914.

   Their retention would however be very much dependent on any proposed design and introduction of or increase of potential Targets within their projected fall zone.

3. The remaining trees on this site are all considered to be reasonably good specimens of their given species and would be considered to be suitable for inclusion into an area of POS.

   However it is in my opinion that more efforts should be spent on retaining and successfully including as many of the trees detailed in point one above; albeit if it needs to come to the detriment of one or more of these other trees.

5. Key Findings of the Assessment; POS 1

4. It is difficult to provide any further recommendations at this stage without seeing any further detailed designs proposed for the POS.

   However it is strongly recommended that the location and TPZ of each of these trees be accurately surveyed (sub-metre accuracy), and overlaid onto any plans as part of the detailed design process (or at the very least the better and poorer quality trees).

   Any encroachment that is proposed to occur into any tree's TPZ must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines.

   This is not to say that some encroachment and development activity cannot be undertaken within any designated TPZ area. However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process.

   In specific, further arboricultural input will likely be required during detailed design to discuss:

   4.1 Current existing ground levels and resulting levels of the area within the TPZ of any given tree. Note: Retaining and maintaining current existing ground levels within the designated TPZ of any tree is of paramount importance to the success of tree retention.

   4.2 Delineation of any underground services pipework; specifically should they pass through any designated TPZ.

   4.3 Final landscape of the area around any tree selected for retention (including any irrigation pipework, underground services, hardscape structures, or softscape landscaping).

   4.4 In some instances Lot boundary treatment, and/or detailed design of any adjoining road to the POS may also have some bearing and impact on some of the identified trees.

5. Protection of the TPZ of any tree selected for retention as part of the development during construction will also be required and will need to be in accordance with AS 4970 guidelines.

   TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical landscape works of the POS to ensure protection of trees selected for retention occurs.

   The details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

6. Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

   Extent of pruning for each tree will however be very much dependent on final detailed design and the introduction of any Targets within their projected fall zone area.

   All pruning will need to be undertaken by qualified and experienced tree surgery contractors under the direct guidance of the nominated arboricultural consultant.

   All canopy pruning works will need to comply with AS 4373.

5. Key Findings of the Assessment; POS 1; Table of Assessment Results

The following table provide tree-by-tree information on each of the trees identified in POS 1 during the inspection.

Explanation of Fields of Information

Tree No. Provides the schedule number of the identified tree.

Species Provides the most commonly used species and true botanical name of the specimen.

Estimated Height Provides an estimated height (in metres) of the specimen.

Estimated Trunk Calliper (DBH) Provides an estimated trunk calliper of the specimen (in mm, and generally measured at 1.3 metres ("DBH") above ground level as per the industry standard), although sometimes measurements taken below the level of any unions should lower canopy formation start below 1.3 metres above ground level.

Note: An average DBH has been provided for trees with multiple main stem structures.

Estimated Canopy Spread Provides an estimated spread of the trees canopy; provided in metres diameter.

Health Condition Provides a view of the specimen's health/vigour condition at the time of inspection based on a number of predetermined criteria.

Health Rating	Explanation
Excellent	Shows to have typical foliage condition and amount of foliage mass for a specimen of the species. May have a minor amount of deadwood, but no signs of any pest or disease factor that may affect its health.
Good	Shows to have typical foliage condition. Canopy foliage may be slightly chlorotic, sparse, or it may have a slightly higher percentage of deadwood than usual, or exhibit signs of being affected by environmental conditions or bushfire activity. May have a minor pest or disease present that could start to affect its health.
Fair	Shows to be sparse in the density of its foliage, and/or have a relatively high percentage of deadwood than considered typical for a specimen of the given species. Apical sections of the canopy (may also be) dead. May show signs of a pest or disease factor evident.
Poor	Canopy mass and foliage condition shows to be in a poor state for a specimen of the species. Has a high percentage of deadwood material in its canopy and a low volume of live canopy mass (typically <15%).
Dead	Shows to have either no live tissue within its structure, or at best has <5% live foliage mass remaining in its canopy.

5. Assessment Findings; Table of Assessment Results

Structural Form

Provides a view of the specimen's structural form at the time of inspection based on a number of predetermined criteria.

Structure Rating	Explanation
Good	Shows typical structural form for a specimen of the species. Branch unions show typical form at the point of attachment. May have a small number of minor structural defects; but are within the scope of tree surgery management to rectify. Shows to be root-stable.
Acceptable - Good	Shows an acceptable form, but may have a number of structural defects present i.e. bi-furcation (but with no major swelling or movement), or areas of stem cavities, but structure remains within the scope of management at this stage; albeit with a higher risk/management requirement. Can include previously lopped trees that are known to have good points of attachment of any regrowth that occurs.
Acceptable/ Acceptable (undesirable)	Shows an undesirable structure for a specimen of the species. Structural condition likely to cause future issues in regards to the potential for stem or complete tree failure to occur. Generally includes previously lopped trees, or trees with large areas of cavity and/or associated decay, or trees with bi-furcated unions with clear signs of swelling at the union.
Poor	Major structural defects evident. May have very large stem cavities, extensive termite damage, or noticeable movement in main stem, branch unions or root plate area.

Comment

Provides any additional information (seen as relevant) to the individual specimen.

Comments are (generally) self explanatory.

TPZ

Provides a recommended area in metres RADIUS of the trees main stem which is recommended to be retained and treated as a 'Tree Protection Zone' ("TPZ").

Whilst some reference to Australian Standard Guidelines (AS 4970; *Protection of trees on development* sites) has been taken, TPZ areas have been calculated based on the species of tree, its known tolerance to root zone disturbance and/or loss, its expected root zone spread in the known soil conditions of the given site, as well as the current physical size, health condition and age of the tree.

Considerations

Provides further comment on the considerations that should be given to ensure that impact on the tree during the physical development of the POS will be minimal.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
1	Coastal Banksia	8	450	8-10	Good	Good	Large mature specimen. Canopy is slightly sparse but otherwise ok.	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
2	Coastal Banksia	8	300	6-8	Excellent	Good	Large mature specimen. Canopy is slightly one sided due to proximity and influence of adjacent larger tree but otherwise ok.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
3	Bull Banksia	7	400	6-8	Excellent	Acceptable (undesirable)	Mature specimen. One side of its canopy is dead. Has created an undesirable structural form (but ok for a low target area of a POS).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
4	Jarrah	9	300	6-8	Fair	Acceptable - Good	Multi stemmed specimen. Canopy is sparse; probably due to environment issues as opposed to a pest or disease pathogen.	3.5	Ok for a POS, but minimise Target introduction within it fall zone (canopy spread).
5	Common Sheoak	8	300	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen. Basal fire damage on main stem structure but otherwise ok.	3.5	Ok for a POS, but minimise Target introduction within it fall zone (canopy spread).
6	Jarrah	9	300	6-8	Fair	Acceptable - Good	Multi stemmed specimen. Basal cavity in main stem structure. Canopy is sparse; probably due to environment issues as opposed to a pest or disease pathogen.	3.5	Ok for a POS, but minimise Target introduction within it fall zone (canopy spread).
7	Coastal Banksia	8	300	6-8	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse and has grown on a lean due to proximity and influence of adjacent larger tree but otherwise ok for a POS.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Minimise Target introduction within its fall zone (canopy spread). Landscape design to minimise disturbance to its TPZ.
8	Jarrah	9	350	6-8	Fair	Good	Canopy is sparse; probably due to environment issues as opposed to a pest or disease pathogen.	4	Ok for a POS. Close to road reserve. Any upgrades/alterations to the road or road side verge area could impact on this tree.
9	Jarrah	9	350 x3	8-10	Good	Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen. Multi stemmed from near ground level.	5	Ok for a POS. Close to road reserve. Any upgrades/alterations to the road or road side verge area could impact on this tree.
10	Jarrah	9	350	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen. Has grown on a lean towards/over adjacent road but otherwise ok.	4.5	Ok for a POS. Close to road reserve. Any upgrades/alterations to the road or road side verge area could impact on this tree.
11	Tuart	24	600	10-12	Excellent	Acceptable - Good	Large mature specimen; one of the larger ones in this POS. Cavity higher up in main stem but otherwise ok for a POS.	7	Ok for a POS. Landscape design to minimise disturbance to TPZ area.
12	Common Sheoak	6	300	4-6	Good	Good	Canopy is slightly sparse and suppressed but adjacent larger tree. Otherwise ok.	3	Ok for a POS. Close to road reserve. Any upgrades/alterations to the road or road side verge area could impact on this tree.
13	Jarrah	12	550	10-12	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen. Has grown on a slight lean towards/over adjacent road but otherwise ok.	7	Ok for a POS. Close to road reserve. Any upgrades/alterations to the road or road side verge area could impact on this tree.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
14	Jarrah	8	300	6-8	Good	Good	Canopy is slightly sparse; possibly due to environment issues as opposed to a pest or disease pathogen. Otherwise ok.	3	Ok for a POS. Close to road reserve. Any upgrades/alterations to the road or road side verge area could impact on this tree.
15	Jarrah	10	300	6-8	Poor	Acceptable (undesirable)	Multi stemmed specimen. Basal cavity in main stem structure. Canopy is very sparse; probably due to environment issues as opposed to a pest or disease pathogen.	4	Ok for a POS, but minimise Target introduction within it fall zone (canopy spread). Landscape design to minimise disturbance to its TPZ.
16	Bull Banksia	10	400	6-8	Fair	Acceptable - Good	Mature specimen. One side of its canopy is dead.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Ok for a low Target area of the POS only. Landscape design to minimise disturbance to its TPZ.
17	Jarrah	12	300	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen.	4	Landscape design to minimise disturbance to its TPZ.
18	Jarrah	22	1050	10-12	Poor	Acceptable (undesirable)	Large mature specimen. Mostly dead with only a small amount of live growth remaining. Possible termites in main stem. Good habitat tree, but only suitable for a low Target area of the POS.	7	Landscape design must minimise introduction of Targets within its fall zone (canopy spread) if it is desired to be retained.
19	Jarrah	13	300	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen.	4	Landscape design to minimise disturbance to its TPZ.
20	Jarrah	10	300	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen.	4	Landscape design to minimise disturbance to its TPZ.
21	Bull Banksia	8	350	6-8	Excellent	Acceptable (undesirable)	Mature specimen. Has grown on a lean due to proximity and influence of adjacent larger tree but otherwise ok.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Ok for a low Target area of the POS only. Landscape design to minimise disturbance to its TPZ.
22	Common Sheoak	14	400	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen. Fire damage and cavity (that extends all the way through) its main stem structure but otherwise ok.	4	Landscape design to minimise disturbance to its TPZ and introduction of Targets within its fall zone (canopy spread). Quite close to road reserve; road design to minimise disturbance to its TPZ.
23	Coastal Banksia	8	350	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen. Evidence of a recent branch failure.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
24	Jarrah	16	450	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen.	4.5	Landscape design to minimise disturbance to its TPZ. Quite close to road reserve; road design to minimise disturbance to its TPZ.
25	Jarrah	16	350	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen.	3.5	Landscape design to minimise disturbance to its TPZ.
26	Jarrah	14	850	10-12	Poor	Acceptable (undesirable)	Large mature specimen. Limited volume of live growth remaining. Basal cavity in main stem. Good habitat tree, but only suitable for a low Target area of the POS.	7	Landscape design must minimise introduction of Targets within its fall zone (canopy spread) if it is desired to be retained.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
27	Jarrah	16	350	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
28	Coastal Banksia	8	300	6-8	Excellent	Acceptable - Good	Reasonably good mature specimen. Has grown on a slight lean due to proximity and influence of adjacent larger trees but otherwise ok.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
29	Coastal Banksia	8	350	6-8	Good	Acceptable - Good	Reasonably good mature specimen. Has grown on a slight lean due to proximity and influence of adjacent larger trees but otherwise ok.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
30	Jarrah	14	350	6-8	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues as opposed to a pest or disease pathogen. Has grown on a lean due to proximity and influence of adjacent larger tree but otherwise ok.	4	Landscape design to minimise disturbance to its TPZ.
31	Jarrah	16	300	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues as opposed to a pest or disease pathogen. Multi stemmed from ground level.	3.5	Landscape design to minimise disturbance to its TPZ.
32	Jarrah	16	400	6-8	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues as opposed to a pest or disease pathogen. Main stem bi furcates with signs of swelling at union, but ok for a low Target area of the POS.	3.5	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (tree height).
33	Jarrah	16	350	4-6	Fair	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues as opposed to a pest or disease pathogen. Main stem bi furcates with signs of swelling at union, but ok for a low Target area of the POS.	3.5	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (tree height).
34	Jarrah	14	300	6-8	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues as opposed to a pest or disease pathogen. Main stem bi furcates with signs of swelling at union, but ok for a low Target area of the POS.	3.5	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (tree height).
35	Jarrah	9	350	4-6	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates, but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ.
36	Jarrah	12	350	4-6	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed specimen. Otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ.
37	Coastal Banksia	13	450	6-8	Excellent	Good	Reasonably good mature specimen.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
38	Jarrah	16	850	12-14	Poor	Acceptable (undesirable)	Larger mature tree. Canopy is very sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Cavity in main stem structure. Otherwise ok for a low Target area of the POS.	8	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
39	Jarrah	14	400	8-10	Fair	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Cavity in main stem structure. Otherwise ok for a low Target area of the POS.	4.5	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy spread).
40	Jarrah	15	350	6-8	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Otherwise ok for a POS.	4	Landscape design to minimise disturbance to its TPZ.
41	Jarrah	15	350	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed specimen. Otherwise ok for a POS.	4	Landscape design to minimise disturbance to its TPZ.
42	Jarrah	13	300	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
43	Jarrah	13	300	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
45	Coastal Banksia	9	350 x2	8-10	Excellent	Acceptable - Good	Reasonably good mature specimen. Multi stemmed from near ground level. Small basal cavity. Ok for a POS.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Possibly in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
46	Bull Banksia	9	350	6-8	Excellent	Acceptable (undesirable)	Mature specimen. Has grown on a lean due to proximity and influence of adjacent larger tree (but ok for a low target area of a POS).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Possibly in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
47	Jarrah	10	300	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level. Otherwise ok for a POS.	3	Landscape design to minimise disturbance to its TPZ.
48	Jarrah	10	300	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level. Otherwise ok for a POS.	3	Landscape design to minimise disturbance to its TPZ.
49	Jarrah	15	400	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
50	Jarrah	15	750	10-12	Fair	Acceptable - Good	Larger more mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates but otherwise ok for a POS.	8	Landscape design to minimise disturbance to its TPZ.
51	Jarrah	13	300	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
52	Coastal Banksia	8	450	6-8	Good	Good	Reasonably good mature specimen.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
53	Bull Banksia	9	300	6-8	Excellent	Acceptable - Good	Mature specimen. Has grown on a lean due to proximity and influence of adjacent larger tree (but ok for a low target area of a POS).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
54	Jarrah	14	450	8-10	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from ground level (regrowth around an old stump).	4.5	Landscape design to minimise disturbance to its TPZ. Possibly close to road reserve; road design to minimise disturbance to its TPZ.
55	Jarrah	12	400	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
56	Bull Banksia	9	300	4-6	Excellent	Good	Reasonably good mature specimen.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
57	Bull Banksia	9	350	6-8	Excellent	Good	Reasonably good mature specimen.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
58	Bull Banksia	9	400	8-10	Excellent	Good	Reasonably good mature specimen.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
59	Jarrah	15	700	10-12	Fair	Acceptable - Good	Larger more mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates but otherwise ok for a POS.	8	Landscape design to minimise disturbance to its TPZ.
60	Tuart	18	600	8-10	Excellent	Acceptable - Good	Large mature specimen; one of the larger ones in this POS. Canopy is one sided due to proximity and influence of adjacent larger tree but otherwise ok.	7	Ok for a POS. Landscape design to minimise disturbance to TPZ area.
61	Tuart	24	850	16-18	Excellent	Good	Large mature specimen; one of the larger ones in this POS. Multi stemmed from ground level but otherwise ok.	10	Ok for a POS. Landscape design to minimise disturbance to TPZ area. Possibly close to road reserve; road design to minimise disturbance to its TPZ.
62	Jarrah	15	550	6-8	Poor	Acceptable (undesirable)	Canopy is very sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; ok for a low Target area of the POS only.	4.5	Landscape design to minimise disturbance to its TPZ. Landscape design must also not introduce Targets within its fall zone (canopy spread).
64	Coastal Banksia	7	300	4-6	Poor	Good	Canopy is very sparse. May have limited life span remaining.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
65	Jarrah	9	300	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; Boundary treatment to minimise disturbance to its TPZ.
66	Jarrah	20	1100	12-14	Poor	Acceptable (undesirable)	Larger mature tree. Canopy is very sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen), and likely to have limited life span remaining. Cavity and damage in main stem structure. Ok for a low Target area of the POS only.	8	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy height).
67	Coastal Banksia	11	450	8-10	Good	Good	Reasonably good larger mature specimen.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
68	Jarrah	11	350	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
69	Coastal Banksia	11	500	8-10	Good	Good	Reasonably good mature specimen. One of the larger ones of this species in this POS.	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
70	Jarrah	15	400	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
71	Jarrah	11	300	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
72	Jarrah	15	500	10-12	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; but ok for a POS.	6	Landscape design to minimise disturbance to its TPZ or introduction of Targets within its fall zone (canopy spread).
73	Jarrah	16	850	10-12	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a slight lean. Small basal cavity and fire damage in main stem structure; but ok for a POS.	9	Landscape design to minimise disturbance to its TPZ or introduction of Targets within its fall zone (canopy spread).
74	Jarrah	14	300	6-8	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed with basal cavity in main stem structure; ok for a low Target area of the POS only.	4	Landscape design to minimise disturbance to its TPZ. Landscape design must also not introduce Targets within its fall zone (canopy spread).
75	Jarrah	15	450	8-10	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
76	Jarrah	15	700	12-14	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Small basal cavity and fire damage in main stem structure; but ok for a POS.	7	Landscape design to minimise disturbance to its TPZ or introduction of Targets within its fall zone (canopy spread).
77	Bull Banksia	8	300	4-6	Good	Good	Reasonably good mature specimen.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
78	Jarrah	14	300	4-6	Fair	Poor	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates with large amount of swelling at union; ok for a low Target area of the POS only.	3.5	Landscape design to minimise disturbance to its TPZ. Landscape design must also not introduce Targets within its fall zone (height).
79	Jarrah	14	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
80	Jarrah	14	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
81	Jarrah	18	1400	16-18	Fair	Acceptable (undesirable)	Very large mature tree; clearly remnant vegetation. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen), and may have limited life span remaining. Cavity and damage in main stem structure; leaning west. Ok for a low Target area of the POS only.	10	Landscape design to minimise disturbance to its TPZ, and must minimise the introduction of Targets within its fall zone (canopy height).
82	Jarrah	10	350	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from ground level and canopy is one sided due to proximity and influence of adjacent larger tree but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
879	Common Sheoak	11	400	4-6	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Column of decay in main stem structure.	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve ; road design to minimise disturbance to its TPZ.
880	Jarrah	14	300	4-6	Fair	Acceptable (undesirable)	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
881	Tuart	24	450	16-18	Fair	Acceptable (undesirable)	Regrowth around an old burnt stump. Large basal cavity in main stem structure, evidence of termites. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Suited to a low Target area of the POS only.	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
882	Jarrah	12	300	4-6	Fair	Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level; cavity in base of main stem.	3	Landscape design to minimise disturbance to its TPZ.
883	Bull Banksia	6	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
884	Jarrah	12	700	10-12	Poor	Acceptable (undesirable)	Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen); may have limited life span remaining.	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve ; road design to minimise disturbance to its TPZ (although I would strongly question the retention of this tree in a road reserve situation).
885	Coastal Banksia	7	400	6-8	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Bark wound on main stem.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
896	Jarrah	14	400	6-8	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
897	Jarrah	12	300	6-8	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
898	Jarrah	12	350	6-8	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
899	Jarrah	14	350	4-6	Fair	Acceptable - Good	Spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates.	2	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
900	Jarrah	12	300	6-8	Fair	Acceptable - Good	Spindly multi stemmed tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
901	Bull Banksia	10	300	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem has snapped.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ (although I would question the retention of this tree in a higher Target area).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
902	Bull Banksia	10	300	4-6	Good	Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
903	Jarrah	16	350	6-8	Good	Acceptable - Good	Spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union.	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
904	Tuart	10	450	2-4	Poor	Poor	Main stem has snapped. Very low volume of live leaf mass remaining; likely to have limited life span remaining.	4	Looks to be situated close to Lot boundary; I would question the retention of this tree in a higher Target area.
905	Jarrah	13	300	4-6	Good	Acceptable - Good	Spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
906	Bull Banksia	9	350	4-6	Poor	Acceptable - Good	Top half of the tree's canopy is dead. Otherwise ok.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ (although I would question the retention of this tree in a higher Target area).
907	Jarrah	14	400	6-8	Fair	Acceptable - Good	Spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean west.	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
908	Coastal Banksia	10	300	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem has snapped.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ (although I would question the retention of this tree in a higher Target area).
909	Tuart	17	300	4-6	Good	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Otherwise ok.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
910	Jarrah	16	350	4-6	Fair	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Otherwise ok.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
911	Jarrah	16	300	4-6	Poor	Acceptable (undesirable)	Canopy is very sparse, with the top half dead; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ (although I would question the retention of this tree in a higher Target area).
912	Jarrah	16	350	6-8	Fair	Acceptable (undesirable)	Spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ (although I would possibly question the retention of this tree in a higher Target area).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
913	Jarrah	13	350	6-8	Good	Acceptable - Good	Spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is slightly one sided.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
914	Bull Banksia	10	350	6-8	Good	Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
915	Jarrah	16	300	6-8	Good	Acceptable - Good	Multi stemmed tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean north and is slightly suppressed by tree 81 but otherwise ok.	3.5	Landscape design to minimise disturbance to its TPZ.

5. Key Findings of the Assessment; POS 2







General Comments

A total of 127 trees that met the specification criteria were identified in this POS, and includes tree tag numbers 83 – 204, and 886 – 890 inclusive.

Age Class

Most of the trees identified in this area were adjudged to be semi-mature – 'young' mature trees; i.e. between 20-35 years old.

However there were an equal if not larger number of smaller sized trees in this POS, most of which may only be around the 10 – 20 years old.

There were some larger Tuart, Marri, and Jarrah that may be in the order of 60 - 80 years, as well as a number of very old trees; considered to be well in excess of 100 years of age, and so would probably be classed as 'remnant vegetation'.

Species Identified

The dominant species in this area included, Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Tuart (*Eucalyptus gomphocephala*), Coastal Banksia (*Banksia attenuata*), Bull Banksia (*Banksia grandis*), and Common Sheoak (*Allocasuarina fraseriana*).

The Marri were noted to be the dominant tree species in this area.

5. Key Findings of the Assessment; POS 2

Health Condition

The majority of the trees in this area showed varying indications of canopy stress/ trauma typically associated with impact from bushfire activity and/or environmental issues such as poor seasonal rainfalls.

A reasonably good volume of new foliage was however noted on the majority of the trees in this area, and given time most (if not all) could be expected to make a full recovery; albeit slowly over a number of years. Full extent of recovery and time frame taken will however be very much dependent on seasonal rainfalls, if any further bushfire activity occurs, and any impact from development.

There were no noticeable major pest/disease pathogens (i.e. *Phytophthora*) visible at the time of my inspection.

Structural Form

The majority of the trees in this POS showed to have what is considered to be typical structural form for specimens of their given species.

Whilst a few of the trees showed to have what are considered to be structural defects such as bi-furcated unions with some associated swelling, and/or areas of cavity within their main stem structures, the majority of the identified trees looked to be within the realms of management to mitigate any associated risks; particularly considering they are to be situated in an area of POS where Targets are likely to be either transitional or only in the potential Target area for relatively short periods of time, and not necessarily during the periods of higher risk of failure (i.e. during a storm).

Suitability for Inclusion

The majority of the trees inspected were considered suitable for inclusion into an area of POS.

In saying this, the retention of some of the trees may still yet become questionable pending detailed design of the landscape area around them and the introduction of any potential Targets within their likely fall zone; primarily due to their structural condition and in view of risk management responsibilities.

In general based on my observations and findings of the trees in POS 2:

1. The better quality trees on this site included the trees numbered 98, 125, 162 – 164, 168 – 174, 191 – 194, 196, and 198 (which is considered to potentially be remnant vegetation).

   Retention of as many of these trees as possible as part of the development of the POS is encouraged.

2. There are a number of trees in this area that may be considered 'questionable' for retention and inclusion into a POS; either due to their current health condition and/or structural form.

   This includes trees numbered; 83, 84, 116, 117, 118, 123, 130, 148, 149, 156, 161, 166, 181, 183, 197 and 889.

   Note: Tree numbers 130, 148, 149, 156, and 889 are however all considered to be 'remnant vegetation' based on their physical size and estimated age.

   Their retention will however be very much dependent on any proposed design and introduction of or increase of potential Targets within their projected fall zone.

3. The remaining trees on this site are all considered to be reasonably good specimens of their given species and would be considered to be suitable for inclusion into an area of POS.

5. Key Findings of the Assessment; POS 2

4. As with POS 1, it is difficult to provide any further recommendations at this stage without seeing any further detailed designs proposed for the POS.

   However it is strongly recommended that the location and TPZ of each of these trees be accurately surveyed (sub-metre accuracy), and overlaid onto any plans as part of the detailed design process (or at the very least the better and poorer quality trees).

   Any encroachment that is proposed to occur into any tree's TPZ must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines.

   This is not to say that some encroachment and development activity cannot be undertaken within any designated TPZ area. However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process.

   Specific details for the POS will need to be discussed; namely levels for the POS, delineation of any underground services, drainage, final landscape treatment (and how it is to be achieved), introduction of potential Targets (particularly near the poorer quality trees), and in some instances the adjoining roads may also have some bearing and impact on some of the trees in this POS

5. Similar to POS 1, protection of the TPZ of any tree selected for retention during construction will also be required and will need to be in accordance with AS 4970 guidelines.

   TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical landscape works; the details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

6. Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

   Extent of pruning for each tree will however be very much dependent on final detailed design and the introduction of any Targets within their projected fall zone area.

   All pruning will need to be undertaken by qualified and experienced tree surgery contractors under the direct guidance of the nominated arboricultural consultant.

   All canopy pruning works will need to comply with AS 4373.

The following pages provide tree-by-tree information on each of the trees identified in POS 2 during the inspection.

The same terminology used for the table of assessment results for POS 1 has again been used.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
83	Coastal Banksia	9	450	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree. Main stem bi furcates with signs of swelling at union; but otherwise ok for a POS.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
84	Jarrah	11	300	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean. Termites in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
85	Coastal Banksia	8	350	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
86	Jarrah	15	400	8-10	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
87	Jarrah	16	400	8-10	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
88	Marri	16	450	10-12	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy leans slightly over road reserve but otherwise ok for a POS.	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
89	Coastal Banksia	9	450	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
90	Coastal Banksia	8	450	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger trees.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
91	Marri	13	400	8-10	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
92	Jarrah	13	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
93	Jarrah	13	350	6-8	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
94	Coastal Banksia	8	450	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; ok at this stage but may cause future issues longer term.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
95	Jarrah	14	350	6-8	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
96	Bull Banksia	8	450	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
97	Coastal Banksia	8	400	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
98	Tuart	17	550	8-10	Excellent	Good	Good mature specimen.	5.5	Landscape design to minimise disturbance to its TPZ.
99	Coastal Banksia	7	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean and canopy is one sided, but ok for a POS.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
100	Coastal Banksia	7	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
101	Jarrah	12	400	6-8	Excellent	Good	Good mature specimen.	4	Landscape design to minimise disturbance to its TPZ.
102	Jarrah	11	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
103	Jarrah	14	350	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure but otherwise ok.	3.5	Landscape design to minimise disturbance to its TPZ.
104	Marri	12	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
105	Jarrah	9	600	8-10	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean.	6	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
106	Jarrah	11	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
107	Jarrah	14	350	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
108	Coastal Banksia	9	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Development/form has clearly been affected by adjacent larger trees.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
109	Jarrah	14	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Tall, upright spindly tree.	3.5	Landscape design to minimise disturbance to its TPZ.
110	Jarrah	13	400	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from ground level (regrowth around an old stump).	4.5	Landscape design to minimise disturbance to its TPZ.
111	Coastal Banksia	9	450	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
112	Jarrah	14	300	4-6	Good	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level but ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ.
113	Marri	10	400	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal wound on main stem.	4.5	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
114	Marri	13	300	4-6	Good	Good	Reasonably good semi mature specimen.	3	Landscape design to minimise disturbance to its TPZ.
115	Jarrah	11	350	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
116	Bull Banksia	7	400	6-8	Excellent	Poor	Has grown on a major lean due to proximity and influence of adjacent larger tree. Basal cavity in main stem structure; considered to be ok for a low Target area of the POS only.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although would question the retention of this tree in a higher Target area).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
117	Jarrah	17	500	8-10	Good	Acceptable (undesirable)	Larger older tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level with signs of included bark and cavity at union; but ok for a POS.	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
118	Marri	9	300	4-6	Good	Acceptable (undesirable)	Reasonably good semi mature specimen. Canopy is one sided and looks to be suppressed to some extent by adjacent larger tree but otherwise ok.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
119	Marri	9	350	6-8	Excellent	Good	Good semi mature specimen.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
120	Jarrah	13	450	8-10	Fair	Acceptable - Good	Larger older tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from ground level, small basal cavity in main stem structure; but ok for a POS.	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
121	Marri	18	550	12-14	Good	Acceptable - Good	Larger older tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level but otherwise ok.	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
122	Jarrah	12	300	8-10	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level, and canopy is one sided but otherwise ok for a POS.	3	Landscape design to minimise disturbance to its TPZ.
123	Marri	16	500	6-8	Good	Acceptable (undesirable)	Larger older tree. Basal cavity in main stem structure but otherwise ok.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
124	Jarrah	12	450	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
125	Marri	19	650	10-12	Good	Good	Larger older tree.	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
126	Marri	14	450	8-10	Good	Good	Good mature specimen.	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
127	Jarrah	16	450	8-10	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	4.5	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
128	Marri	17	450	8-10	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	4.5	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
129	Marri	14	550	10-12	Good	Good	Good mature specimen.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
130	Jarrah	24	1300	14-16	Fair	Acceptable - Good	Clearly a large very old specimen; likely to be considered remnant vegetation. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Large wound and cavity in main stem structure. But otherwise ok for a POS (suggest low Target area).	10	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
131	Jarrah	13	350	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree. Multi stemmed from ground level.	4	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
132	Bull Banksia	7	300	4-6	Excellent	Good	Reasonably good mature specimen.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
133	Jarrah	14	700	14-16	Good	Good	Good larger mature specimen. Canopy is slightly sparse but otherwise ok.	8	Landscape design to minimise disturbance to its TPZ.
134	Coastal Banksia	8	350	4-6	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
135	Bull Banksia	8	300	4-6	Good	Acceptable - Good	Reasonably good mature specimen. Evidence of a couple of branch failures, but otherwise ok for a POS.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
136	Jarrah	16	500	8-10	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided. Basal cavity in main stem structure.	5	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
137	Coastal Banksia	9	300	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
138	Jarrah	16	500	8-10	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure, possibly regrowth off an old stump but otherwise ok.	5	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
139	Jarrah	15	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure, possibly regrowth off an old stump but otherwise ok.	3	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
140	Jarrah	14	350	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure, but otherwise ok.	3.5	Landscape design to minimise disturbance to its TPZ. Close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
141	Coastal Banksia	10	300 x2	6-8	Good	Acceptable - Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree. Main stem bi furcates near ground level; small basal cavity in union; but ok for a POS.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
142	Bull Banksia	10	400	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent but otherwise ok.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
143	Bull Banksia	8	350	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a slight lean but otherwise ok.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
144	Coastal Banksia	9	350	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
145	Bull Banksia	8	350	6-8	Poor	Acceptable - Good	Near dead specimen; canopy is very sparse; likely to have limited life span remaining.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry; would suggest this tree will have limited chance of surviving any disturbance as a result of development. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
146	Bull Banksia	9	350	6-8	Good	Acceptable - Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean but otherwise ok.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
147	Jarrah	17	400	6-8	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
148	Jarrah	17	850	12-14	Fair	Acceptable - Good	Old specimen and likely to be 'remnant' vegetation. Canopy is slightly sparse,; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem structure has previously snapped. Bark wounds all over main stem structure, possibly termites; but still considered to be ok for a POS (suggest low Target area only).	8	Landscape design to minimise disturbance to its TPZ and introduction of Targets within its fall zone.
149	Jarrah	17	1000	12-14	Fair	Acceptable (undesirable)	Old specimen and likely to be 'remnant' vegetation. Canopy is slightly sparse,; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem structure has previously snapped. Basal wound and cavity in main stem structure, possibly termites; but still considered to be ok for a POS (suggest low Target area only).	10	Landscape design to minimise disturbance to its TPZ and introduction of Targets within its fall zone.
150	Marri	17	450	10-12	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
151	Marri	18	400	8-10	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	4	Landscape design to minimise disturbance to its TPZ.
152	Marri	17	350	6-8	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
153	Jarrah	10	400	8-10	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided and somewhat suppressed by the adjacent larger tree.	4	Landscape design to minimise disturbance to its TPZ.
154	Marri	16	400	8-10	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is slightly one sided due to proximity and influence of adjacent larger tree.	4	Landscape design to minimise disturbance to its TPZ.
155	Marri	17	400	8-10	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
156	Marri	18	1400	18-20	Good	Acceptable (undesirable)	Clearly a large very old specimen and 'remnant' vegetation. Canopy is slightly sparse,; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem structure has previously snapped. Basal wound on main stem structure, likely to have areas of decay in main stem structure, evidence of termites in main stem structure; but still considered to be ok for a POS (suggest low Target area only).	10	Landscape design to minimise disturbance to its TPZ and introduction of Targets within its fall zone. Looks to be situated close to culvert/drainage sump; any changes to this area to minimise disturbance to its TPZ.
157	Marri	16	300	4-6	Good	Good	Reasonably good semi mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
158	Marri	16	400	6-8	Fair	Good	Reasonably good semi mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
159	Marri	12	300	4-6	Good	Good	Reasonably good semi mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
160	Marri	10	300	4-6	Good	Good	Reasonably good semi mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
161	Marri	26	1200	14-16	Poor	Acceptable - Good	Clearly a large very old specimen and 'remnant' vegetation. Canopy is sparse, with top section dead; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). May have limited life span remaining, but ok for a POS (suggest low Target area).	10	Landscape design to minimise disturbance to its TPZ and introduction of Targets within its fall zone.
162	Marri	18	450	8-10	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
163	Marri	18	500	8-10	Good	Acceptable - Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level; Termites noted in main stem structure; but possibly just in outer bark.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
164	Marri	18	500	8-10	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
165	Marri	15	300	6-8	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
166	Jarrah	9	500	8-10	Poor	Poor	Old specimen. Canopy is very sparse, with top section dead; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). May have limited life span remaining, but ok for a POS (suggest low Target area).	10	Landscape design to minimise disturbance to its TPZ and introduction of Targets within its fall zone.
167	Marri	15	350	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
168	Marri	18	400	8-10	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
169	Marri	17	450	6-8	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
170	Marri	17	450	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
171	Marri	17	500	10-12	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.
172	Marri	18	450	10-12	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
173	Marri	17	300	6-8	Good	Good	Reasonably good semi mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
174	Marri	15	300	6-8	Good	Good	Reasonably good semi mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
175	Bull Banksia	9	350	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
176	Jarrah	10	350	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Regrowth around an old stump; basal cavity in main stem structure but otherwise ok for a POS.	4	Landscape design to minimise disturbance to its TPZ.
177	Jarrah	9	350	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Regrowth around an old stump.	4	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
178	Jarrah	9	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ.
179	Bull Banksia	9	450	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Evidence of a branch failure. Has grown on a lean due to proximity and influence of adjacent larger tree but otherwise ok.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
180	Jarrah	10	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Regrowth around an old stump; basal cavity in main stem structure but otherwise ok for a POS.	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
181	Jarrah	9	500	6-8	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Section of canopy has been burnt out completely. Basal injury and small cavity in main stem structure but otherwise ok for a POS (suggest low Target).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
182	Marri	10	350	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated in road reserve; road design to minimise disturbance to its TPZ.
183	Marri	16	550	8-10	Good	Acceptable (undesirable)	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
184	Bull Banksia	8	450	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
185	Bull Banksia	8	450	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean due to proximity and influence of adjacent larger tree.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
186	Marri	12	450	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
187	Marri	12	400	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates but union looks to be ok at this stage.	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
188	Jarrah	17	500	8-10	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; but looks to be ok at this stage.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
189	Jarrah	11	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Tall spindly tree.	3.5	Landscape design to minimise disturbance to its TPZ.
190	Marri	8	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
191	Marri	19	650	8-10	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
192	Marri	19	450	6-8	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	4.5	Landscape design to minimise disturbance to its TPZ.
193	Marri	19	650	8-10	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
194	Marri	19	700	10-12	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
195	Marri	11	350	4-6	Poor	Acceptable - Good	Canopy is sparse, and top section is dead. Basal wound on main stem structure, possibly termites. Would probably question the retention of this tree other than in a low Target area of the POS.	3.5	Landscape design to minimise disturbance to its TPZ.
196	Marri	16	600	10-12	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
197	Marri	14	450	6-8	Good	Acceptable (undesirable)	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; but ok for a low Target area of the POS at this stage.	4.5	Landscape design to minimise disturbance to its TPZ., or introduction of Targets within its fall zone (canopy height).
198	Marri	26	1200	20-22	Good	Acceptable - Good	Very large, very old specimen; clearly remnant vegetation. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Evidence of a number of larger sized branch failures in upper canopy, evidence of a basal cavity in main stem structure, possibly termites as well but overall ok for a POS .	10	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
199	Marri	14	350	4-6	Good	Good	Semi-mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
200	Marri	12	350	4-6	Good	Good	Semi-mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
201	Jarrah	13	400	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS.	4	Landscape design to minimise disturbance to its TPZ. Situated close to drainage sump; any changes to this area to minimise disturbance to its TPZ.
202	Jarrah	10	400	8-10	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level.	4	Landscape design to minimise disturbance to its TPZ. Situated close to drainage sump; any changes to this area to minimise disturbance to its TPZ.
203	Jarrah	12	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Co-dominant leader, but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ. Situated close to drainage sump; any changes to this area to minimise disturbance to its TPZ.
204	Jarrah	12	400	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Co-dominant leaders from near ground level and canopy is one sided due to proximity and influence of adjacent tree, but otherwise ok for a POS.	4.5	Landscape design to minimise disturbance to its TPZ. Situated close to drainage sump; any changes to this area to minimise disturbance to its TPZ.
886	Coastal Banksia	11	500	8-10	Good	Good	Good large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
887	Jarrah	16	300	8-10	Fair	Acceptable - Good	Spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates at ground level. Basal cavity in main stem structure.	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
888	Coastal Banksia	10	350	6-8	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean (towards proposed road). Basal cavity in main stem structure.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
889	Marri	22	1050	18-20	Poor	Acceptable - Good	Very large mature tree; clearly remnant vegetation. Canopy is very sparse, if not mostly dead; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). May have limited life span remaining.	10	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would strongly question the retention of this tree in a road reserve situation).
890	Coastal Banksia	7	300	6-8	Good	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean north-east.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

5. Key Findings of the Assessment; POS 3







General Comments

A total of 247 trees that met the specification criteria were identified in this area, and includes tree tag numbers 205 – 222, 225 – 226, 232 – 254, 258, 263 – 315, 402, 403, 786 – 878, and (MAPS previous survey numbers) 903 , 904, 906, 907, 909 – 914, 918, 920, 924, 926- 934, 939, 941 -945, 980 – 983, 985, 993 – 999, 1003 – 1006, 1009, -1013, 1015, 1016, and 1021 -1023.

Age Class

Most of the trees identified in this area were again adjudged to be semi-mature – 'young' mature trees; i.e. between 20 - 35 years old.

There was again a much a lesser number of smaller sized trees in this area compared to POS 1 and POS 2.

There are some larger Marri in this area (particularly along the southern boundary of the POS) that may be in the order of 60 - 80 years, as well as a number of very old trees; considered to be well in excess of 100 years of age, and so would probably be classed as 'remnant vegetation'.

Species Identified

The dominant species in this area included, Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Tuart (*Eucalyptus gomphocephala*), Coastal Banksia (*Banksia attenuata*), Bull Banksia (*Banksia grandis*), and Common Sheoak (*Allocasuarina fraseriana*).

The Marri were again noted to be the dominant tree species in this area.

5. Key Findings of the Assessment; POS 3

Health Condition

The majority of the trees in this area showed varying indications of canopy stress/ trauma typically associated with impact from bushfire activity and/or environmental issues such as poor seasonal rainfalls.

A reasonably good volume of new foliage was however noted on the majority of the trees in this area, and given time most (if not all) could be expected to make a full recovery; albeit slowly over a number of years. Full extent of recovery and time frame taken will however be very much dependent on seasonal rainfalls, if any further bushfire activity occurs, and any impact from development.

There were no noticeable major pest/disease pathogens (i.e. *Phytophthora*) visible at the time of my inspection.

Structural Form

The majority of the trees in this POS showed to have what is considered to be typical structural form for specimens of their given species.

Whilst a few of the trees showed to have what are considered to be structural defects such as bi-furcated unions with some associated swelling, and/or areas of cavity within their main stem structures, the majority of the identified trees looked to be within the realms of management to mitigate any associated risks; particularly considering they are to be situated in an area of POS where Targets are likely to be either transitional or only in the potential Target area for relatively short periods of time, and not necessarily during the periods of higher risk of failure (i.e. during a storm).

Suitability for Inclusion

The majority of the trees inspected were considered suitable for inclusion into an area of POS.

In saying this, the retention of some of the trees may still yet become questionable pending detailed design of the landscape area around them and the introduction of any potential Targets within their likely fall zone; primarily due to their structural condition and in view of risk management responsibilities.

In general based on my observations and findings of the trees in POS 3:

1. The better quality trees on this site included the trees numbered 225, 232, 233, 234, 235, 267, 273, 402, 403, 788, 808, 818, 819, 825, 840, 856, 864, 868, 869, 870, 903, 907, 910, 911, 924, 926, 927, 929, 931, 981, 982, 983, 985, 994, 1003, 1009, 1010, 1011, 1012, 1013, 1022, and 1023.

   Note: Tree numbers 788 and 1013 are both considered to be 'remnant vegetation'.

   Retention of as many of these trees as possible as part of the development of the POS is therefore encouraged.

2. There are a number of trees in this area that may be considered 'questionable' for retention and inclusion into a POS; either due to their current health condition and/or structural form.

   This includes; 226, 264, 265, 266, 269, 271, 281, 286, 288, 289, 292, 298, 305, 307, 310, 315, 790, 794, 806, 812, 817, 829, 830, 837, 841, 848, 852, 853, 862, 865, 913, 914, 920, 923, 928, 932, 943, 980, 998, 999, 1004, 1005, 1009, 1021.

   Note: Tree numbers 315, 841, 932, 980, and 999 are all considered to be 'remnant vegetation'.

5. Key Findings of the Assessment; POS 3

Their retention will however be very much dependent on any proposed design and introduction of or increase of potential Targets within their projected fall zone.

3. The remaining trees on this site are all considered to be reasonably good specimens of their given species and would be considered to be suitable for inclusion into an area of POS.

4. As with the previous POS areas, it is difficult to provide any further recommendations at this stage without seeing any further detailed designs proposed for the POS.

   However it is strongly recommended that the location and TPZ of each of these trees be accurately surveyed (sub-metre accuracy), and overlaid onto any plans as part of the detailed design process (or at the very least the better and poorer quality trees).

   Any encroachment that is proposed to occur into any tree's TPZ must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines. Again, this is not to say that some encroachment and development activity cannot be undertaken within any designated TPZ area. However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process.

   Specific details for the POS will need to be discussed; namely levels for the POS, delineation of any underground services, drainage, final landscape treatment (and how it is to be achieved), introduction of potential Targets (particularly near the poorer quality trees), and in some instances the adjoining roads may also have some bearing and impact on some of the trees in this POS.

5. Similar to the previous POS areas, protection of the TPZ of any tree selected for retention during construction will also be required and will need to be in accordance with AS 4970 guidelines.

   TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical landscape works; the details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

6. Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

   Extent of pruning for each tree will however be very much dependent on final detailed design and more specifically the introduction of any Targets within their projected fall zone area.

   All pruning will need to be undertaken by qualified and experienced tree surgery contractors under the direct guidance of the nominated arboricultural consultant.

   All canopy pruning works will need to comply with AS 4373.

The following pages provide tree-by-tree information on each of the trees identified in POS 3 during the inspection.

The same terminology used for the table of assessment results for the previous POS areas has again been used.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
205	Jarrah	11	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
206	Coastal Banksia	7	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
207	Bull Banksia	8	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
208	Coastal Banksia	8	450	8-10	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is slightly one sided.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
209	Coastal Banksia	8	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is one sided.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
210	Coastal Banksia	8	400	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is slightly one sided. Basal bark wound on main stem structure but otherwise ok.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
211	Coastal Banksia	7	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is one sided and slightly suppressed by adjacent larger tree.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
212	Marri	11	300	4-6	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
213	Bull Banksia	7	300	4-6	Good	Good	Ok smaller but mature specimen.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
214	Coastal Banksia	7	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy development/form has been affected/influenced by the adjacent larger tree.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
215	Jarrah	11	300	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem structure bi furcates but otherwise ok.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary (possibly even outside of POS); boundary treatment to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
216	Jarrah	11	300	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem structure bi furcates but otherwise ok.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary (possibly even outside of POS); boundary treatment to minimise disturbance to its TPZ.
217	Jarrah	9	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from ground level.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary (possibly even outside of POS); boundary treatment to minimise disturbance to its TPZ.
218	Coastal Banksia	7	450	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy development/form has been affected/influenced by the adjacent tree.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
219	Marri	11	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
220	Coastal Banksia	7	400	6-8	Poor	Acceptable - Good	Canopy is sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy development/form has been affected/influenced by the adjacent tree.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
221	Marri	12	450	6-8	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
222	Marri	12	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
225	Marri	23	750	16-18	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary (possibly even outside of POS); boundary treatment to minimise disturbance to its TPZ.
226	Bull Banksia	9	300	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Basal cavity in main stem structure; would probably question the retention of this tree in an area of increased Targets.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
232	Marri	20	400	6-8	Good	Good	Good specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary (possibly even outside of POS); boundary treatment to minimise disturbance to its TPZ.
233	Marri	22	650	12-14	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
234	Marri	20	500	10-12	Fair	Good	Larger more mature tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
235	Tuart	26	850	18-20	Excellent	Good	Larger more mature good specimen tree.	9	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
236	Bull Banksia	8	350	4-6	Poor	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Basal wound in main stem structure; would probably question the retention of this tree in an area of increased Targets.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its TPZ.
237	Marri	16	350	6-8	Good	Good	Good specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
238	Bull Banksia	9	400	6-8	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is one sided and has grown on a lean due to proximity and influence of adjacent larger tree.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
239	Bull Banksia	9	350	4-6	Fair	Good	Canopy is sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
240	Bull Banksia	9	350	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
241	Coastal Banksia	9	350	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Small basal injury but otherwise ok.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
242	Bull Banksia	8	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree. Small basal injury but otherwise ok.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
243	Bull Banksia	9	400	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Cavity in main stem structure.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
244	Bull Banksia	7	300	4-6	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
245	Jarrah	11	300	4-6	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
246	Marri	11	300	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
247	Jarrah	11	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
248	Jarrah	16	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
249	Jarrah	16	400	6-8	Fair	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
250	Jarrah	11	300	4-6	Good	Acceptable - Good	Tall spindly tree. Canopy has a large percentage of regrowth; probably due to impact from bushfire.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
251	Marri	17	350	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Co-dominant leader but otherwise ok.	4	Landscape design to minimise disturbance to its TPZ.
252	Marri	17	400	8-10	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
253	Coastal Banksia	8	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
254	Marri	16	400	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
258	Coastal Banksia	8	350	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
263	Marri	9	350	4-6	Poor	Good	Canopy is very sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
264	Jarrah	8	300	8-10	Fair	Poor	Multi stemmed regrowth around an old burnt out stump. Has grown on a lean; would probably question the retention of this tree other than in a low Target area of the POS.	4	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
265	Coastal Banksia	8	300	8-10	Fair	Poor	Canopy is sparse; probably due to environment and/or impact from bushfire. Has grown on a lean; would probably question the retention of this tree other than in a low Target area of the POS.	4	Species do not readily tolerate disturbance to their root zone. Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy spread).
266	Jarrah	9	400	6-8	Poor	Poor	Multi stemmed regrowth around an old burnt out stump. Canopy is mostly dead; would probably question the retention of this tree other than in a low Target area of the POS.	5	Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve.
267	Marri	22	400	8-10	Fair	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
268	Bull Banksia	8	350	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
269	Marri	19	300	4-6	Poor	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Would probably question the retention of this tree other than in a low Target area of the POS.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
270	Marri	22	400	8-10	Fair	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
271	Marri	13	300	4-6	Poor	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Would probably question the retention of this tree other than in a low Target area of the POS.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
272	Jarrah	14	300	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided. Would probably question the retention of this tree other than in a low Target area of the POS.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
273	Marri	24	700	16-18	Fair	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
274	Marri	16	350	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
275	Bull Banksia	8	450	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
276	Bull Banksia	7	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
277	Bull Banksia	7	350	6-8	Good	Good	Reasonably good mature specimen. canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
278	Bull Banksia	7	350	4-6	Fair	Poor	Evidence of a large branch failure. Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
279	Marri	12	300	6-8	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
280	Marri	16	450	8-10	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
281	Jarrah	8	300	4-6	Fair	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Regrowth around an old burnt stump. Basal cavity in main stem structure but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
282	Marri	12	350	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
283	Bull Banksia	7	400	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
284	Marri	10	350	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
285	Jarrah	15	400	6-8	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level.	4	Landscape design to minimise disturbance to its TPZ.
286	Jarrah	13	300	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Regrowth around an old burnt stump. Basal cavity in main stem structure but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
287	Coastal Banksia	7	300	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
288	Jarrah	16	400	6-8	Fair	Acceptable (undesirable)	Tall spindly tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS; but suggest low Target area only.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
289	Jarrah	16	450	8-10	Fair	Acceptable (undesirable)	Multi stemmed from near ground level. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS; but suggest low Target area only.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
290	Marri	8	300	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
291	Marri	18	650	10-12	Good	Good	Larger tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
292	Jarrah	16	600	8-10	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure but otherwise ok for a low Target area of the POS.	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
293	Coastal Banksia	8	350	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a slight lean but otherwise ok.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
294	Coastal Banksia	8	300	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a slight lean but otherwise ok.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
295	Bull Banksia	8	300	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a slight lean but otherwise ok.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
296	Coastal Banksia	7	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy is also one sided and has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
297	Bull Banksia	8	300	6-8	Poor	Good	Canopy is very sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Has grown on a lean but otherwise ok.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
298	Jarrah	10	350	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure but otherwise ok for a low Target area of the POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
299	Coastal Banksia	8	450	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
300	Coastal Banksia	7	300	6-8	Good	Acceptable (undesirable)	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a major lean; but still ok for a POS.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
301	Coastal Banksia	7	350	6-8	Good	Acceptable - Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean; but still ok for a POS.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
302	Jarrah	16	350	10-12	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Development/form slightly affected by adjacent larger tree but otherwise ok.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
303	Coastal Banksia	7	350	6-8	Good	Acceptable - Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean; but still ok for a POS.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
304	Coastal Banksia	8	350 x2	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from ground level.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
305	Coastal Banksia	8	450	6-8	Good	Acceptable (undesirable)	Mature specimen. Large failure in main stem; but still ok for a low Target area of the POS.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
306	Coastal Banksia	8	450	6-8	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree. Evidence of a large branch failure.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
307	Coastal Banksia	6	350	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean. Basal cavity in main stem structure.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
308	Coastal Banksia	7	350	4-6	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
309	Jarrah	18	500	10-12	Excellent	Good	Reasonably good mature specimen. Multi stemmed from near ground level.	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
310	Jarrah	10	350	6-8	Good	Acceptable (undesirable)	Reasonably good mature specimen. Has grown on a lean due to proximity and influence of adjacent larger tree but otherwise ok.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
311	Jarrah	17	450	8-10	Excellent	Good	Reasonably good mature specimen.	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
312	Jarrah	10	350	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Slightly suppressed by adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
313	Jarrah	12	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided and slightly suppressed by adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
314	Jarrah	12	350	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
315	Tuart	25	1200	18-20	Excellent	Acceptable (undesirable)	Large very old specimen; clearly remnant vegetation. Has a very large cavity in main stem structure. Evidence of termites. Would suggest to retain only in a low Target area of the POS.	10	Landscape design to minimise disturbance to its TPZ., or the introduction of Targets within its fall zone (canopy height).
402	Jarrah	18	500	10-12	Excellent	Acceptable - Good	Good mature specimen. Multi stemmed from near ground level.	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
403	Marri	18	650	8-10	Excellent	Good	Good mature specimen.	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
786	Coastal Banksia	9	350	6-8	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided and has grown on a lean due to proximity and influence of adjacent larger tree.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
787	Marri	10	350	6-8	Fair	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided and has grown on a lean due to proximity and influence of adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
788	Marri	30	1050	18-20	Fair	Good	Very large very old specimen; clearly remnant vegetation. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	10	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
789	Coastal Banksia	8	350	6-8	Fair	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided and has grown on a lean due to proximity and influence of adjacent larger tree.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
790	Tuart	24	650	14-16	Good	Acceptable (undesirable)	Tall mature specimen. Main stem bi furcates with signs of swelling at union; may cause future issues longer term. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
791	Jarrah	15	600	10-12	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates at ground level.	6	Landscape design to minimise disturbance to its TPZ.
792	Jarrah	12	500	8-10	Good	Good	Mature specimen. Canopy is slightly sparse and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.
793	Jarrah	10	450	6-8	Fair	Good	Mature specimen. Canopy is slightly sparse and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
794	Jarrah	13	350	10-12	Fair	Acceptable (undesirable)	Spindly multi stemmed tree; regrowth around an old burnt stump. Basal cavity in main stem structure. Canopy is slightly sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
795	Jarrah	13	350	6-8	Fair	Good	Spindly tree. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
796	Jarrah	10	300	4-6	Fair	Good	Spindly tree. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
797	Jarrah	13	350	4-6	Fair	Good	Spindly tree. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
798	Jarrah	13	350	4-6	Good	Good	Spindly tree. Canopy is slightly sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
799	Jarrah	9	300	4-6	Fair	Good	Spindly tree. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
800	Jarrah	10	350	4-6	Good	Good	Spindly tree. Canopy is slightly sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
801	Coastal Banksia	8	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
802	Coastal Banksia	8	350	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
803	Jarrah	11	300	4-6	Fair	Good	Spindly tree. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
804	Jarrah	11	300	4-6	Fair	Good	Spindly tree. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
805	Jarrah	10	300	4-6	Fair	Good	Spindly tree. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
806	Jarrah	10	300	6-8	Fair	Acceptable (undesirable)	Spindly multi stemmed tree; regrowth around an old burnt stump. Canopy is sparse and what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
807	Jarrah	10	300	8-10	Fair	Good	Spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
808	Marri	18	450	10-12	Fair	Good	Mature specimen. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
809	Marri	19	450	8-10	Fair	Acceptable - Good	Tall spindly tree. Canopy is one sided due to proximity and influence of adjacent larger tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
810	Marri	17	400	6-8	Good	Acceptable - Good	Suppressed by adjacent larger tree; canopy is one sided and has grown on a slight lean. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
811	Marri	22	550	10-12	Fair	Good	Tall spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ.
812	Jarrah	17	350	6-8	Fair	Acceptable (undesirable)	Tall spindly tree. Main stem bi furcates. Canopy is sparse, with one half dead and majority of what leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
813	Marri	17	400	6-8	Good	Good	Tall spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
814	Marri	18	450	8-10	Good	Good	Mature specimen. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
815	Marri	17	300	4-6	Good	Good	Tall spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
816	Marri	19	400	6-8	Fair	Good	Tall spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
817	Jarrah	11	350	6-8	Fair	Acceptable (undesirable)	Multi stemmed specimen; regrowth around an old burnt stump. Basal cavity in main stem structure. Canopy is sparse and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
818	Marri	12	450	6-8	Good	Good	Good specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
819	Marri	24	800	14-16	Good	Good	Tall mature tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ.
820	Jarrah	10	300	6-8	Fair	Acceptable (undesirable)	Suppressed by adjacent larger tree; canopy is one sided and has grown on a lean. Canopy is also sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
821	Coastal Banksia	9	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean east.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
822	Jarrah	13	300	4-6	Fair	Acceptable - Good	Spindly multi stemmed tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
823	Coastal Banksia	8	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean south-west.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
824	Jarrah	14	350	6-8	Fair	Acceptable (undesirable)	Spindly multi stemmed tree; basal cavity in main stem structure. Canopy is slightly sparse, with one half dead and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
825	Tuart	24	600	14-16	Good	Good	Tall mature tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
826	Jarrah	11	300	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level; cavity in base of main stem.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve ; road design to minimise disturbance to its TPZ.
827	Coastal Banksia	7	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
828	Bull Banksia	8	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
829	Jarrah	16	550	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is one sided (north). Canopy is also sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small cavity in base of main stem; probably better suited to a low Target area of the POS.	5.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height; north-east).
830	Jarrah	11	300	4-6	Fair	Acceptable (undesirable)	Tall spindly tree. Canopy is one sided (north-east). Canopy is also sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level; large cavity in base of main stem; probably better suited to a low Target area of the POS.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height; north-east).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
831	Coastal Banksia	7	300 x2	6-8	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem furcates at ground level.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
832	Jarrah	14	350	4-6	Fair	Good	Tall spindly tree. Canopy is one sided (north). Canopy is also sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
833	Bull Banksia	8	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent tree.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
834	Bull Banksia	7	300 x2	6-8	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem furcates at ground level.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
835	Coastal Banksia	8	300	4-6	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
836	Coastal Banksia	8	350	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided, and has grown on a slight lean north.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
837	Jarrah	16	400	6-8	Fair	Acceptable (undesirable)	Tall spindly tree. Regrowth around an old burnt stump; basal cavity in main stem structure. Canopy is also sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Probably better suited to a low Target area of the POS.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
838	Jarrah	14	350	4-6	Fair	Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
839	Coastal Banksia	9	350	4-6	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided, and has grown on a slight lean north.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
840	Jarrah	16	700	12-14	Fair	Good	Larger mature tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
841	Tuart	26	1300	20-22	Good	Acceptable (undesirable)	Larger mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem furcates into three at around 1.7 metres above ground level. Very large basal cavity in main stem structure; probably only 20-25% holding wood remaining (mostly on southern side). Evidence of termites. Probably better suited to a low Target area of the POS.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within in fall zone (canopy height/spread).
842	Jarrah	7	300	4-6	Fair	Good	Smaller spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
843	Jarrah	14	300	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates.	3	Landscape design to minimise disturbance to its TPZ.
844	Jarrah	12	350	6-8	Fair	Acceptable - Good	Multi stemmed specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
845	Jarrah	12	350	6-8	Fair	Good	Reasonably good specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
846	Common Sheoak	18	400	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound (fire damage) and area of decay in main stem structure.	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
847	Jarrah	13	350	8-10	Fair	Acceptable - Good	Multi stemmed specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
848	Jarrah	12	600	8-10	Poor	Acceptable (undesirable)	Larger mature tree. Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large section of its canopy is dead. Large wound on main stem structure (fire damage), basal cavity.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
849	Tuart	22	750	16-18	Good	Good	Larger mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
850	Common Sheoak	13	350	4-6	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound (fire damage) and area of decay in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
851	Jarrah	15	300	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level.	3	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
852	Jarrah	15	300	4-6	Poor	Acceptable - Good	Canopy is very sparse; likely to have limited life span remaining; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates at around 1.4 metres above ground level.	3	Landscape design to minimise disturbance to its TPZ.
853	Jarrah	15	400	6-8	Poor	Acceptable - Good	Canopy is very sparse; likely to have limited life span remaining; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates at around 1.4 metres above ground level.	3	Landscape design to minimise disturbance to its TPZ.
854	Common Sheoak	8	350	4-6	Good	Acceptable - Good	Mature specimen. Canopy is fairly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound (fire damage) and area of decay in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ.
855	Common Sheoak	8	350	4-6	Good	Acceptable - Good	Mature specimen. Canopy is fairly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound (fire damage) and area of decay in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ.
856	Tuart	20	800	18-20	Fair	Acceptable - Good	Larger mature tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height/spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
857	Common Sheoak	10	350	6-8	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound (fire damage) and area of decay in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
858	Common Sheoak	12	350	6-8	Good	Acceptable - Good	Mature specimen. Canopy is fairly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound (fire damage) and area of decay in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
859	Jarrah	10	300	6-8	Good	Good	Reasonably good specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
860	Tuart	18	400	6-8	Good	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
861	Jarrah	16	350 x2	6-8	Good	Acceptable - Good	Mature specimen. Main stem bi furcates near ground level; basal cavity in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
862	Common Sheoak	8	350	4-6	Good	Acceptable (undesirable)	Mature specimen. Canopy is fairly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound (fire damage) and area of decay in main stem structure. Has grown on a slight lean east as a result.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height east).
863	Jarrah	16	450	6-8	Good	Good	Very good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
864	Tuart	26	1000	18-20	Good	Acceptable - Good	Larger mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Cavity in main stem structure, possibly termites. Has grown on a slight lean east.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height/spread).
865	Bull Banksia	7	350	4-6	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean south-west due to proximity and influence of adjacent tree. Cavity and area of decay in main stem structure; probably better suited to a low Target area of the POS.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height; south-west).
866	Bull Banksia	6	350	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
867	Jarrah	14	350	4-6	Fair	Acceptable - Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
868	Jarrah	16	550	10-12	Fair	Acceptable - Good	Larger mature tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree. Basal cavity in main stem structure (fire damage).	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
869	Jarrah	14	500	8-10	Good	Acceptable - Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with some signs of swelling at the union but considered to be ok at this stage.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
870	Jarrah	17	550	8-10	Good	Acceptable - Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is slightly one sided due to proximity and influence of adjacent trees.	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
871	Jarrah	13	300	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree. Main stem bi furcates.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
872	Coastal Banksia	10	400 x2	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level. Canopy is slightly one sided and has grown on a slight lean north west due to proximity and influence of adjacent trees.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
873	Jarrah	14	300	4-6	Fair	Acceptable - Good	Spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
874	Bull Banksia	7	400	6-8	Good	Poor	Mature specimen. Main stem has snapped; would question the retention of this tree in a POS.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Looks to be situated close to road reserve; would question the retention of this tree in a POS or road reserve situation.
875	Bull Banksia	9	300	4-6	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal wound on main stem.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
876	Coastal Banksia	10	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
877	Coastal Banksia	7	300	4-6	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
878	Coastal Banksia	9	350	4-6	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
903	Jarrah	18	550	14-16	Excellent	Good	Good mature specimen. Multi stemmed from near ground level.	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
904	Coastal Banksia	7	450	6-8	Good	Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
906	Coastal Banksia	6	350	4-6	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
907	Jarrah	18	450	8-10	Good	Good	Good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
909	Jarrah	18	600	10-12	Excellent	Acceptable - Good	Reasonably good mature specimen. Multi stemmed from near ground level. Possibly termites (but may just be in the outer bark area).	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
910	Jarrah	17	500	10-12	Excellent	Good	Good mature specimen.	5	Landscape design to minimise disturbance to its TPZ.
911	Jarrah	18	550	10-12	Excellent	Acceptable - Good	Reasonably good mature specimen. Canopy is one sided due to proximity and influence of adjacent tree. Possibly termites (but may just be in the outer bark area).	6	Landscape design to minimise disturbance to its TPZ.
912	Jarrah	12	400	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from ground level.	4	Landscape design to minimise disturbance to its TPZ.
913	Coastal Banksia	7	400	4-6	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Large bark wound on main stem, evidence of termites. Suggest ok for a low Target area of the POS only.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy height).
914	Coastal Banksia	8	300	4-6	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Large bark wound on main stem, evidence of termites. Suggest ok for a low Target area of the POS only.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or introduction of Targets within its fall zone (canopy height).
918	Jarrah	11	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level, basal cavity in main stem structure.	4	Landscape design to minimise disturbance to its TPZ.
920	Jarrah	12	350	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ.
923	Jarrah	16	1000	12-14	Fair	Poor	Older tree, possibly remnant vegetation. Canopy is very sparse and there is a large burnt out section in its main stem. Suggest only retain in a low Target area of the POS.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
924	Jarrah	16	450	12-14	Good	Good	Good mature specimen. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
926	Jarrah	16	500	6-8	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
927	Marri	22	800	16-18	Good	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
928	Marri	22	600	16-18	Fair	Acceptable (undesirable)	Larger more mature tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level; large cavity in base of main stem structure; suggest to retain in a low Target area of the POS only.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
929	Marri	19	450	8-10	Good	Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).Canopy is one sided due to proximity and influence of adjacent larger tree.	4.5	Landscape design to minimise disturbance to its TPZ.
930	Coastal Banksia	8	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
931	Jarrah	17	450	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem structure bi furcates but otherwise ok.	4.5	Landscape design to minimise disturbance to its TPZ.
932	Marri	25	1100	16-18	Poor	Acceptable (undesirable)	Large very old specimen; clearly remnant vegetation. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Evidence of a large cavity in main stem structure. Evidence of termites. Would suggest to retain only in a low Target area of the POS.	10	Landscape design to minimise disturbance to its TPZ., or the introduction of Targets within its fall zone (canopy spread).
933	Jarrah	16	400	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem structure bi furcates but otherwise ok.	4	Landscape design to minimise disturbance to its TPZ.
934	Coastal Banksia	8	400	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen). Canopy development/form has been affected/influenced by the adjacent tree.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to Lot boundary; boundary treatment to minimise disturbance to its TPZ.
939	Jarrah	17	400	10-12	Good	Acceptable - Good	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Multi stemmed from near ground level.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
941	Coastal Banksia	8	400	4-6	Good	Good	Canopy is slightly sparse; probably due to environment issues or damage from bushfire activity (as opposed to a pest or disease pathogen).	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
942	Coastal Banksia	8	300	4-6	Fair	Acceptable (undesirable)	Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean and has a large basal cavity in main stem structure but otherwise ok for a low Target area of the POS.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
943	Jarrah	14	400	8-10	Fair	Poor	Multi stemmed from ground level; regrowth around an old burnt stump. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS; but suggest low Target area only.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
944	Jarrah	16	400	8-10	Fair	Acceptable - Good	Multi stemmed from ground level. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
945	Jarrah	16	400	10-12	Fair	Good	Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
980	Marri	30	1300	20-22	Fair	Acceptable - Good	Very large very old specimen; clearly remnant vegetation. Canopy is sparse, with large sections dead; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure, evidence of termites.	10	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
981	Marri	22	550	12-14	Good	Good	Good specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
982	Marri	18	450	12-14	Good	Acceptable - Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates but otherwise ok.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
983	Marri	24	600	16-18	Fair	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
985	Marri	22	500	12-14	Good	Good	Good specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
993	Marri	20	450	8-10	Fair	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
994	Marri	24	650	18-20	Fair	Acceptable - Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates but otherwise ok.	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
995	Marri	19	450	10-12	Good	Good	Tall spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
996	Marri	17	300	4-6	Good	Acceptable - Good	Spindly tree. Suppressed by adjacent larger tree; canopy is one sided. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
997	Marri	19	400	6-8	Good	Good	Tall spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
998	Marri	18	500	8-10	Fair	Poor	Tall spindly tree. Large basal cavity in main stem structure, evidence of termites; would suggest this tree is suited to a low Target area of the POS only. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Target Targets within its fall zone (canopy height). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
999	Marri	24	1100	16-18	Fair	Poor	Very large very old specimen; clearly remnant vegetation. Canopy is sparse, with large sections dead; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure, evidence of termites.	10	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
1003	Marri	24	650	14-16	Good	Good	Good large mature specimen. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
1004	Marri	17	550	10-12	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent tree. Main stem bi furcates.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
1005	Marri	22	450	6-8	Good	Acceptable (undesirable)	Tall spindly tree. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent tree. Main stem bi furcates.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Target Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
1006	Marri	18	550	10-12	Good	Good	Mature specimen. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
1009	Marri	19	500	10-12	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse, and what leaf mass is present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent tree. Main stem bi furcates.	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
1010	Marri	22	500	12-14	Fair	Acceptable - Good	Mature specimen. Canopy is slightly sparse, and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent tree.	5	Landscape design to minimise disturbance to its TPZ.
1011	Marri	22	550	8-10	Fair	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
1012	Marri	20	550	12-14	Fair	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
1013	Jarrah	19	1400	24-26	Fair	Good	Larger mature tree; clearly remnant vegetation. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
1015	Marri	16	400	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree.	4	Landscape design to minimise disturbance to its TPZ.
1016	Marri	16	400	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree.	4	Landscape design to minimise disturbance to its TPZ.
1021	Marri	23	750	16-18	Fair	Acceptable (undesirable)	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; but ok for a POS at this stage.	8	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
1022	Marri	22	650	10-12	Fair	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Co-dominant leader but otherwise ok.	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
1023	Marri	18	450	6-8	Fair	Good	Larger more mature tree. Canopy is slightly sparse; probably due to environment issues and/or impact from bushfire (as opposed to a pest or disease pathogen). Canopy is slightly one sided due to proximity and influence of adjacent larger trees but otherwise ok.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

5. Key Findings of the Assessment; POS 4







General Comments

This was the most open area of the six, with only a small group of trees found oat the northern and southern ends of the POS with a wide open expanse in the centre.

A total of 27 trees that met the specification criteria were identified in this area, and includes tree tag numbers 418, 419, 427, 429 – 433, 436, 443, and 769 – 785.

Age Class

Most of the trees identified in this area were again adjudged to be semi-mature – 'young' mature trees; i.e. between 20 - 35 years old.

There was however a much a lesser number of smaller sized trees in this area compared to POS 1 and 2.

There are some larger Tuart in this area (particularly along the southern boundary of the POS) that may be in the order of 60 - 80 years.

Species Identified

The dominant species in this area included, Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Tuart (*Eucalyptus gomphocephala*), Coastal Banksia (*Banksia attenuata*), Common Sheoak (*Allocasuarina fraseriana*), and Bull Banksia (*Banksia grandis*).

The Marri were again noted to be the dominant tree species in this area.

5. Key Findings of the Assessment; POS 4

Health Condition

The majority of the trees in this area showed varying indications of canopy stress/ trauma typically associated with impact from bushfire activity and/or environmental issues such as poor seasonal rainfalls.

A reasonably good volume of new foliage was however noted on the majority of the trees in this area, and given time most (if not all) could be expected to make a full recovery; albeit slowly over a number of years. Full extent of recovery and time frame taken will however be very much dependent on seasonal rainfalls, if any further bushfire activity occurs, and any impact from development.

There were no noticeable major pest/disease pathogens (i.e. *Phytophthora*) visible at the time of my inspection.

Structural Form

The majority of the trees in this POS showed to have what is considered to be typical structural form for specimens of their given species.

Whilst a few of the trees showed to have what are considered to be structural defects such as bi-furcated unions with some associated swelling, and/or areas of cavity within their main stem structures, the majority of the identified trees looked to be within the realms of management to mitigate any associated risks; particularly considering they are to be situated in an area of POS where Targets are likely to be either transitional or only in the potential Target area for relatively short periods of time, and not necessarily during the periods of higher risk of failure (i.e. during a storm).

Suitability for Inclusion

The majority of the trees inspected were considered suitable for inclusion into an area of POS.

In saying this, the retention of some of the trees may still yet become questionable pending detailed design of the landscape area around them and the introduction of any potential Targets within their likely fall zone; primarily due to their structural condition and in view of risk management responsibilities.

In general based on my observations and findings of the trees in POS 4:

1. The better quality trees on this site included trees numbered 436, 771, 772, 779, 783, and 784.

   Retention of as many of these trees as possible as part of the development of the POS is therefore encouraged.

2. There are a number of trees in this area that may be considered 'questionable' for retention and inclusion into a POS; either due to their current health condition and/or structural form.

   This includes tree tag numbers 418, 429, 442, 776, 778, 780, and 785.

   Their retention would however be very much dependent on any proposed design and introduction of or increase of potential Targets within their projected fall zone.

3. The remaining trees in this POS area are all considered to be reasonably good specimens of their given species and would be considered to be suitable for inclusion into an area of POS.

5. Key Findings of the Assessment; POS 4

4. As with the previous POS areas, it is difficult to provide any further recommendations at this stage without seeing any further detailed designs proposed for the POS.

   However it is strongly recommended that the location and TPZ of each of these trees be accurately surveyed (sub-metre accuracy), and overlaid onto any plans as part of the detailed design process (or at the very least the better and poorer quality trees).

   Any encroachment that is proposed to occur into any tree's TPZ must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines. Again, this is not to say that some encroachment and development activity cannot be undertaken within any designated TPZ area. However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process.

   Specific details for the POS will need to be discussed; namely levels for the POS, delineation of any underground services, drainage, final landscape treatment (and how it is to be achieved), introduction of potential Targets (particularly near the poorer quality trees), and in some instances the adjoining roads may also have some bearing and impact on some of the trees in this POS.

5. Similar to the previous POS areas, protection of the TPZ of any tree selected for retention during construction will also be required and will need to be in accordance with AS 4970 guidelines.

   TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical landscape works; the details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

6. Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

   Extent of pruning for each tree will however be very much dependent on final detailed design and more specifically the introduction of any Targets within their projected fall zone area.

   All pruning will need to be undertaken by qualified and experienced tree surgery contractors under the direct guidance of the nominated arboricultural consultant.

   All canopy pruning works will need to comply with AS 4373.

The following pages provide tree-by-tree information on each of the trees identified in POS 4 during the inspection.

The same terminology used for the table of assessment results for the other POS areas has again been used.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
418	Marri	13	450	4-6	Poor	Good	Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
419	Marri	17	500	8-10	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean due to proximity and influence of adjacent trees.	5.5	Landscape design to minimise disturbance to its TPZ.
427	Marri	12	300	4-6	Fair	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due and influence of adjacent larger tree.	3	Landscape design to minimise disturbance to its TPZ.
429	Jarrah	21	1100	18-20	Fair	Poor	Larger mature specimen; probably remnant vegetation. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; only an estimated 35-40% holding wood remaining; would probably question the retention of this tree other than in a low Target area of the POS.	9	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
430	Marri	10	350	6-8	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due and influence of adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
431	Marri	14	300	6-8	Fair	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due and influence of adjacent larger tree.	3	Landscape design to minimise disturbance to its TPZ.
432	Marri	19	550	10-12	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
433	Jarrah	15	300	6-8	Fair	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due and influence of adjacent larger tree.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
436	Marri	16	500	8-10	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
442	Jarrah	16	750	8-10	Fair	Poor	Mature specimen; possibly remnant vegetation. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; limited holding wood remaining; would probably question the retention of this tree other than in a low Target area of the POS.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
769	Marri	12	300	2-4	Good	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
770	Coastal Banksia	6	350	4-6	Fair	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal injury (fire damage).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
771	Jarrah	16	550	10-12	Fair	Acceptable - Good	Reasonably good mature specimen. Canopy is slightly sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level.	5.5	Landscape design to minimise disturbance to its TPZ.
772	Tuart	25	1050	20-22	Good	Acceptable - Good	Very large mature specimen. Main stem furcates into four stem structures at around 1.5 metres above ground level. Cavity forming in main stem structure at union; may cause future issues longer term. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	9	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
773	Jarrah	12	350	6-8	Fair	Acceptable - Good	Multi stemmed specimen; regrowth around an old burnt stump. Canopy is slightly sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
774	Jarrah	12	350	4-6	Fair	Acceptable - Good	Spindly tree. Basal cavity in main stem structure. Canopy is slightly sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
775	Bull Banksia	8	550	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve ; road design to minimise disturbance to its TPZ.
776	Jarrah	9	300	6-8	Poor	Acceptable - Good	Multi stemmed specimen; regrowth around an old burnt stump. Canopy is very sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
777	Jarrah	11	350	6-8	Fair	Acceptable - Good	Multi stemmed specimen; regrowth around an old burnt stump. Canopy is slightly sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
778	Jarrah	11	350	6-8	Fair	Acceptable (undesirable)	Multi stemmed specimen; regrowth around an old burnt stump. Large basal cavity in main stem structure. Canopy is slightly sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
779	Tuart	28	750	18-20	Good	Good	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
780	Tuart	28	600	16-18	Good	Acceptable (undesirable)	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Cavity in main stem structure. Canopy is also one sided due to proximity and influence of adjacent larger tree.	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
781	Tuart	26	450	12-14	Good	Acceptable - Good	Tall spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
782	Coastal Banksia	6	650	6-8	Poor	Good	Mature specimen. Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve ; road design to minimise disturbance to its TPZ, although its unlikely to survive development.
783	Jarrah	14	750	18-20	Fair	Acceptable - Good	Mature specimen. Canopy is slightly sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
784	Tuart	22	850	18-20	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse and majority of leaf mass is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
785	Jarrah	8	450	6-8	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse and majority of leaf mass present is epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).

5. Key Findings of the Assessment; POS 5







General Comments

A total of 100 trees that met the specification criteria were identified in this area, and includes tree tag numbers 442 – 524, 551 – 564, and 766 – 768 (although tree numbers 522 – 524, 563 and 564 may actually be in the proposed road reserve/road pavement area between POS 5 and POS 6).

Age Class

The age class of the trees in this area was considered to be much greater than many of the other areas; particularly in the southern part of the POS, with most of the trees being in the order of 60 - 80 years old plus.

There was again a much a lesser number of smaller sized trees in this area compared to POS 1 and 2.

Species Identified

The dominant species in this area included, Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Coastal Banksia (*Banksia attenuata*), and Bull Banksia (*Banksia grandis*).

The Tuart were noted to be the dominant tree species in this area.

5. Key Findings of the Assessment; POS 5

Health Condition

The majority of the trees in this area showed varying indications of canopy stress/ trauma typically associated with impact from bushfire activity and/or environmental issues such as poor seasonal rainfalls.

A reasonably good volume of new foliage was however noted on the majority of the trees in this area, and given time most (if not all) could be expected to make a full recovery; albeit slowly over a number of years. Full extent of recovery and time frame taken will however be very much dependent on seasonal rainfalls, if any further bushfire activity occurs, and any impact from development.

There were no noticeable major pest/disease pathogens (i.e. *Phytophthora*) visible at the time of my inspection.

Structural Form

The majority of the trees in this POS showed to have what is considered to be typical structural form for specimens of their given species.

Whilst a few of the trees showed to have what are considered to be structural defects such as bi-furcated unions with some associated swelling, and/or areas of cavity within their main stem structures, the majority of the identified trees looked to be within the realms of management to mitigate any associated risks; particularly considering they are to be situated in an area of POS where Targets are likely to be either transitional or only in the potential Target area for relatively short periods of time, and not necessarily during the periods of higher risk of failure (i.e. during a storm).

Suitability for Inclusion

The majority of the trees inspected were considered suitable for inclusion into an area of POS.

In saying this, the retention of some of the trees may still yet become questionable pending detailed design of the landscape area around them and the introduction of any potential Targets within their likely fall zone; primarily due to their structural condition and in view of risk management responsibilities.

In general based on my observations and findings of the trees in POS 5:

1. The better quality trees on this site included trees numbered 444, 451, 454, 475, 481, 486 – 489, 493, 495, 509 – 511, 514 – 522, 553 – 556, 561 – 564 and 768.

   Note: Tree numbers 563 and 564 are both considered to be 'remnant vegetation'.

   Retention of as many of these trees as possible as part of the development of the POS is therefore encouraged.

2. There are a number of trees in this area that may be considered 'questionable' for retention and inclusion into a POS; either due to their current health condition and/or structural form.

   This includes tree tag numbers 442, 443, 446, 456 – 459, 463, 464, 473, 474, 478, 479, 483, 485, 492, 494, 497, 504, 507, 508, 559, 766 and 767.

   Note: Tree numbers 442, 443 and 524 are however all considered to be 'remnant vegetation'.

   Their retention would however be very much dependent on any proposed design and introduction of or increase of potential Targets within their projected fall zone.

5. Key Findings of the Assessment; POS 5

3. The remaining trees in this POS area are all considered to be reasonably good specimens of their given species and would be considered to be suitable for inclusion into an area of POS.

4. As with the previous POS areas, it is difficult to provide any further recommendations at this stage without seeing any further detailed designs proposed for the POS.

   However it is strongly recommended that the location and TPZ of each of these trees be accurately surveyed (sub-metre accuracy), and overlaid onto any plans as part of the detailed design process (or at the very least the better and poorer quality trees).

   Any encroachment that is proposed to occur into any tree's TPZ must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines. Again, this is not to say that some encroachment and development activity cannot be undertaken within any designated TPZ area. However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process.

   Specific details for the POS will need to be discussed; namely levels for the POS, delineation of any underground services, drainage, final landscape treatment (and how it is to be achieved), introduction of potential Targets (particularly near the poorer quality trees), and in some instances the adjoining roads may also have some bearing and impact on some of the trees in this POS.

5. Similar to the previous POS areas, protection of the TPZ of any tree selected for retention during construction will also be required and will need to be in accordance with AS 4970 guidelines.

   TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical landscape works; the details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

6. Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

   Extent of pruning for each tree will however be very much dependent on final detailed design and more specifically the introduction of any Targets within their projected fall zone area.

   All pruning will need to be undertaken by qualified and experienced tree surgery contractors under the direct guidance of the nominated arboricultural consultant.

   All canopy pruning works will need to comply with AS 4373.

The following pages provide tree-by-tree information on each of the trees identified in POS 5 during the inspection.

The same terminology used for the table of assessment results for the other POS areas has again been used.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
442	Jarrah	16	750	8-10	Fair	Poor	Mature specimen; possibly remnant vegetation. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; limited holding wood remaining; would probably question the retention of this tree other than in a low Target area of the POS.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
443	Jarrah	20	1200	18-20	Fair	Acceptable (undesirable)	Large mature specimen; possibly remnant vegetation. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large wound and small cavity in main stem structure. Has grown on a lean (towards south east); would probably question the retention of this tree other than in a low Target area of the POS.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
444	Marri	18	500	10-12	Fair	Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
445	Marri	13	400	6-8	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ.
446	Jarrah	15	450	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
447	Marri	15	300	8-10	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
448	Jarrah	14	300	4-6	Fair	Poor	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; would probably question the retention of this tree other than in a low Target area of the POS.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
449	Jarrah	16	350	4-6	Fair	Poor	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large scars and wounds from large branch failures on main stem structure; would probably question the retention of this tree other than in a low Target area of the POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
450	Jarrah	16	450	6-8	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
451	Marri	16	500	8-10	Fair	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
452	Marri	15	300	4-6	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
453	Jarrah	16	450	8-10	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
454	Marri	17	600	10-12	Fair	Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
455	Marri	17	450	6-8	Fair	Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
456	Jarrah	17	450	8-10	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union but otherwise ok for a POS.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
457	Jarrah	13	350	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure, and canopy is also one sided due to proximity and influence of adjacent tree but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
458	Jarrah	12	300	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure, and canopy is also one sided due to proximity and influence of adjacent tree but otherwise ok for a POS.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
459	Bull Banksia	12	350	6-8	Fair	Acceptable (undesirable)	Mature tree. Canopy is sparse; probably due to impact from bushfire (as opposed to a pest or disease pathogen). Has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
460	Bull Banksia	10	300	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
461	Jarrah	12	400	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure but otherwise ok for a POS.	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
462	Jarrah	12	450	6-8	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates but otherwise ok for a POS.	4.5	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
463	Jarrah	11	450	6-8	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS, but would probably question the retention of this tree in a road reserve situation.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
464	Tuart	25	850	20-22	Good	Acceptable (undesirable)	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; would probably question the retention of this tree other than in a low Target area of the POS.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
465	Jarrah	11	400	4-6	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union but otherwise ok for a POS.	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
466	Jarrah	11	400	4-6	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
467	Bull Banksia	8	300	4-6	Fair	Good	Canopy is sparse; probably due to impact from bushfire (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
468	Jarrah	12	450	6-8	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates but otherwise ok for a POS.	4.5	Landscape design to minimise disturbance to its TPZ.
469	Jarrah	12	450	8-10	Good	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
470	Jarrah	9	300	4-6	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
471	Bull Banksia	8	350	4-6	Good	Acceptable (undesirable)	Mature tree. Has grown on a lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
472	Bull Banksia	8	300	4-6	Good	Good	Tall spindly tree.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
473	Tuart	23	700	14-16	Good	Acceptable (undesirable)	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; would probably question the retention of this tree other than in a low Target area of the POS.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
474	Tuart	21	600	14-16	Good	Acceptable (undesirable)	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; would probably question the retention of this tree other than in a low Target area of the POS.	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
475	Marri	20	700	12-14	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
476	Jarrah	16	350	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
477	Jarrah	14	300	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
478	Jarrah	15	400	8-10	Good	Poor	Multi stemmed specimen; regrowth around an old burnt stump. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Some of its stem structures have limited holding wood remaining; would probably question the retention of this tree other than in a low Target area of the POS.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
479	Jarrah	15	450	8-10	Good	Acceptable (undesirable)	Multi stemmed specimen; regrowth around an old burnt stump. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Would probably question the retention of this tree other than in a low Target area of the POS.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
480	Bull Banksia	7	350	4-6	Good	Good	Good mature specimen.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
481	Marri	18	550	10-12	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve ; road design to minimise disturbance to its TPZ.
482	Marri	12	350	6-8	Good	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is slightly suppressed by adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve ; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
483	Jarrah	16	500	10-12	Fair	Poor	Multi stemmed specimen; regrowth around an old burnt stump. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Some of its stem structures have limited holding wood remaining; would probably question the retention of this tree other than in a low Target area of the POS.	5.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
484	Marri	15	450	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large bark wound on main stem.	4.5	Landscape design to minimise disturbance to its TPZ.
485	Jarrah	15	1000	12-14	Fair	Acceptable (undesirable)	Mature specimen; probably remnant vegetation. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean (north) and has a large cavity in southern side of its main stem structure; would probably question the retention of this tree other than in a low Target area of the POS.	9	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
486	Marri	20	450	10-12	Good	Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
487	Marri	17	450	8-10	Good	Acceptable - Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is slightly one sided due to proximity and influence of adjacent larger tree.	4.5	Landscape design to minimise disturbance to its TPZ.
488	Marri	20	500	10-12	Good	Acceptable - Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem structure bi furcates.	5	Landscape design to minimise disturbance to its TPZ.
489	Marri	20	500	10-12	Good	Acceptable - Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem structure bi furcates.	5	Landscape design to minimise disturbance to its TPZ.
490	Jarrah	13	350	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
491	Marri	17	400	8-10	Good	Acceptable - Good	Reasonably good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean and canopy is slightly one sided due to proximity and influence of adjacent larger tree.	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
492	Jarrah	10	300	4-6	Fair	Poor	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a major lean and has a basal cavity in main stem structure; suggest ok for a low Target area of the POS only.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
493	Tuart	24	650	14-16	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
494	Jarrah	10	350	6-8	Fair	Acceptable (undesirable)	Regrowth around an old burnt stump. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure but otherwise ok for a POS.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
495	Marri	16	450	8-10	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
496	Jarrah	9	300	6-8	Fair	Acceptable - Good	Multi stemmed specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
497	Jarrah	13	350	6-8	Fair	Poor	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a major lean and has a small basal cavity in main stem structure; suggest ok for a low Target area of the POS only.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
498	Marri	12	300	6-8	Fair	Good	Reasonably good smaller specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
499	Marri	12	300	6-8	Fair	Good	Reasonably good smaller specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
500	Marri	13	300	6-8	Fair	Good	Reasonably good smaller specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
501	Marri	13	300	4-6	Fair	Good	Reasonably good smaller specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
502	Jarrah	15	450	8-10	Fair	Good	Reasonably good specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
503	Jarrah	13	450	6-8	Fair	Good	Reasonably good specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
504	Bull Banksia	8	350	6-8	Good	Acceptable (undesirable)	Mature specimen. Has grown on a major lean due to proximity and influence of adjacent larger trees.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
505	Marri	16	450	8-10	Fair	Good	Reasonably good mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
506	Jarrah	9	300	4-6	Fair	Acceptable - Good	Smaller specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
507	Jarrah	10	350	6-8	Fair	Acceptable (undesirable)	Multi stemmed specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a lean. Basal cavity in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
508	Jarrah	10	300	4-6	Poor	Acceptable (undesirable)	Smaller specimen. Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
509	Tuart	25	800	16-18	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
510	Tuart	25	900	20-22	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree.	9	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
511	Tuart	23	550	14-16	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree.	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
512	Tuart	17	350	6-8	Good	Good	Smaller mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also suppressed by adjacent trees.	4	Landscape design to minimise disturbance to its TPZ. L
513	Tuart	25	500	8-10	Good	Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.
514	Tuart	25	750	18-20	Good	Acceptable - Good	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Termites noted in main stem structure; possibly just in outer bark.	7	Landscape design to minimise disturbance to its TPZ.
515	Tuart	25	650	16-18	Good	Acceptable (undesirable)	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates. Termites noted in main stem structure; possibly just in outer bark.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
516	Tuart	25	650	12-14	Good	Acceptable - Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree. Bark wound on main stem, termites noted.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height/spread).
517	Marri	17	550	10-12	Good	Acceptable - Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates.	5.5	Landscape design to minimise disturbance to its TPZ.
518	Marri	17	450	8-10	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
519	Marri	17	650	14-16	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
520	Tuart	25	650	12-14	Good	Acceptable - Good	Large mature tall spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
521	Tuart	25	550	10-12	Good	Acceptable - Good	Tall spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ.
522	Tuart	28	850	14-16	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates.	9	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
523	Tuart	11	300	4-6	Fair	Acceptable (undesirable)	Smaller specimen. Canopy is suppressed by adjacent larger tree.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
524	Jarrah	13	950	8-10	Fair	Poor	Possibly remnant vegetation. Limited canopy remaining, and what canopy is present is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; limited holding wood remaining; would probably question the retention of this tree other than in a low Target area of the POS.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
551	Marri	11	300	4-6	Good	Good	Smaller specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
552	Jarrah	10	300	4-6	Good	Acceptable - Good	Smaller specimen. Regrowth around an old burnt stump. Basal cavity in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
553	Tuart	25	500	10-12	Good	Acceptable - Good	Tall spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
554	Tuart	25	750	18-20	Good	Acceptable - Good	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates. Possibly termites in main stem structure.	7	Landscape design to minimise disturbance to its TPZ.
555	Tuart	25	950	20-22	Excellent	Acceptable - Good	Large mature specimen; possibly remnant vegetation. Bark wound and basal cavity in main stem. Possibly termites as well.	10	Landscape design to minimise disturbance to its TPZ.
556	Jarrah	16	650	12-14	Good	Acceptable - Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure.	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
557	Jarrah	10	300	4-6	Good	Acceptable - Good	Smaller multi stemmed specimen. Regrowth around an old burnt stump. Basal cavity in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
558	Bull Banksia	8	500	6-8	Excellent	Good	Good mature specimen.	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
559	Jarrah	13	850	8-10	Fair	Acceptable (undesirable)	Large mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; probably better suited to a low Target area of the POS.	9	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
560	Bull Banksia	8	350	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Possibly situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
561	Tuart	18	500	12-14	Good	Acceptable (undesirable)	Tall mature specimen. Has grown on a lean due to proximity and influence of adjacent larger tree. Basal bark wound on main stem structure. Possibly termites in main stem structure.	5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
562	Bull Banksia	8	600	8-10	Excellent	Good	Very good mature specimen; one of the best examples of the species.	7	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Possibly situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
563	Tuart	28	900	18-20	Excellent	Acceptable - Good	Large tall mature specimen; possibly remnant vegetation. Bark wound on main stem; possibly termites as well. Main stem structure bi furcates with signs of swelling at the union; would suggest this tree is better suited to a low Target area of the POS only.	9	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
564	Tuart	28	950	20-22	Excellent	Good	Large tall mature specimen; possibly remnant vegetation.	10	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
766	Jarrah	14	500	10-12	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem has previously snapped, basal cavity in main stem structure.	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve ; road design to minimise disturbance to its TPZ (although TPZ (although I would probably question the retention of this tree in a road reserve situation).
767	Jarrah	14	650	10-12	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure.	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread). Looks to be situated close to road reserve ; road design to minimise disturbance to its TPZ (although TPZ (although I would probably question the retention of this tree in a road reserve situation).
768	Marri	16	450	8-10	Good	Good	Good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

5.. Key Findings of the Assessment; POS 6







General Comments

A total of 181 trees that met the specification criteria were identified in this area, and includes tree tag numbers 530 - 533, 539, 565 - 575, 584 - 663, and 672 - 765.

Age Class

The age class of the trees in this area was considered to be much greater than the other areas; particularly in the south-eastern part of the POS, with most of the trees being easily in the order of 60 - 80 years plus.

There was again a much a lesser number of smaller sized trees in this area compared to POS 1 and 2.

A few much larger trees were also noted in this POS; estimated to be in excess of 100 years of age and so would probably be considered to be remnant vegetation.

Species Identified

The dominant species in this area included, Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Coastal Banksia (*Banksia attenuata*), and Bull Banksia (*Banksia grandis*).

The Tuart were again noted to be the dominant tree species in this area.

5. Key Findings of the Assessment; POS 6

Health Condition

The majority of the trees in this area showed varying indications of canopy stress/ trauma typically associated with impact from bushfire activity and/or environmental issues such as poor seasonal rainfalls.

A reasonably good volume of new foliage was however noted on the majority of the trees in this area, and given time moist (if not all) could be expected to make a full recovery; albeit slowly over a number of years.

There were no noticeable major pest/disease pathogens (i.e. *Phytophthora*) visible at the time of my inspection.

Structural Form

The majority of the trees showed to have what is considered to be typical structural forms for specimens of their given species.

Whilst a few of the trees showed to have (what are considered to be) structural defects (such as bi-furcated unions with some associated swelling, and/or areas of cavity within their main stem structures), the majority of the identified trees looked to be within the realms of management to mitigate any associated risks; particularly considering they are to be situated in an area of POS where Targets are likely to be either transitional or only in the potential Target area for relatively short periods of time, and not necessarily during the periods of higher risk of failure (i.e. during a storm).

Suitability for Inclusion

The majority of the trees inspected were considered suitable for inclusion into an area of POS.

In saying this, the retention of some of the trees may still yet become questionable pending detailed design of the landscape area around them and the introduction of any potential Targets within their likely fall zone; primarily due to their structural condition and in view of risk management responsibilities.

In general based on my observations and findings of the trees in POS 5:

1. The better quality trees on this site included trees numbered 565, 566, 572, 586, 602, 605, 606, 609, 610, 615, 616, 623, 630, 633, 645, 651, 662, 672, 673, 677, 685, 691, 692, 693, 696, 698, 699, 705, 707, 709, 710, 712, 714, 718, 719, 721, 722, 724, 726, 727, 728, 731, 733, 737, 738, 739, 743, 745, 749, 755, 758

   Note: Tree numbers 565, 566, 572, 616 and 677 are considered to be 'remnant vegetation'.

   Retention of as many of these trees as possible as part of the development of the POS is therefore encouraged.

2. There are a number of trees in this area that may be considered 'questionable' for retention and inclusion into a POS; either due to their current health condition and/or structural form.

   This includes tree tag numbers 574, 585, 587, 588, 591, 593, 599, 601, 602, 611, 613, 614, 617, 622, 625, 626, 628, 631, 635, 642, 648, 649, 650, 652, 658, 683, 686, 687, 688, 695, 701, 702, 703, 706, 711, 713, 734, 735, 736, 744, 746, 748, 751, 752, 753, 754, 764, and 765.

   Note: Tree numbers 442, 443, 622, and 683 are however considered to be 'remnant vegetation'.

   Their retention would however be very much dependent on any proposed design and introduction of or increase of potential Targets within their projected fall zone.

5. Key Findings of the Assessment; POS 6

3. The remaining trees in this POS area are all considered to be reasonably good specimens of their given species and would be considered to be suitable for inclusion into an area of POS.

4. As with the previous POS areas, it is difficult to provide any further recommendations at this stage without seeing any further detailed designs proposed for the POS.

   However it is strongly recommended that the location and TPZ of each of these trees be accurately surveyed (sub-metre accuracy), and overlaid onto any plans as part of the detailed design process (or at the very least the better and poorer quality trees).

   Any encroachment that is proposed to occur into any tree's TPZ must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines. Again, this is not to say that some encroachment and development activity cannot be undertaken within any designated TPZ area. However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process.

   Specific details for the POS will need to be discussed; namely levels for the POS, delineation of any underground services, drainage, final landscape treatment (and how it is to be achieved), introduction of potential Targets (particularly near the poorer quality trees), and in some instances the adjoining roads may also have some bearing and impact on some of the trees in this POS.

5. Similar to the previous POS areas, protection of the TPZ of any tree selected for retention during construction will also be required and will need to be in accordance with AS 4970 guidelines.

   TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical landscape works; the details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

6. Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

   Extent of pruning for each tree will however be very much dependent on final detailed design and more specifically the introduction of any Targets within their projected fall zone area.

   All pruning will need to be undertaken by qualified and experienced tree surgery contractors under the direct guidance of the nominated arboricultural consultant.

   All canopy pruning works will need to comply with AS 4373.

The following pages provide tree-by-tree information on each of the trees identified in POS 6 during the inspection.

The same terminology used for the table of assessment results for the other POS areas has again been used.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
530	Coastal Banksia	8	400	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem tri-furcates.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
531	Coastal Banksia	8	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
533	Coastal Banksia	7	300	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
539	Coastal Banksia	7	400	4-6	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
565	Marri	19	800	14-16	Good	Good	Large tall mature specimen; possibly remnant vegetation. Canopy is slightly sparse; particularly the upper section; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
566	Marri	19	800	14-16	Good	Good	Large tall mature specimen; possibly remnant vegetation. Canopy is slightly sparse; particularly the upper section; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ.
567	Jarrah	12	350	6-8	Fair	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
568	Jarrah	14	450	6-8	Fair	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
569	Jarrah	10	350	6-8	Poor	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
570	Jarrah	14	300	6-8	Fair	Acceptable (undesirable)	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height)

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
571	Marri	17	650	8-10	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	6	Landscape design to minimise disturbance to its TPZ.
572	Jarrah	18	1000	10-12	Poor	Good	Large mature specimen; possibly remnant vegetation. Canopy is sparse; particularly the upper section; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	10	Landscape design to minimise disturbance to its TPZ.
573	Bull Banksia	8	350	6-8	Excellent	Acceptable - Good	Mature specimen. Main stem bi furcates.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Possibly situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
574	Marri	18	450	10-12	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem furcates into three; signs of a cavity/area of decay at union; probably better suited to a low Target area of the POS.	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
575	Bull Banksia	8	400	4-6	Excellent	Acceptable - Good	Mature specimen. Has grown on a slight lean.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
584	Marri	9	300	4-6	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
585	Coastal Banksia	8	350	6-8	Fair	Acceptable - Good	Mature specimen. Has grown on a major lean due to proximity and influence of adjacent larger tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Would suggest this tree its better suited to a low Target area of the POS.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
586	Marri	20	600	12-14	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
587	Coastal Banksia	9	450	6-8	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; Would suggest this tree its better suited to a low Target area of the POS.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
588	Coastal Banksia	9	450	6-8	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; would suggest this tree its better suited to a low Target area of the POS.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
589	Bull Banksia	9	500	6-8	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
590	Coastal Banksia	9	450	6-8	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent trees.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
591	Bull Banksia	8	350	6-8	Good	Poor	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem has previously failed resulting in a poor structure; would suggest this tree its better suited to a low Target area of the POS.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
592	Coastal Banksia	9	400	6-8	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
593	Marri	12	450	8-10	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
594	Marri	12	350	6-8	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
595	Marri	16	450	8-10	Good	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
596	Tuart	24	500	8-10	Good	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.
597	Coastal Banksia	10	550	8-10	Good	Acceptable - Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
598	Jarrah	12	350	6-8	Fair	Acceptable - Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height)
599	Jarrah	12	350	6-8	Fair	Acceptable (undesirable)	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree. Basal cavity in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height)
600	Bull Banksia	10	450	6-8	Excellent	Acceptable - Good	Large mature specimen. Has grown on a slight lean.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
601	Bull Banksia	9	350	6-8	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Number of branch failures. Large wound on main stem structure, cavity in main stem structure, possibly termites; would suggest this tree its better suited to a low Target area of the POS.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
602	Jarrah	19	650	8-10	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height)
603	Marri	12	400	6-8	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large cavity in main stem structure, possibly termites; would suggest this tree is better suited to a low Target area of the POS.	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
604	Jarrah	12	300	6-8	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
605	Marri	19	650	12-14	Good	Acceptable - Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height)
606	Marri	19	600	8-10	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
607	Marri	12	450	6-8	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
608	Bull Banksia	8	650	8-10	Excellent	Good	Good large mature specimen.	7	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
609	Marri	19	600	10-12	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
610	Marri	19	700	10-12	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
611	Bull Banksia	7	350	6-8	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a major lean (north-west).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
612	Jarrah	13	450	6-8	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided (east).	4.5	Landscape design to minimise disturbance to its TPZ.
613	Tuart	25	750	12-14	Good	Acceptable (undesirable)	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal injury and termites noted in main stem structure. Bee hive in upper canopy indicates presence of cavity higher up in main stem structure; looks to have occurred due to failure of its main stem at some point in the past.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
614	Tuart	25	750	12-14	Good	Acceptable (undesirable)	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity and termites noted in main stem structure.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
615	Marri	17	700	12-14	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
616	Jarrah	21	1000	16-18	Fair	Acceptable - Good	Large mature specimen; possibly remnant vegetation. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates; some swelling at union.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
617	Tuart	25	950	16-18	Good	Acceptable (undesirable)	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity and termites noted in main stem structure; suggest this tree is better suited to a low Target area of the POS only.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
618	Marri	10	350	6-8	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Also slightly suppressed by adjacent larger tree.	3.5	Landscape design to minimise disturbance to its TPZ.
619	Marri	16	350	6-8	Good	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
620	Marri	17	500	8-10	Fair	Good	Mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.
621	Marri	16	650	12-14	Fair	Good	Mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
622	Jarrah	15	900	10-12	Good	Acceptable (undesirable)	Large mature specimen; possibly remnant vegetation. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity and fire damage noted in main stem structure; suggest this tree is better suited to a low Target area of the POS only.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
623	Marri	19	550	10-12	Fair	Good	Mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
624	Jarrah	11	300	6-8	Fair	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
625	Coastal Banksia	10	400	6-8	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean south. Evidence of termites in base of main stem structure.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
626	Jarrah	11	300	4-6	Fair	Acceptable (undesirable)	Regrowth around an old burnt stump. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
627	Coastal Banksia	9	500	6-8	Fair	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean west.	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
628	Coastal Banksia	9	450	6-8	Fair	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a major lean north.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
629	Coastal Banksia	9	400	8-10	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean north. Main stem bi furcates near ground level.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
630	Bull Banksia	10	500	6-8	Excellent	Good	Good mature specimen.	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
631	Coastal Banksia	11	450	6-8	Poor	Hazardous	Mature specimen. Canopy is very sparse; main stem has failed into two; would probably question the retention of this tree regardless.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Would probably question the retention of this tree in even in a POS.
632	Coastal Banksia	9	400	8-10	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
633	Marri	22	650	10-12	Fair	Good	Mature tree. Canopy is sparse; particularly the upper canopy section; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
634	Marri	22	550	10-12	Fair	Acceptable - Good	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Co-dominant leaders.	5.5	Landscape design to minimise disturbance to its TPZ. Possibly situated in Road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
635	Marri	21	450	8-10	Fair	Acceptable (undesirable)	Tall spindly tree. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates.	4.5	Landscape design to minimise disturbance to its TPZ. Possibly situated in Road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
640	Marri	22	450	8-10	Good	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Possibly situated in Road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
642	Coastal Banksia	9	500	8-10	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a major lean south-east.	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
643	Marri	12	300	4-6	Poor	Good	Tall spindly tree. Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
644	Marri	15	450	8-10	Good	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent larger tree.	4.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
645	Marri	22	600	12-14	Good	Good	Large mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Co-dominant leaders with some signs of swelling at union; may cause future issues longer term.	6	Landscape design to minimise disturbance to its TPZ.
646	Coastal Banksia	9	450	6-8	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean due to proximity and influence of adjacent larger tree. Main stem bi furcates and possible termites in main stem structure.	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
647	Jarrah	9	300	4-6	Good	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
648	Coastal Banksia	8	300	4-6	Good	Acceptable (undesirable)	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a major lean north-west.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
649	Jarrah	9	350	4-6	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height)
650	Tuart	22	750	14-16	Good	Acceptable (undesirable)	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure, termites noted. Has grown on a slight lean (north); would suggest this tree is better suited to a low Target area of the POS only.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height; to the north). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
651	Tuart	26	1000	20-22	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Number of bi-furcated unions.	10	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
652	Jarrah	11	300	6-8	Fair	Poor	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large basal cavity in main stem structure; has grown on a major lean (west). Would suggest this tree is suited to a low Target area of the POS only.	3.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ (although I would strongly question the retention of this tree in a road reserve situation).
653	Jarrah	11	400	6-8	Fair	Good	Multi stemmed specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to (or even in) road reserve; road design to minimise disturbance to its TPZ.
657	Coastal Banksia	9	400	6-8	Fair	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
658	Tuart	26	750	18-20	Good	Acceptable (undesirable)	Large mature specimen. Multi stemmed from near ground level; signs of a cavity in union (main stem structure) and termites. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Probably better suited to a low Target area of the POS.	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height). Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ (although I would question the retention of this tree in a road reserve situation).
659	Jarrah	11	300	4-6	Fair	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided due to proximity and influence of adjacent larger tree.	3	Landscape design to minimise disturbance to its TPZ.
660	Jarrah	12	450	6-8	Fair	Good	Multi stemmed specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
661	Tuart	20	350	6-8	Good	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
662	Tuart	25	500	8-10	Good	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ.
663	Jarrah	11	300	4-6	Fair	Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
672	Tuart	25	450	6-8	Good	Acceptable - Good	Tall spindly tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ. Possibly situated in Road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
673	Tuart	26	750	10-12	Good	Good	Three tall mature trees in very close proximity effectively forming the one canopy; treat as one tree during design and construction. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8 (each)	Landscape design to minimise disturbance to its TPZ. Possibly situated in Road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
674	Coastal Banksia	7	300	4-6	Fair	Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
675	Jarrah	8	300	4-6	Fair	Good	Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
676	Coastal Banksia	7	300	4-6	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
677	Tuart	28	1500	20-22	Good	Good	Very large very old specimen; clearly remnant vegetation. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Evidence of a number of larger sized branch failures, Bark wound on main stem, area of decay and possibly termites. But ok for a POS.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
678	Coastal Banksia	9	450	4-6	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
679	Jarrah	9	300	4-6	Fair	Good	Canopy is predominantly epicormic regrowth; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
680	Jarrah	9	350	4-6	Fair	Acceptable - Good	Canopy is sparse probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Multi stemmed specimen.	3.5	Landscape design to minimise disturbance to its TPZ.
681	Jarrah	9	350	4-6	Poor	Acceptable - Good	Canopy is very sparse probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Multi stemmed specimen. Basal cavity in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ.
682	Coastal Banksia	8	400	4-6	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
683	Jarrah	19	1300	14-16	Poor	Poor	Very large very old specimen; clearly remnant vegetation. Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Very large basal cavity in main stem structure; limited holding wood remaining; would probably question the retention of this tree other than in a low Target area of the POS .	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height) if it is desired to be retained.
684	Coastal Banksia	7	350	4-6	Good	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided and has grown on a slight lean.	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
685	Tuart	25	700	12-14	Good	Good	Tall mature tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated close to road reserve; road design to minimise disturbance to its TPZ.
686	Coastal Banksia	7	400	4-6	Poor	Acceptable (undesirable)	Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Cavity, decay and evidence of termites in main stem structure. Would probably question the retention of this tree regardless.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Looks to be situated in road reserve; would question the retention of this tree in such a situation.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
687	Tuart	25	550	12-14	Good	Acceptable (undesirable)	Mature specimen; regrowth around an old burnt stump. Basal cavity in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ. Looks to be situated in Road reserve; road design to minimise disturbance to its TPZ if it is to be retained (although I would probably question the retention of this tree in a road reserve situation).
688	Coastal Banksia	7	300	6-8	Poor	Good	Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ. Looks to be situated in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
689	Tuart	25	650	12-14	Good	Acceptable - Good	Mature specimen. Main stem bi furcates. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ. Looks to be situated very close to or even in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
690	Tuart	8	300	4-6	Good	Acceptable - Good	Smaller specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Also suppressed by adjacent larger tree.	3	Landscape design to minimise disturbance to its TPZ. Looks to be situated very close to or even in road reserve; road design to minimise disturbance to its TPZ (although I would probably question the retention of this tree in a road reserve situation).
691	Tuart	25	900	20-22	Good	Good	Very good mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	9	Landscape design to minimise disturbance to its TPZ. Looks to be situated very close to or even in road reserve; road design to minimise disturbance to its TPZ if it is desired to be retained.
692	Tuart	19	650	12-14	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree. Main stem bi furcates.	6	Landscape design to minimise disturbance to its TPZ.
693	Tuart	25	600	12-14	Good	Acceptable - Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
694	Coastal Banksia	6	300	6-8	Fair	Acceptable - Good	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Wide canopy spread.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
695	Coastal Banksia	6	300	4-6	Fair	Acceptable (undesirable)	Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large area of decay in main stem structure. Has grown on a slight lean south-west.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
696	Tuart	23	650	14-16	Good	Acceptable - Good	Mature specimen. Main stem bi furcates near ground level. Bark wound on main stem. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is also one sided due to proximity and influence of adjacent tree.	7	Landscape design to minimise disturbance to its TPZ.
697	Jarrah	9	300	4-6	Fair	Acceptable - Good	Canopy is sparse probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Multi stem bi furcates with signs of swelling at union; may cause future issues longer term.	3	Landscape design to minimise disturbance to its TPZ.
698	Tuart	25	600	12-14	Good	Acceptable - Good	Tall spindly mature specimen. Canopy is one sided due to proximity and influence of adjacent trees. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
699	Tuart	25	700	12-14	Good	Good	Tall spindly mature specimen. Canopy is one sided due to proximity and influence of adjacent trees. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
700	Tuart	16	450	8-10	Good	Acceptable - Good	Mature specimen. Canopy is slightly suppressed by adjacent larger trees. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
701	Tuart	18	600	12-14	Good	Acceptable (undesirable)	Tall spindly mature specimen. Has grown on a lean south due to proximity and influence of adjacent larger tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
702	Tuart	25	700	14-16	Good	Acceptable (undesirable)	Tall spindly mature specimen. Bark wound on main stem, possibly termites. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
703	Tuart	22	750	14-16	Good	Acceptable (undesirable)	Mature specimen. Large bark wound on main stem, possibly termites. Evidence of bees indicates presence of cavity in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
704	Jarrah	10	350	6-8	Fair	Acceptable - Good	Canopy is sparse probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure.	3.5	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
705	Tuart	18	500	10-12	Good	Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal bark wound on main stem structure.	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
706	Tuart	16	500	10-12	Good	Acceptable (undesirable)	Mature specimen. Has grown on a lean north, and canopy is one sided due to proximity and influence of adjacent trees. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates near ground level.	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
707	Tuart	22	550	10-12	Good	Acceptable - Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean west.	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
708	Tuart	21	400	8-10	Good	Acceptable - Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
709	Tuart	24	700	16-18	Good	Good	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.
710	Tuart	30	1000	18-20	Good	Acceptable - Good	Very tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates. Cavity in main stem structure, possibly termites.	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
711	Jarrah	14	700	12-14	Fair	Acceptable (undesirable)	Mature specimen. Has grown on a lean west due to proximity and influence of adjacent trees. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Large cavity in main stem structure; would suggest this tree is better suited to a low Target area of the POS.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
712	Tuart	24	1000	18-20	Good	Good	Large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	10	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
713	Tuart	25	800	20-22	Good	Acceptable (undesirable)	Large mature specimen. Main stem bi furcates near ground level; regrowth around an old burnt stump; large basal cavity in main stem structure; would suggest this tree is better suited to a low Target area of the POS. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
714	Tuart	25	650	14-16	Good	Acceptable - Good	Tall spindly mature specimen. Canopy is one sided (north) due to proximity and influence of adjacent larger tree. Canopy is also slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
715	Jarrah	10	300	4-6	Fair	Good	Spindly tree. Canopy is sparse probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
716	Bull Banksia	8	350	4-6	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
717	Jarrah	10	350	4-6	Fair	Good	Spindly tree. Canopy is sparse probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
718	Tuart	26	650	12-14	Good	Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Landscape design to minimise disturbance to its TPZ.
719	Tuart	17	450	8-10	Good	Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ.
720	Coastal Banksia	8	300	4-6	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Decay and termites noted in main stem structure.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).
721	Tuart	17	350	4-6	Good	Good	Tall spindly mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3.5	Landscape design to minimise disturbance to its TPZ.
722	Tuart	25	750	14-16	Good	Acceptable - Good	Tall mature specimen. Main stem bi furcates near ground level. Bark wounds on both main stem structures, evidence of termites. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
723	Jarrah	11	300	4-6	Fair	Acceptable (undesirable)	Spindly tree. Canopy is sparse probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	3	Landscape design to minimise disturbance to its TPZ.
724	Tuart	25	450	10-12	Good	Acceptable - Good	Tall spindly mature specimen. Main stem bi furcates near ground level. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
725	Tuart	17	400	8-10	Good	Acceptable (undesirable)	Tall spindly mature specimen. Main stem bi furcates near ground level with signs of swelling at union; may cause future issues longer term. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
726	Tuart	28	650	14-16	Good	Acceptable - Good	Tall spindly mature specimen. Canopy is slightly one sided due to proximity and influence of adjacent trees. Canopy is also slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Termites noted in main stem structure of small offshoot to this tree.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
727	Tuart	28	750	14-16	Good	Good	Tall spindly mature specimen. Canopy is one sided due to proximity and influence of adjacent trees. Canopy is also slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
728	Tuart	28	650	14-16	Good	Good	Tall spindly mature specimen. Canopy is also slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
729	Coastal Banksia	8	300	4-6	Poor	Good	Mature specimen. Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
730	Coastal Banksia	9	450	6-8	Poor	Good	Mature specimen. Canopy is very sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
731	Tuart	24	800	16-18	Good	Acceptable (undesirable)	Tall mature specimen. Large basal cavity in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
732	Coastal Banksia	8	350	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
733	Tuart	28	650	16-18	Good	Good	Tall spindly mature multi stemmed specimen; possibly two separate trees in close proximity. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
734	Tuart	28	450	6-8	Good	Acceptable (undesirable)	Tall spindly specimen. Cavity in main stem structure, evidence of termites. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
735	Tuart	24	450	6-8	Good	Acceptable (undesirable)	Tall spindly specimen. Area of decay in main stem structure, evidence of termites. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
736	Tuart	16	400	6-8	Good	Acceptable (undesirable)	Tall spindly specimen. Suppressed by adjacent larger trees. Basal cavity in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
737	Tuart	26	450	6-8	Good	Acceptable - Good	Tall spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
738	Tuart	28	550	10-12	Good	Acceptable - Good	Tall spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Bark wound on main stem structure, evidence of termites.	5.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
739	Tuart	28	650	14-16	Good	Acceptable - Good	Tall spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Bark wound on main stem structure, evidence of termites.	7	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
740	Tuart	16	300	4-6	Good	Acceptable (undesirable)	Spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).Cavity in main stem structure, evidence of termites.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
741	Tuart	14	350	4-6	Good	Acceptable - Good	Spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Bark wound on main stem structure, evidence of termites.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
742	Jarrah	14	300	4-6	Good	Acceptable - Good	Spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Small basal cavity in main stem structure.	3	Landscape design to minimise disturbance to its TPZ.
743	Tuart	26	500	10-12	Good	Acceptable - Good	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Bark wound on main stem structure, evidence of termites.	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
744	Tuart	15	400	8-10	Good	Acceptable (undesirable)	Has grown on a lean south-west due to proximity and influence of adjacent larger tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Bark wound on main stem structure, evidence of termites.	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
745	Tuart	30	900	20-22	Good	Good	Very large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	9	Landscape design to minimise disturbance to its TPZ.
746	Tuart	17	350	6-8	Good	Acceptable (undesirable)	Has grown on a slight lean south-west due to proximity and influence of adjacent larger tree. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Bark wound on main stem structure, evidence of termites.	3.5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
747	Tuart	28	700	16-18	Good	Good	Tall mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	7	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
748	Bull Banksia	7	350	6-8	Fair	Acceptable (undesirable)	Mature specimen. Has grown on a lean north due to proximity and influence of adjacent larger trees. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
749	Tuart	30	900	20-22	Good	Good	Very large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	9	Landscape design to minimise disturbance to its TPZ.
750	Bull Banksia	6	300	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
751	Marri	11	300	4-6	Good	Acceptable (undesirable)	Spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	3	Landscape design to minimise disturbance to its TPZ.
752	Coastal Banksia	6	350	6-8	Fair	Acceptable (undesirable)	Mature specimen. Has grown on a major lean east. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread; east)
753	Jarrah	8	350	6-8	Good	Acceptable (undesirable)	Regrowth around an old burnt stump. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Basal cavity in main stem structure.	3	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
754	Marri	18	500	10-12	Fair	Acceptable (undesirable)	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	5	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
755	Marri	18	550	10-12	Fair	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Landscape design to minimise disturbance to its TPZ.
756	Marri	16	300	6-8	Good	Good	Spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	3	Landscape design to minimise disturbance to its TPZ.
757	Bull Banksia	9	300	4-6	Fair	Acceptable - Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Has grown on a slight lean west.	4	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
758	Marri	20	800	16-18	Good	Good	Good large mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ.

Tree Tag No.	Species	Approximate Height (metres)	DBH (mm)	Canopy Spread (metres diameter)	Health	Structure	Comments	TPZ	Considerations
759	Bull Banksia	8	500	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
760	Bull Banksia	8	500	6-8	Fair	Good	Mature specimen. Canopy is sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	6	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
761	Bull Banksia	8	400	4-6	Good	Acceptable - Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Canopy is one sided.	5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
762	Bull Banksia	8	450	6-8	Good	Good	Mature specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	5.5	Species generally not tolerant of disturbance to their root zone area or changes to soil chemistry. Landscape design to minimise disturbance to its TPZ.
763	Marri	10	300	4-6	Good	Acceptable - Good	Spindly specimen. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen). Main stem bi furcates with signs of swelling at union; may cause future issues longer term.	3	Landscape design to minimise disturbance to its TPZ.
764	Tuart	18	400	8-10	Good	Acceptable (undesirable)	Tall spindly specimen. Basal injury and evidence of termites in main stem structure. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	4	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy spread).
765	Tuart	24	800	14-16	Good	Acceptable (undesirable)	Mature specimen. Cavity and evidence of termites in main stem structure; cavity extends all the way through; would suggest this tree is better suited to a low Target area of the POS only. Canopy is slightly sparse; probably due to impact from bushfire and environment issues (as opposed to a pest or disease pathogen).	8	Landscape design to minimise disturbance to its TPZ, or the introduction of Targets within its fall zone (canopy height).

6. Summary of Findings and Overall Opinion

It is difficult to provide any further recommendations at this stage without seeing any further detailed designs proposed for the various areas of POS and the relevant adjoining areas of the development.

The areas of proposed POS are however clearly dense areas of native tree vegetation so retention of all of the trees is quite likely not going to be a viable or achievable unless landscape in these areas is proposed to be minimal if any at all.

The majority of the trees in the identified areas of POS were considered to be suitable for inclusion into POS; particularly the better quality specimens that have been identified in the various areas, and retention of as many of these better quality trees as possible is highly recommended.

In some instances however retention of some of the trees even in an area of POS may be considered to be questionable, although their retention will be very much dependent on detailed landscape design, and more specifically if any potential Targets are proposed to be introduced into their projected fall zone by way of the development.

Whilst there are a number of what would be considered to be remnant vegetation trees in the various areas of proposed POS, the retention of some of these trees will be very much dependent on the design of the POS not only minimising disturbance to their designated TPZ areas, but also minimising the introduction or encouragement of potential Targets within their projected fall zones (primarily due to their structural condition).

To further aid in the design of the various POS areas, it is recommended that as a minimum the location of these trees, along with the better quality trees and the poor quality trees be surveyed and along with their designated TPZ area be overlayed onto all relevant detailed design plans.

From this better management decisions on the various trees can be made as part of detailed design.

Any encroachment that is proposed to occur into the TPZ of any tree highlighted for retention must include further arboricultural input from an experienced independent arboricultural consultant, and must be undertaken in accordance with AS 4970 guidelines.

This is not to say that some encroachment and development activity cannot be undertaken within any designated TPZ area. However any encroachment required/proposed will require further input and discussion with the arboricultural consultant as part of any detailed design process.

In specific, further arboricultural input will likely be required during detailed design to discuss:

1. Current existing ground levels and resulting levels of the area within the TPZ of any given tree. Note: Retaining and maintaining current existing ground levels within the designated TPZ of any tree is of paramount importance to the success of tree retention.
2. Delineation of any underground services pipework; specifically should they pass through any designated TPZ.
3. Final landscape of the area around any tree selected for retention (including the introduction of any potential Targets, delineation of any irrigation pipework or underground services, location of any hardscape structures, or softscape landscaping).
4. In some instances Lot boundary treatment, and/or detailed design of any adjoining road may also have some bearing and impact on some of the trees in this POS.

6. Summary of Findings and Overall Opinion

Protection of the TPZ of any tree selected for retention during the construction of the POS areas will also be a vital part of successful tree retention.

TPZ method statements in accordance with AS 4970 guidelines will likely need to be formulated and provided as part of any tender specification for implementation during the physical development works to ensure protection of trees selected for retention occurs.

The details of which will be very much dependent on detailed designs of the POS and adjoining sections of the development.

Some extent of canopy pruning will also likely be required on some of the trees to address potential site safety issues and in some instances provide clearances to enable development to occur.

Extent of pruning for each tree will however be very much dependent on final detailed designs; specifically the introduction of any areas of potential Target in the fall zone of any given tree.

All pruning will need to be undertaken by qualified and experienced tree surgery contractors under the direct guidance of the nominated arboricultural consultant.

All canopy pruning works will need to comply with AS 4373.

I look forward to continuing to aid Satterley Property Group and the design team as the development of E26 continues, and should you have any queries regarding the findings of this report, or if I can be of any further assistance, please do not hesitate to contact me.

Yours sincerely



Jason Royal
Dip. Arboriculture (UK)
Tech. Arbor A

7. Company Information

Company Name:	
A.C.N.:	107 194 061
A.B.N.:	66 566 369 687

Insurance Details:

General Liability	QBE Insurance Ltd	$20 million
Professional Indemnity:	Dual Australia Pty Ltd	$5 million
Workers Compensation:	QBE Australia	As per 'Acts'

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8. Disclaimer

This advice has been provided in good faith and based upon the material information provided by the Client to Arbor logic, and based on the visual inspection of the tree(s) at the time this advice was prepared.

Arbor logic does not accept liability arising out of loss or damage that results from: -

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- The provision of misleading or incorrect information by the Client or any other party to Arbor logic upon which this advice was prepared.
- This advice being used by the Client or any other party in circumstances or situations other than the specific subject of this advice.
- Failure by the Client to follow this advice.
- The action(s) or inaction(s) of the Client or any other party that gives rise to the loss of, or damage to, the subject of this advice.

The information provided in this advice may not be reissued or printed without Arbor logic's written permission.

It is also important to take into consideration that all trees are living organisms and as such there are many variables that can affect their health and structural properties that remain beyond the scope of reasonable management practices or the advice provided in this report based on the visual inspection of the tree(s).

As such a degree of risk will still remain with any given tree(s) despite the adoption of any best management practices or recommendations made in this report.

APPENDIX 3
Servicing and Engineering Report

DEPARTMENT OF HOUSING and SATTERLEY PROPERTY GROUP

LOT E26, 303 & 9014 GILMORE AVE, KWINANA

REPORT ON ENGINEERING ASPECTS ASSOCIATED WITH STRUCTURE PLAN

June 2013

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1. INTRODUCTION

This report has been prepared by Cossill & Webley Pty Ltd, Consulting Engineers, and it summarises the results of investigations undertaken by the firm, to date, of the engineering aspects of urban development of the Lot E26, 303 & 9014 Gilmore Ave, Kwinana.

The investigations have been based on the Structure Plan prepared by Burgess Design Group. The plan covers the area of urban zoned land bounded by Gilmore Avenue, Wellard Road, Meares Avenue and Challenger Avenue.

This report details the requirements for siteworks, earthworks, roadworks, drainage, sewerage reticulation, water supply and other public utility services to facilitate urban development as they relate to the Lot E26, 303 & 9014 Gilmore Ave, Kwinana.

2. SITE DESCRIPTION

The site, encompassing an area of approximately 36 hectares, is bounded by Gilmore Avenue, Wellard Road, Meares Avenue and Challenger Avenue in Kwinana.

The majority of the subject site is comprised of uncleared bushland. A small portion of the site on the eastern boundary has been cleared and fenced for Water Corporation sewage pump station and a Council drainage sump.

The site surface ground level is undulating with several drainage discharges onto the site. The existing levels on the site vary from RL4.0m to RL 16.0m AHD. The site vegetation is dense bushland and generally appears to be in good healthy condition.

Regional geological mapping (Geological Survey of Western Australia) identifies the site as comprised of sands derived from Tamala Limestone. They feature pale yellow brown, fine-to-course grained, sub-angular to well rounded quartz, with high-to-medium permeability and contribute to groundwater infiltration.

Hydrogeological information obtained from the Water and Rivers Commission – Perth Groundwater Atlas ,and based on current contours, indicates that groundwater is located approximately three and 15 metres below the current ground surface (2-3 metres AHD) and generally flows towards the south-west of the site.

The Western Australian Planning Commission *Planning Bulletin Number 64* indicate the site has a no-to-low risk of Actual Acid Sulphate Soils (AASS) and Potential Acid Sulphate Soils (PASS) occurring generally at depths greater than three metres.

3. SITEWORKS & EARTHWORKS

The existing contours vary on the site from a high point of RL16.0m AHD at the central western area of site to low points of RL 4.0m AHD to the south and RL 5.0m AHD in the north-east corner. The existing roads are relatively uniform around the site with all of these roads varying in level from RL 8.6 to RL 12.2 AHD at a average grade of between 0.8 to 1.1%. Generally the site falls from the adjacent road reserve into the site prior to rising to the high point of RL 16.0 AHD.

Preliminary earthworks designs have been undertaken on the proposal layout .The basis of the design was to keep where possible landform, minimise batters within areas of POS to facilitate retention of existing vegetation, proposed levels to match existing road reserves, level pads to Lots to minimise siteworks to potential purchasers, to limit extent of imported fill and facilitate drainage disposal into proposed POS areas and thus eliminating the requirement for drainage sumps.

The resultant lot levels vary from approx RL 13.40 in the central western area to RL 9.10 in the north east and RL 8.50m in the southern area. The retention of existing bushland to be accommodated within the POS area is as detailed in Emerge Associates section of this report.

The preliminary earthworks design does indicate the need to import material to obtain the required levels.

4. ROADS INFRASTRUCTURE

An assessment of the traffic and transport planning aspects of the Lot E26, 303 & 9014 Gilmore Ave, Kwinana has been carried out by Sinclair Knight Merz, and is reported separately.

In general this makes recommendations for the development road network of neighbourhood connectors, access streets and laneways, in terms of cross-sectional elements, pedestrian and cyclist provisions, public transport, etc.

In all cases these standards are consistent with the Liveable Neighbourhoods Community Design Code and will ensure adequate provision in the Development Plan for engineering services, street trees (where required), pedestrian and cyclist facilities and car parking.

The engineering design of the development roads will be in accordance with the Liveable Neighbourhoods Community Design Code and the requirements of the Town of Kwinana. This will include the provision of traffic calming measures, to contain vehicle speeds, and road pavement and landscaping treatments aimed at creating a high quality residential environment and improved safety, as well as a high standard of access.

Construction of the development roads will be staged to suit the rate and pattern of development of the Development Plan area.

5. DRAINAGE INFRASTRUCTURE

The proposed strategy to manage drainage within the site involves incorporating the drainage discharge into the various POS areas as detailed below This will alleviate the need for fenced drainage sumps which provides better use of land as well as better aesthetic values for the Community. The drainage will be treated via swales within the POS with 1:10 year depth not to exceed 900mm and 1:100 year not to exceed 1100mm deep.

Landscape treatments of the POS areas are contained within Emerge Associates Report for this Development.

All drainage discharge within POS areas will be via Gross Pollutant Traps. Water Sensitive design principals including the use of flush kerbing to roads adjacent to the POS areas and the use bottomless drainage pits to facilitate at source infiltration will be incorporated in the design.

The development of Lot E26, 303 and 9014 Gilmore Ave, Kwinana has to also manage the drainage from areas adjoining the site. There is currently eight existing drainage outlets into the site which consist of outlets into existing bushland except for one outlet into a fenced sump located on Meares Avenue. Details of existing catchments are included in the various drainage disposal areas below .Following preliminary design for the proposed development the drainage areas as indicated on Emerge Associates Landscape Masterplan dated 31/1/13.

i) POS "1" (adjacent to Challenger Ave)

The drainage within this area includes the majority of the north central and north west side of the development but also includes a total of 5500m2 of drainage from areas off site including Challenger Ave. The existing pipework includes the possibility of connection of a portion of the Shopping Centre site on the northern side of Challenger Ave but our calculations have not allowed for any input from this site.

ii) POS "2" (cnr Challenger Ave/Meares Ave)

The drainage within this area includes the majority of the north east side of the development but also includes a total of 12.95 hectares of drainage from existing areas to the east and north-east of the site. There are currently two existing drainage outfalls in this location including 750mm dia pipe. Due to the size of the catchment the treatment of initial "nuisance" storms (less than 1:1 year) will require detail design to evaluate the possible use of underground storage structures to ensure impact on POS is minimised from these storm events.

iii.) POS "3" (Central within Development)

The drainage within this area includes the majority of the central eastern portion of the development. The drainage will be contained with a grass swale located in the south-east portion of the POS which enables the retention of the vegetation in the western portion that runs north-south adjacent to the main connector road.

iv.) Drainage Swale – (adjacent to Gilmore Ave)

The drainage within this area includes a portion of the western side of the development but also includes the portion of Gilmore Ave adjacent to the site. There are currently three existing drainage outfalls in this location The drainage will be treated via creating a swale within the 12.0m wide POS area. Due to the existing levels of Gilmore Ave and the proposed levels within the Development the swale will be able to be created with the retention of the existing significant trees in this area.

v.) POS "5" (Southern Central within Development)

The drainage disposal in this area is only from adjacent road reserves within the Development. Disposal will be via swales shaped to facilitate retention of existing trees and enables at source infiltration in line with Water Sensitive Urban Design principals.

vi.) POS "6" (adjacent to Wellard Ave/Meares Ave)

The drainage within this area includes the majority of the southern side of the development but also includes a total of 8.85 hectares of drainage from existing areas east of the site that currently discharges into the fenced sump located at the southern end Meares Ave .Due to the size of the catchment the treatment of initial "nuisance" storms (less than 1:1 year) will require detail design to evaluate the possible use of underground storage structures to ensure impact on POS is minimised from these storm events.

vii.) Drainage Swale – (adjacent to Meares Ave)

The drainage within this area includes a portion of the eastern side of the development but also includes the portion of Meares Ave adjacent to the site as well as existing areas to the east that currently drain onto the site. The drainage will be treated via creating a swale within the POS area. Due to the existing levels of Meares Ave and the proposed levels within the Development the swale will be able to be created with the retention of the existing significant trees in the area.

Surface drainage within the subdivision areas will be via a conventional system of road gullies and underground pipes draining to the above detention basins. The pipe system will be designed to cater for run-off from minor storms with a frequency of up to 1 in 5 years with flows from less frequent major events, up to 1 in 100 years, provided for in overland floodways comprising road reserves, drainage channels and swales, linear open space, etc.

6. SEWERAGE INFRASTRUCTURE

The Water Corporation of WA (WCWA) has made provision for the sewerage of the Lots E26, 303 and 9014 Gilmore Ave, Kwinana development in its planning.

The strategy consists of the existing Meares Avenue temporary Waste Water Pump Station being replaced and graded out when a new Type 40 WWPS is built within the development site to service the subject land. There will be a requirement for a 30m radius odour buffer around the centre of the permanent Type 40 WWPS.

The approximate location of the proposed WWPS as indicated on the Water Corporation's adopted planning appears to coincide with a proposed POS 5 (Southern Central within the Development). The final location will need to be determined through the preparation of a detailed pump station catchment plan prior to subdivision of the land. The Water Corporation strategy includes the requirement to ultimately grade out the existing Waste Water Pump Station 10 (Rhodes Crescent, west of Gilmore Ave) into this proposed WWPS and there is also a requirement that north-east part of the site is filled in order to achieve the required fall towards the pump station.

Portions of the site that cannot gravitate into Meares Avenue pump station will need to gravitate to the north west and then along Gilmore Ave to the existing Barrick Road pumping station.

Water Corporation headworks contributions for sewerage would be levied on the Lots E26, 303 and 9014 Gilmore Ave, Kwinana in accordance with the Agreement Area rates.

The Water Corporation have advised that these works are currently covered by funding in the 2017/2018 financial year and if required earlier then the works will need to be undertaken through the Developer constructed works process.

7. WATER SUPPLY

As with sewerage, WCWA has made provision for water supply to the Lot E26, 303 and 9014 Gilmore Ave, Kwinana in its planning for servicing.

The site has existing 300mm distribution mains and 150mm reticulation mains located within both Meares Avenue and Challenger Avenue adjacent to the site. Water supply to the Development area will be via the extension of water reticulation from these adjacent road reserves.

Water Corporation headworks contributions for water are levied on the development in accordance with the standard WCWA.

8. OTHER UTILITY SERVICES

8.1 Electricity Supply

Electricity supply for the proposed development will be via an extension of the existing high voltage system in adjacent road reserves. At this stage it is not expected that any sites for sub-stations, etc, other than for padmount transformers, will be required in the proposed area.

8.2 Gas Supply

Natural Gas supply for the proposed development will be via an extension of the existing service located in the adjacent road reserves.

8.3 Telecommunications

Telephone supply for the proposed development will be via an extension of the existing service located in the adjacent road reserves with provision as per current NBN requirements.

APPENDIX 4
Transport and Access Report

Lot E26, Kwinana



TRANSPORT AND ACCESS REPORT

- Rev 5
- June 2013

Lot E26, Kwinana

TRANSPORT AND ACCESS REPORT

- Rev 5
- June 2013

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Executive summary

This Transport and Access report has been prepared by Sinclair Knight Merz (SKM) for The Department of Housing (DoH) and Satterley Property Group (project managers for DoH) to address the traffic and transport implications of the proposed Lot E26 Local Structure Plan (LSP), Kwinana.

At ultimate development, the major components of the Lot E26 Local Structure Plan (LSP) will be:

Land use	Yield
Single residential dwellings (R25/30/60)	393 dwellings
Dwellings within mixed use site (R-AC3)	84 dwellings
Grouped Housing (R60)	153
Retail	1511m² NLA
Commercial	1492m² NLA

A Strategic Site will also be included within the LSP area. Indicative yields for the Strategic Site are as follows:

Land use	Yield
Multiple Housing Sites R80	110 dwellings
Dwellings within mixed use development (R-AC3)	140 dwellings
Retail	2522m² NLA
Commercial	2540m² NLA

Key aspects of the LSP from a traffic and transport perspective are:

- The development area abuts the Kwinana Town Centre Hub (the Hub), which is to the north. The Hub is a significant shopping area and generates considerable vehicle traffic.
- The higher proposed densities are generally located towards the north of the development, which will enhance access to non-residential land uses for residents.
- The precinct is within the walkable catchment of the Kwinana bus station.
- The precinct has access to Wellard train station, but it is a short distance outside of the commonly accepted 'walkable catchment' (i.e. 800 metres straight line distance).
- A fine-grained, permeable internal street network is planned as are a large number of connections to the external movement network.
- High-quality pedestrian and cycling infrastructure is planned on key internal streets.

In general, for residential land uses, provision of car parking in accordance with the Residential Design Codes is proposed. However, given the significant opportunities for provision of public car parking within the precinct, it is proposed that most visitor car parking is provided on street, except in relation to lots accessed from laneways.

Car parking for the proposed retail land uses will be provided in accordance with the Town of Kwinana Town Planning Scheme No. 2. The applicable parking ratios may be reduced at the Town of Kwinana's discretion subject to development approval of acceptable land uses and detailed planning.

Based on site characteristics and the development plan, some mitigation of car driver trips (i.e. increased mode share for public transport, walking and cycling), may be expected compared with for many suburban areas. Nevertheless, the analyses described in this report assume conservative rates of traffic generation, as shown in **Table 1**.

Table 1 – Development breakdown – trip rates

Land Use	R-Code/Trip Rate	Dwellings/GFA	Trips
Residential	R25/30/R60 @ 5.25/ dwelling	393 dwellings	2,063 trips/ day
	R60 (grouped housing @ 4/ dwelling	153 dwellings	612 trips/ day
	R80 (Multiple Housing) @ 4/ dwelling	110 dwellings	440 trips/ day
	R-AC3 @ 4/ dwelling	224 dwellings	896 trips/ day
Retail (4033m² NLA @ 70/ 100m²)			2,823 trips/ day
Commercial (4032m² NLA @ 8/ 100m²)			323 trips/ day
Total daily trips			7,157 trips/ day

Traffic access to and from the development will function adequately assuming the following key intersection treatments:

- Retention of the give-way control and geometry at the Challenger Avenue/ Gilmore Avenue intersection, which disallows right turn movements from the former on to the latter.
- Full movements allowed at the intersection of the primary East-West Road and Gilmore Avenue.
- Installation of a roundabout at the intersection of Challenger Avenue and the primary North-South Road.

On these bases and assuming the previously identified public transport, walking and cycling provisions, access to and from Lot E26 should occur in a satisfactory manner without adverse traffic impacts.

1. Introduction

1.1. The proposal

This Transport and Access report has been prepared by Sinclair Knight Merz (SKM) for The Department of Housing (DoH) and Satterley Property Group (project managers for DoH) to address the traffic and transport implications of the proposed Lot E26 Local Structure Plan (LSP), Kwinana.

This document has been prepared with reference to the *Transport Assessment Guidelines for Development, Volume 2 – Structure Plans* [Western Australian Planning Commission (WAPC), August 2006]. The current version incorporates feedback provided by the Town of Kwinana.

1.2. Transport assessment objectives

The WAPC guidelines specify that the key objectives of a transport assessment for a structure plan are to assess the:

- proposed internal transport networks with respect to accessibility, circulation and safety for all modes: i.e. motor vehicles, public transport, pedestrians and cyclists;
- level of transport integration between the structure plan area and surrounding land uses;
- impacts of the traffic generated by the structure plan area on surrounding land uses; and
- impacts of the traffic generated by the structure plan area on the surrounding transport network.

1.3. Report updates

Revision 1 of this report was produced and submitted in June 2009. This report (revision 4) has been updated to take account of changes to the proposed development yield and layout; and latest comments received from the Town of Kwinana. The proposed layout of the development and its potential impacts on the local road network has been addressed in this report.

1.4. Structure of the report

The remainder of this report takes the following structure:

- Section 2 – Background
- Section 3 – Existing transport and access
- Section 4 – Planned and committed external network
- Section 5 – Car Parking
- Section 6 – Traffic generation and distribution
- Section 7 – Public transport
- Section 8 – Pedestrians and cyclists
- Section 9 – Conclusions

2. Background

2.1. Site location

The development precinct is 36 hectares in size and is bordered by Challenger Avenue; Meares Avenue; Wellard Road; and Gilmore Avenue. **Figure 1** shows the provisional Structure Plan prepared by Burgess Design Group. Figure 2 places Lot E26 within the sub-regional context[1]. The development is intended to be integrated with the Kwinana Town Centre Hub (the Hub), which is immediately to the north.

2.2. Summary of land use activity

It is proposed that development will include residential, retail and commercial uses, including mixed use in the north-west corner of the site. The proposed yields are described in detail in **Section 3**.

The development will also include a 'Strategic Site' – see **Figure 1**. This area is earmarked by the Town of Kwinana as a possible location for civic and commercial uses associated with the town centre, should the need arise. Indicative yields for the Strategic Site have been considered as part of the traffic analysis presented in this report.

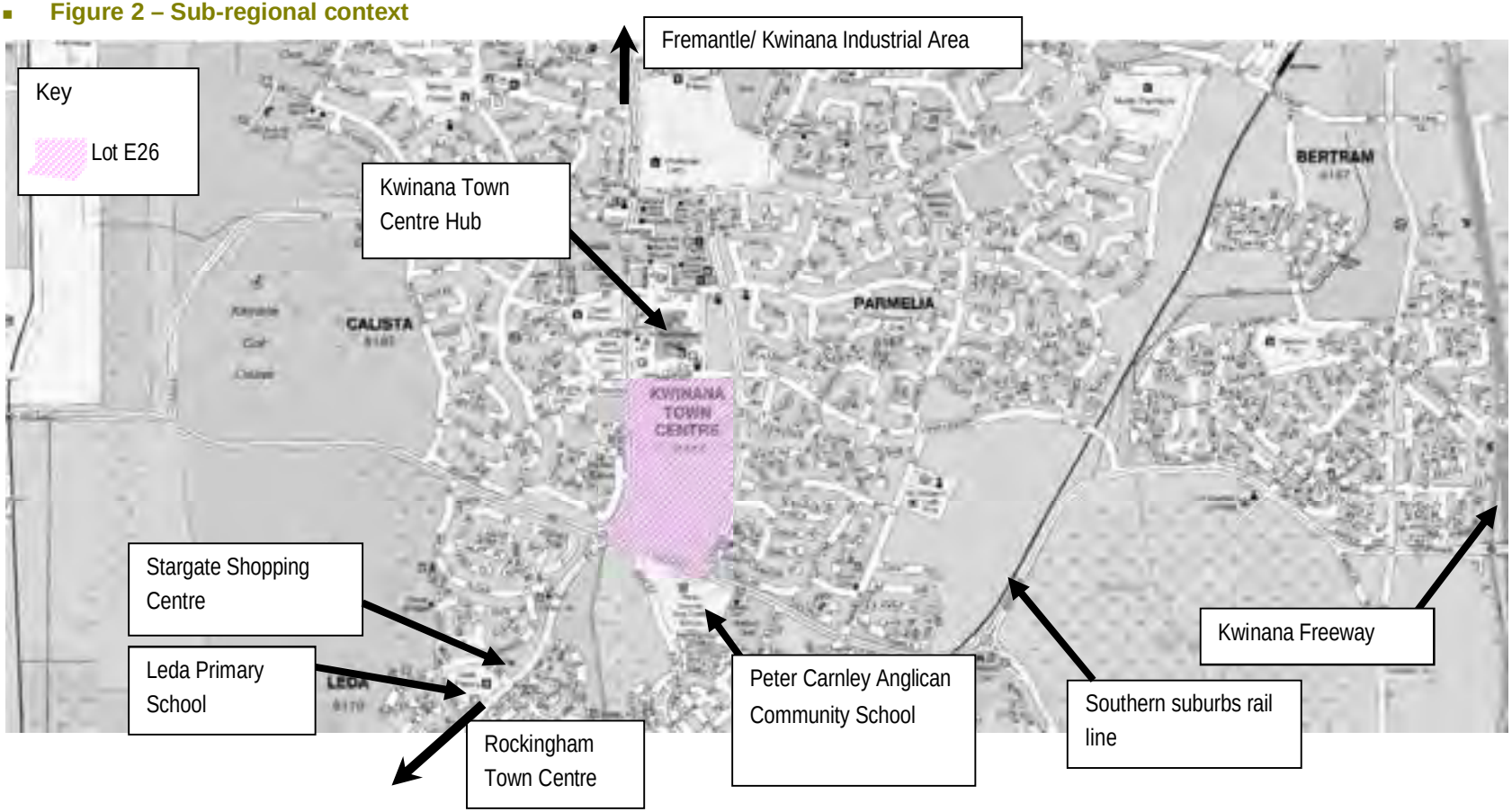
[1] NB. Henley Boulevard and Wellard Road have been realigned: this is reflected in the Provisional Structure Plan.

- **Figure 1 – Provisional structure plan**



Source: Burgess Design Group 2013

- **Figure 2 – Sub-regional context**



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2.3. The existing environment

Presently, the subject site is undeveloped bushland. The principal infrastructure in the vicinity includes Gilmore Avenue, which is a four lane divided road and categorised as a District Distributor (A) within Main Roads Western Australia's (MRWA) Functional Road Hierarchy (refer to **Figure 3**). It is also classified an "Other Regional Road" in the Metropolitan Region Scheme (MRS). Gilmore Avenue borders the site to the west.

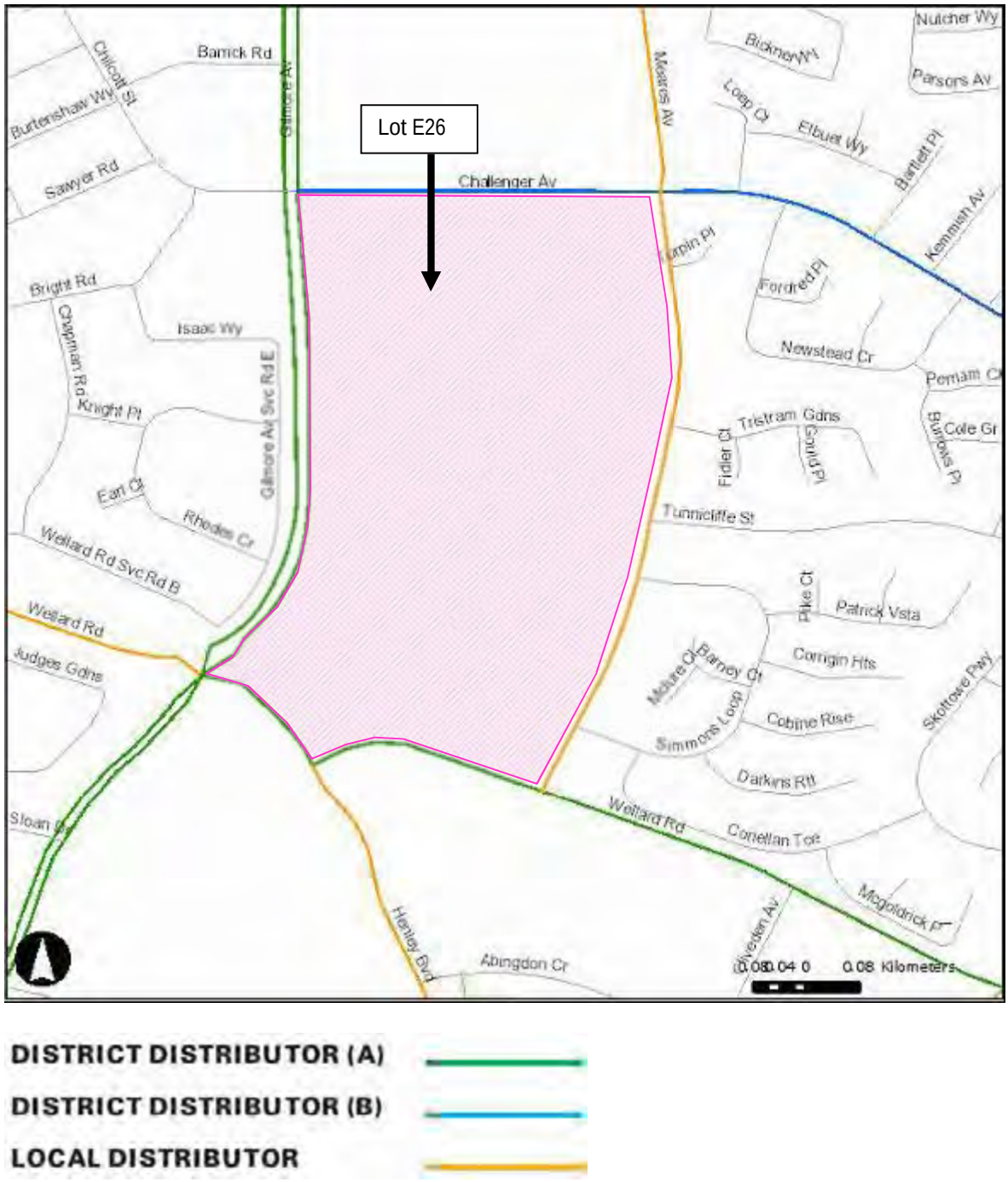
Challenger Avenue, which is a two lane divided road bordering the site to the north is classified as a District Distributor (B) within the Functional Road Hierarchy and is classed a local road in the MRS. It provides access to the Hub and intersects with Gilmore Avenue at a give-way controlled T-junction. Turning movements from Challenger Avenue are restricted to left turns (see **Figure 4**).

Wellard Road is a two lane divided road and classified a District Distributor (A). Meares Avenue is a two lane undivided road and classified a Local Distributor.

Major traffic generators/attractors in the area other than the Hub include the Rockingham Town Centre, which is several kilometres southwest of the site and can be accessed via Gilmore Avenue. Stargate, which is a small shopping centre and Leda Primary School are a short distance southwest of the intersection of Gilmore Avenue and Wellard Road (see **Figure 2**). Peter Carnley Anglican Community School is immediately south of the site.

To the east and west, the adjoining development is low density residential, generally characterised by curvilinear streets and cul-de-sac.

- **Figure 3 – Main Roads WA functional road hierarchy, Kwinana Town Centre**



(Source: Main Roads WA, May 2011)

- **Figure 4 – Intersection of Gilmore Avenue/ Challenger Avenue on the minor approach**



2.4. Proposed development affecting Lot E26

There are no external developments that are considered to directly impact on the Lot E26 LSP.

2.5. Consultation

This report is a revision of the original Transport and Access report produced by SKM in 2009. Subsequent to original 2009 report, revisions were also made to the report in 2011. This report revision has been produced to take account of recent changes to the proposed development yield, site access arrangements and to address comments provided by the Town of Kwinana.

This report (and the previous versions) has been prepared in consultation with the Lot E26 project team (Satterley Property Group, Burgess Design Group, Cossill and Webley, The Department of Housing, 360 Environmental and MNLA Landscape Architects) and Town of Kwinana.

The original 2009 report also included input from the Public Transport Authority (PTA).

3. Existing transport and access

3.1. Provisional yield

It is proposed that a mix of residential, retail and commercial will be provided across the site, including within the Strategic Site.

A summary of the proposed yields for the LSP, excluding the Strategic Site, is provided in **Table 2**.

Table 2 – Proposed development yields (excluding Strategic Site)

Land use	Yield
Single residential dwellings (R25/30/60)	393 dwellings
Dwellings within mixed use site (R-AC3)	84 dwellings
Grouped Housing (R60)	153
Retail	1,511m² NLA
Commercial	1,492m² NLA

A summary of the indicative yields for the Strategic Site is provided in **Table 3**.

Table 3 – Indicative yields for the Strategic Site

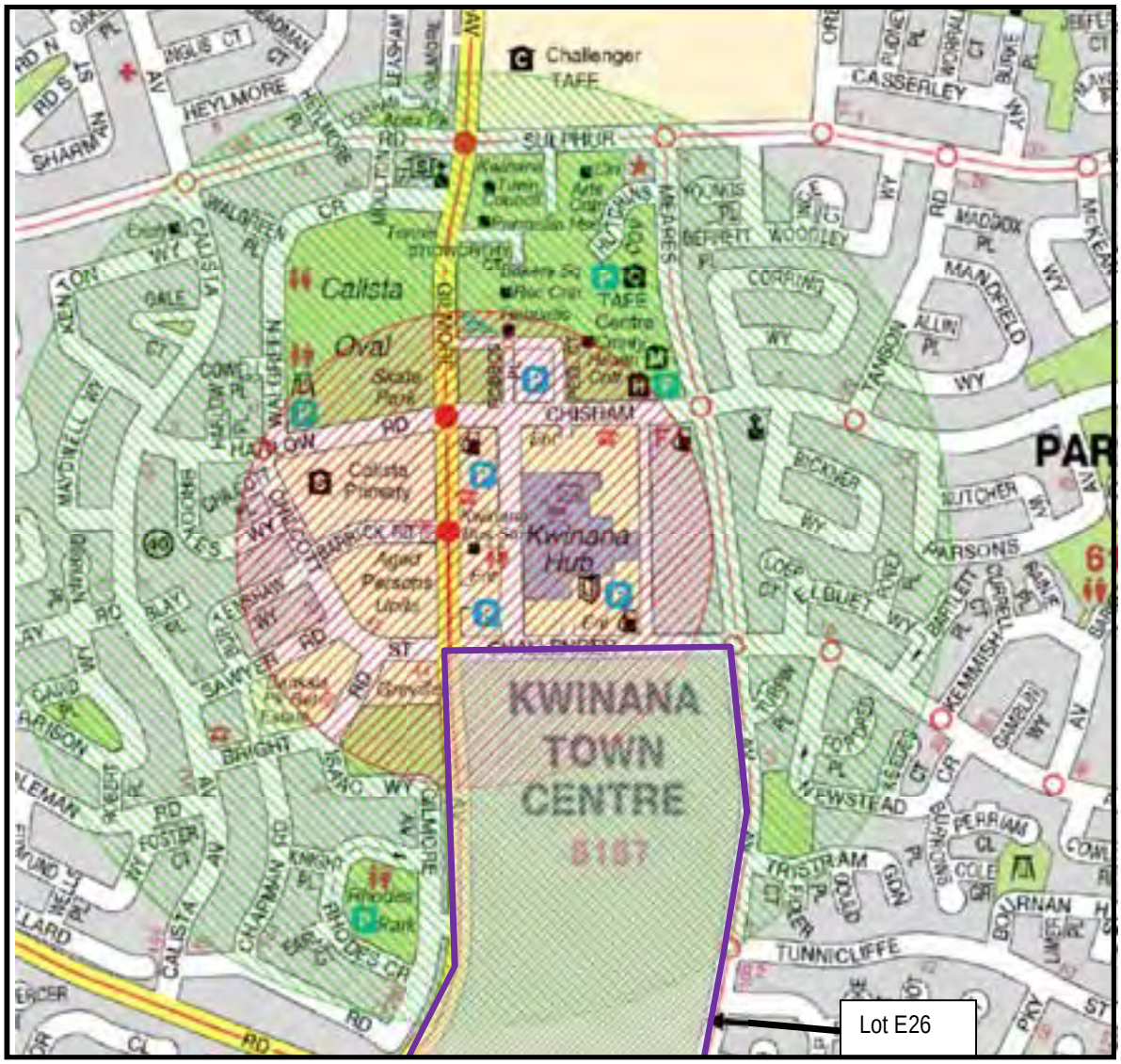
Land use	Yield
Multiple Housing Sites R80	110 dwellings
Dwellings within mixed use development (R-AC3)	140 dwellings
Retail	2,522m² NLA
Commercial	2,540m² NLA

The proposed commercial uses may include offices and other uses ancillary to the residential and retails uses, such as cafes. The LSP also makes allowances for significant areas of public open space.

3.2. Design and access characteristics

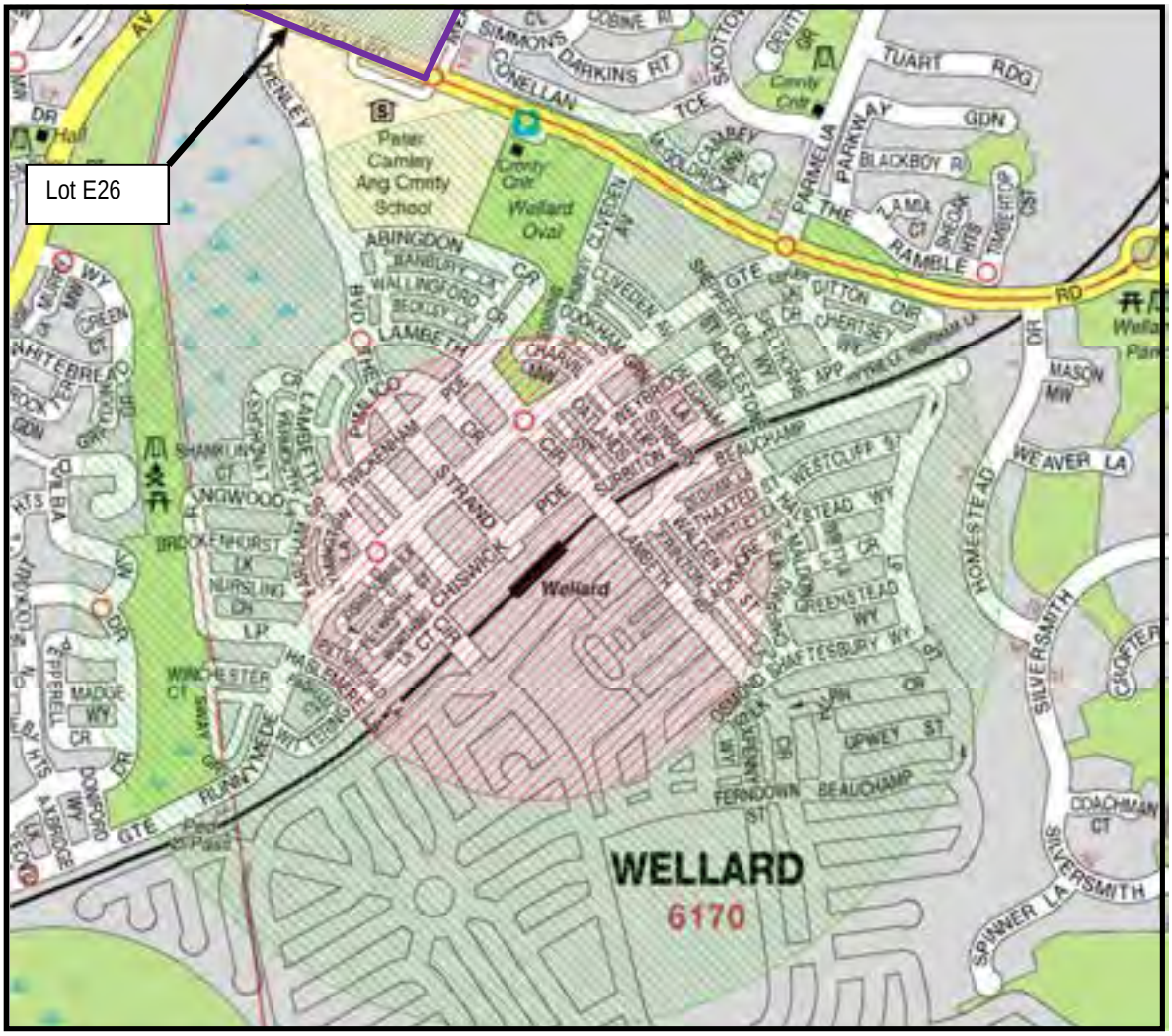
In general terms, the precinct is being planned to incorporate a range of densities and is within good proximity to a number of public transport services. In particular, it is within the walkable catchment – 800 metres straight line distance – of the Kwinana bus station and a short distance outside of the walkable catchment of Wellard train station (see **Figure 5** and **Figure 6**). These characteristics should mitigate car dependence when compared with a conventional suburban development in outer areas of the metropolitan region.

- **Figure 5 – Kwinana bus station walkable catchment in relation to Lot E26**



(Source: Map reproduced with permission of UBD. Copyright Universal Publishers Pty. Ltd.)

- **Figure 6 – Wellard train station walkable catchment in relation to Lot E26**



(Source: Map reproduced with permission of UBD. Copyright Universal Publishers Pty. Ltd.)

4. Planned and committed external network

4.1. Access to the external road network

There are numerous proposed points of ingress to/ egress from the precinct (see **Figure 8**). In particular, there is anticipated to be a high degree of connectivity between the precinct and the Hub, and Gilmore Avenue, which is the principal north-south road in the vicinity.

In general, much of the existing street network to the east and west is characterised by curvilinear streets and culs-de-sac, which is likely to channel development traffic on to higher order roads such as Wellard Road, Challenger Avenue, Meares Avenue and Gilmore Avenue for sub-regional trips.

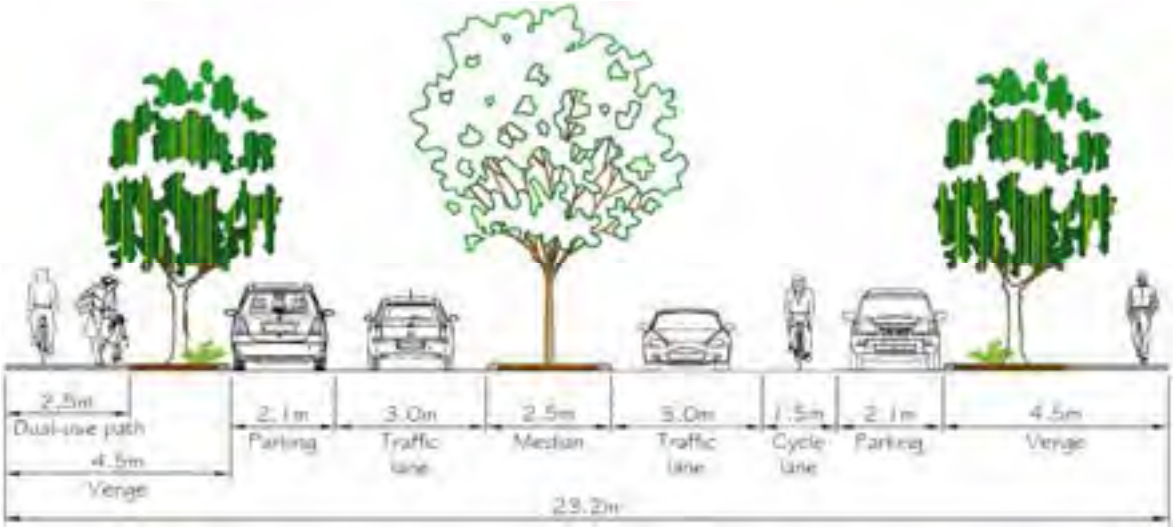
The Town of Kwinana has requested that the current treatment of the Gilmore Avenue/ Challenger Avenue intersection remains as is, given it is considered to mitigate traffic hazards. The present treatment does not allow vehicles to turn right from Challenger Avenue on to Gilmore Avenue but does allow right hand turns from Gilmore Avenue on to Challenger Avenue. There is a left turn slip lane provided on Gilmore Avenue southbound.

It is proposed that the site will have nine access points, with three of the accesses from Gilmore Avenue, one from Wellard Road, two from Challenger Avenue and four from Meares Avenue. The location of the access points are shown in **Figure 8**. Intersection treatments are discussed further in **Section 5** of this report.

It is anticipated that Meares Avenue and Challenger Avenue will be upgraded to 'boulevard' standard streets to include landscaped medians; dual use paths along the southern side of Challenger Avenue and western side of Meares Avenue, with on road cycle lanes on the opposing carriageway; and on-street parking. This type of street layout will help to reduce traffic speeds in the vicinity of the LSP and create a pedestrian friendly, slow speed environment. Development responsibilities for upgrades to Meares Avenue and Challenger Avenue are yet to be determined and contributions to these works are subject to further discussion and negotiation between the City of Kwinana and the Department of Housing (being the landowner).

An indicative cross section of the anticipated street layout for Mears Avenue and Challenger Avenue is shown in **Figure 7**.

- **Figure 7 – Boulevard cross section for Mears Avenue and Challenger Avenue**



Overall, SKM has assessed that the existing linkages and the proposed improvements will adequately accommodate traffic movements in to and out of Lot E26. The large number of linkages ensures that traffic will distribute via other routes if any (unlikely) spot congestion occurs.

Figure 8 – Internal street layout and points of egress/ ingress



Source: Burgess Design Group 2013.

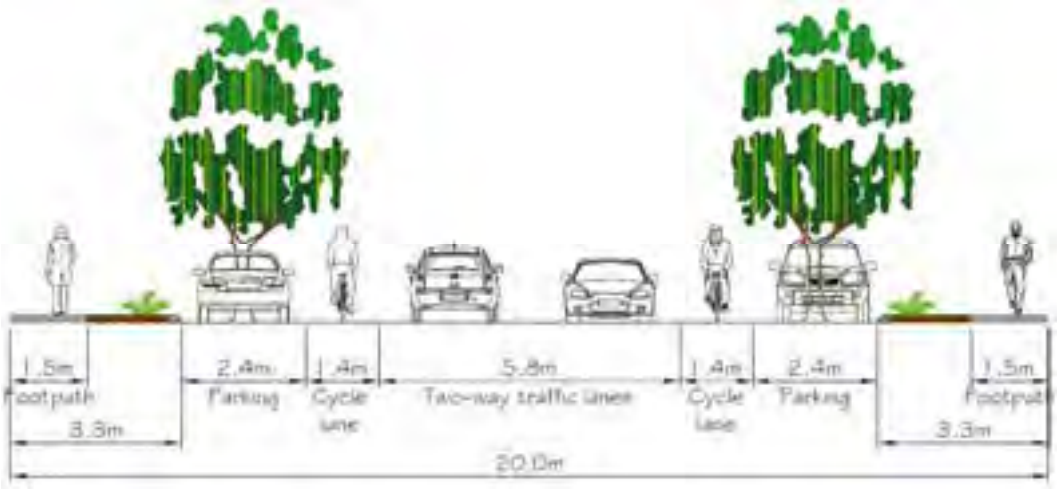
4.2. Internal street layout

The internal street network is sufficiently permeable to allow good site access and traffic circulation. Indicative cross sections have been developed for the key streets proposed within Lot E26.

It is recommended that the key North-South Road is designed as an undivided Neighbourhood Connector B with a reserve width of 20 metres, as outlined in the Kwinana Town Centre Masterplan (see **Figure 9**).

The Kwinana Town Centre Masterplan includes a different indicative design for North-South Road, on the basis that development would occur on both sides and a median would be installed, with dedicated. The current LSP anticipates that the road will be bordered by green space to the east, no vehicles will be required to reverse on to the road and a median will not be required.

- **Figure 9 – Indicative cross section: North-South Road**



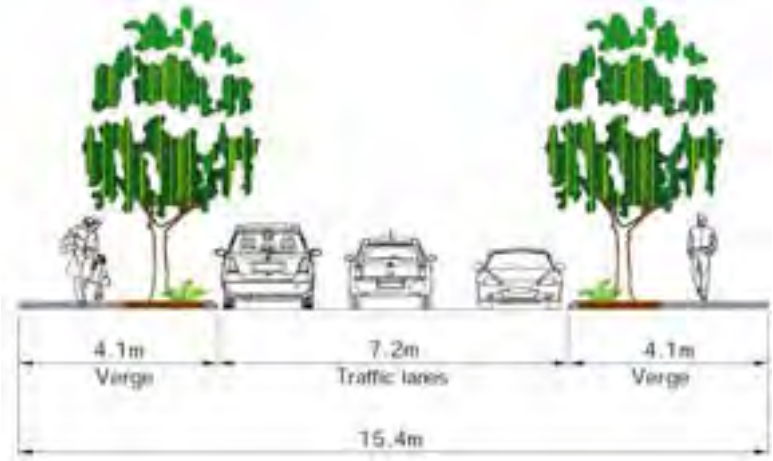
SKM proposes that the primary East-West Road (i.e. the gateway to the site connecting Gilmore Avenue with the principal North-South Road), is also designed as a Neighbourhood Connector with a design incorporating a median. This street is planned to have a total reserve width of up to 25 metres, although the median width may be reduced, if required. This road will be the entrance statement to the precinct. SKM's proposed cross section – see **Figure 10** – with a total width of 25 metres includes provision for dual 2.5 metre shared paths, 2.5 metre indented car parking/ landscaping, 1.5 metre on-street cycle lanes and a six metre median incorporating swales.

- **Figure 10 – Indicative cross section: East-West 'gateway' Road**



All other internal streets, with the exception of laneways, are anticipated to function as local access streets. The cross section for a typical access street is provided in **Figure 11**.

- **Figure 11 – Indicative cross section: typical access street**

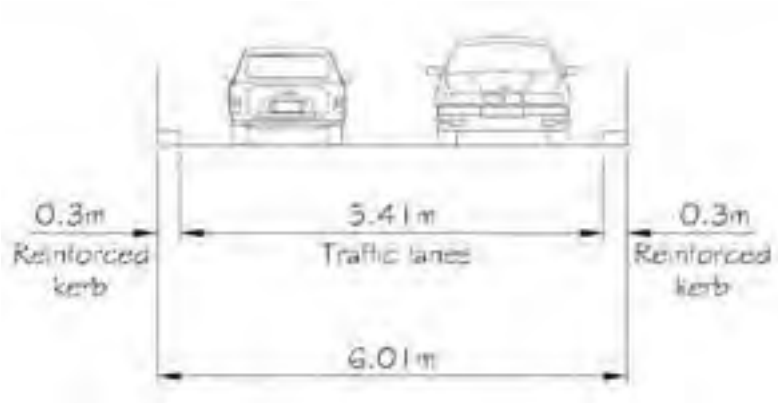


It is generally noted that the Town of Kwinana requires a minimum footpath width of 2.1 metres where the footpath is provided adjacent to retaining walls. This includes 300mm clearance from the wall while still retaining a nominal path width of 1.8 metres.

Laneways are subject to a minimum reserve of 6.01 metres. The Town of Kwinana has requested that 5.41 metre wide seal is provided with 300 mm reinforced kerbing on either side (see **Figure 12**).

The Town of Kwinana has also noted that where 90 degree bends are indicated within the internal street network, there may be a requirement for localised median divides to be provided to prevent vehicles cutting corners. It is anticipated that these requirements can be identified at the subdivision planning stage, although it is noted that the LSP anticipates local widening at such corners to accommodate any requirements.

- **Figure 12 – Indicative cross section: laneways**



5. Car Parking

SKM recommends that residential car parking is generally provided in accordance with the Residential Design Codes, with a lower level of provision per dwelling for higher density units compared with single lot residences. However, visitor car parking should generally be provided on street, given that street cross section designs incorporate car parking adjacent to both kerbs. This will allow car parking to be shared between residences and should be more efficient than requiring each lot to have a minimum of visitor car parking on site.

There may need to be provision for a maximum of visitor parking on site (limited to 0.1 bays per unit in multiple unit arrangements and 0.25 bays per grouped unit as per the R codes), in instances where site access is from laneways (i.e. there is no nearby on street car parking available for use by visitors). The Town of Kwinana has stated a preference for visitor car parking to be provided at a rate of 0.5-0.66 bays per unit; however, SKM considers that this would be an oversupply based on the opportunities for on-street car parking and the provisions within the R codes. In general, needs in relation to car parking can be identified at the subdivision planning stage.

Car parking for the proposed retail uses will be in accordance with the Town Planning Scheme No. 2, however the parking ratios may be reduced at the Council's discretion subject to approval of acceptable land uses and detailed planning.

More generally, on street car parking should be provided in parallel, rather than at 90 degrees to the road. The latter tends to create safety issues for pedestrians wishing to cross the road, and between vehicles using the street and those manoeuvring in to/ out of the bays. The former reduces these safety issues and can also contribute to slowing vehicle traffic speeds through the precinct.

On-site car parking from streets (with the exception of on-street car parking bays), should be minimised, with the preferred locations being behind residential units. In relation to the proposed retail, access to any on-site car parking should be from the service road to the south of the development rather than from Challenger Avenue. It is noted that laneways are shown on the LSP to provide rear access to a large number of residential units, thus meeting this recommendation. Intra block car parking on strata sites is another alternative.

6. Traffic generation and distribution

6.1. Existing traffic volumes

Traffic volumes along major roads in the vicinity of the development are shown in **Table 4**. The Main Roads WA traffic data is now generally dated. A spot count conducted by SKM on a Thursday at the intersection of Challenger Avenue and Gilmore Avenue identified around 580 vehicle trips in the peak hour along Challenger Avenue. Applying industry accepted assumptions that peak traffic flows are about 10% of daily traffic flows, Challenger Avenue may presently carry around 5,800 vehicles per day (vpd) in the vicinity of Gilmore Avenue.

Council traffic count data, collected in 2004, shows that Gilmore Avenue carried about 9,200 vpd in the vicinity of the Hub. More recent data (2007) identifies that Gilmore Avenue carried about 12,400 vpd south of Sulphur Road.

According to 2007 traffic count data, Meares Avenue carried about 3,500-4,000 vpd in the vicinity of Tunnicliffe Street. Data from 2008 shows that Wellard Road carried about 8,000 vpd in the vicinity of the Wellard Road/ Parmelia Avenue/ Runnymede Gate roundabout.

- **Table 4 – Existing traffic volumes along major roads in the vicinity of Lot E26**

Road	Daily traffic volumes	Data source
Challenger Avenue (east of Gilmore Avenue)	4,620	MRWA traffic count 1998/ 1999
Challenger Avenue (east of Gilmore Avenue)	5,800	SKM spot count 2009
Gilmore Avenue (south of Wellard Road)	16,170	MRWA traffic count 2002/ 2003
Gilmore Avenue (north of Wellard Road)	11,330	MRWA traffic count 2002/ 2003
Gilmore Avenue (in the vicinity of the Kwinana Town Centre Hub)	9,200	Town of Kwinana traffic count 2004
Gilmore Avenue (south of Sulphur Road)	12,400	Town of Kwinana traffic count 2007
Meares Avenue	2,550	MRWA traffic count 1998/ 1999
Meares Avenue (near Tunnicliffe Street)	3,500-4,000	Town of Kwinana traffic count 2007
Wellard Road	8,200	MRWA traffic count 2002/ 2003
Wellard Road (near Wellard/ Parmelia/ Runnymede roundabout)	8,000	Town of Kwinana traffic count 2008

6.2. Trip generation

6.2.1. Daily trip generation

At full development it is estimated that the development on Lot E26 could generate about 7,100 vehicle trips per day. The estimated vehicle trip generation associated with the proposed land uses is shown in **Table 5**.

In general, vehicle trip rates depend on the availability of public transport; the quality of walking and cycling infrastructure; local provision of car parking; and the accessibility of important regional destinations such as major employment centres and shopping centres. Lot E26 will be adjacent to the Hub, within the walkable catchment of the Kwinana bus station and a short distance outside of the walkable catchment of Wellard train station, but this level of access is mediated by the general, low density suburban context of the development.

Given these characteristics, trip generation may be a small percentage less on a daily basis than would be expected in other suburban development areas that do not have these relative advantages.

For the proposed residential uses, a daily trip rate of 5.25 trips per dwelling has been assumed. This trip rate has been calculated based on the following assumptions:

- 2.5 people per dwelling
- 3.5 trips per person per day
- 60% car driver mode share (the average car driver mode share for Perth is 58%)

Therefore 2.5 (people) x 3.5 (trips) x 60% (mode share) = 5.25 vpd.

- **Table 5 – Vehicle trip generation associated with different land uses and density of development**

Land Use	R-Code/Trip Rate	Dwellings/GFA	Trips
Residential	R25/30/R60 @ 5.25/ dwelling	393 dwellings	2,063 trips/ day
	R60 (grouped housing @ 4/ dwelling	153 dwellings	612 trips/ day
	R80 (Multiple Housing) @ 4/ dwelling	110 dwellings	440 trips/ day
	R-AC3 @ 4/ dwelling	224 dwellings	896 trips/ day
Retail (4033m² NLA @ 70/ 100m²)			2,823 trips/ day
Commercial (4032m² NLA @ 8/ 100m²)			323 trips/ day
Total daily trips			7,157 trips/ day

6.2.2. Peak hour trip generation

The following proportions of the daily forecast traffic volumes are assumed to occur in the AM peak hour:

Residential	8% (4,011 x 0.08 = 321 trips)
Retail	5% (2,823 x 0.05 = 141 trips)
Commercial	8% (323 x 0.08 = 26 trips)
Total generated AM peak hour traffic	**488 trips**

The following proportions of the daily forecast traffic volumes are assumed to occur in the PM peak hour:

Residential	10% (4,011 x 0.1 = 401 trips)
Retail	10% (210 x 0.1 = 282 trips)
Commercial	10% (323 x 0.1 = 32 trips)
Total generated PM peak hour traffic	**715 trips**

During morning and afternoon peak hours, traffic typically follows the pattern shown in **Table 6**.

- **Table 6 – Directional movements of peak traffic generated by different land uses**

Land use		In	Out
Residential	AM peak	10%	90%
	PM peak	80%	20%
Retail	AM peak	85%	15%
	PM peak	20%	80%
Commercial	AM peak	85%	15%
	PM peak	20%	80%

Table 7 assigns the trips generated by the various land uses based on these patterns.

- **Table 7 – Inbound and outbound trips occurring during the morning and afternoon peak hours**

Land use	AM peak hour		PM peak hour	
	Inbound	Outbound	Inbound	Outbound
Residential	32	289	321	80
Retail	120	21	56	226
Commercial	22	4	6	26
Total	33	222	248	78

6.3. Traffic distribution and impacts

Given the high number of linkages with the external road network proposed and the range of trip attractors in different directions - see **Figure 2** - SKM has predicted that development traffic will distribute fairly evenly. A daily distribution summary is shown in **Table 8** compared with best estimates of existing traffic on the local road network and a peak hour distribution summary is shown in **Table 9**.

About 30% of development traffic is forecast to distribute north via Gilmore Avenue because this provides the most direct linkage through to Thomas Road and subsequently Kwinana Freeway for traffic travelling towards central Perth. Gilmore Avenue also provides access to major local destinations including Kwinana Day Hospital and the recreation complex north of Chisham Avenue.

About 15% of development traffic is forecast to distribute northwards via Meares Avenue; 15% eastwards via Challenger Avenue; and 15% eastwards via Wellard Road. Each of these routes provides access to other local attractors and more circuitous access to Kwinana Freeway.

The remaining 25% of development traffic is forecast to distribute southwards via Gilmore Avenue to access destinations including Stargate Shopping Centre and Rockingham Town Centre.

A negligible amount of traffic is likely to utilise other local roads.

- **Table 8 – Traffic distribution and assignment of daily trips to the road network, compared with existing traffic volumes**

Road	Percentage distribution	Estimated daily trips generated by development (vehs)	Existing daily traffic volumes (excluding development)
Gilmore Avenue north of Challenger Avenue	30%	2,147	12,400 (Town of Kwinana, 2007)
Meares Avenue north of Challenger Avenue	15%	1,074	4,000 (Town of Kwinana, 2007)
Challenger Avenue east of Meares Avenue	15%	1,074	5,800 (SKM, 2009)
Wellard Road east of Gilmore Avenue	15%	1,074	8,000 (Town of Kwinana, 2008)
Gilmore Avenue south of Wellard Road	25%	1,789	16,170 (Town of Kwinana, 2007)
Total		7,157	-

- **Table 9 – Traffic distribution and assignment of peak hour trips to the road network**

Road	AM peak hour (vehs)	PM peak hour (vehs)
Gilmore Avenue north of Challenger Avenue	146	215
Meares Avenue north of Challenger Avenue	73	107
Challenger Avenue east of Meares Avenue	73	107
Wellard Road east of Gilmore Avenue	73	107
Gilmore Avenue south of Wellard Road	122	179
TOTAL	**488**	**715**

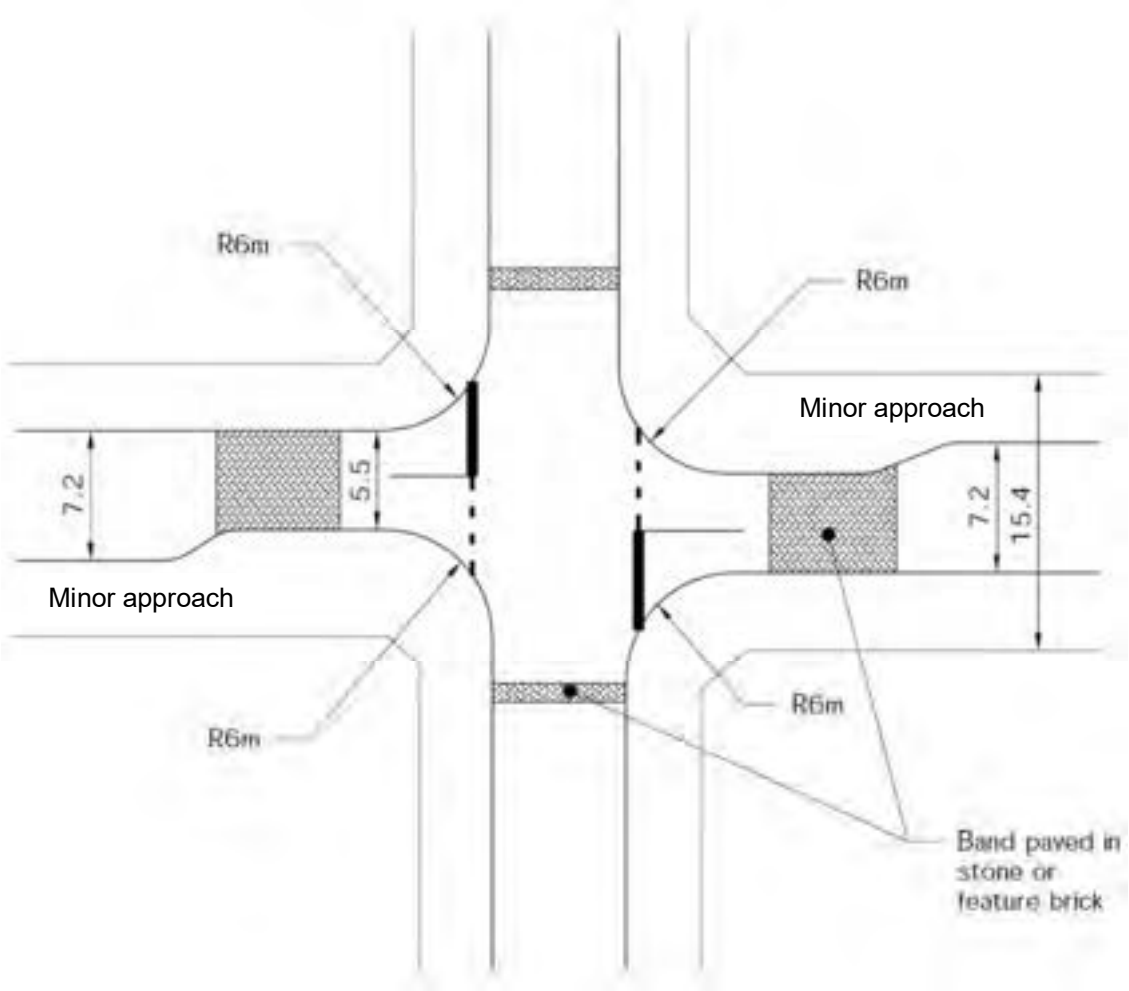
SKM considers that the proposed internal road network will adequately accommodate the daily generated traffic on the basis that it is proposed to be highly permeable and drivers will have a choice of routes. There is likely to be a low level of through traffic, limited to a few trips between the low density residential areas east of Meares Avenue and Gilmore Avenue via East-West Road and some traffic travelling directly between Wellard Road and the Hub via North-South Road (refer to **Figure 8**, where access to the Hub is shown to the north of Lot E26).

The key North-South Road is unlikely to carry more than about 3,000 vehicles per day at any one point, but should be constructed as a Neighbourhood Connector, which ensures it is future proofed. We propose that the primary East-West Road is also built to Neighbourhood Connector standard, which reflects its primacy for development access.

While more detail will be provided at the subdivision approval stage, internal intersections will largely function with give way/ stop sign controls on minor roads except where roundabout controls are considered more appropriate at intersections with the North-South Road to break up the road corridor (see **Figure 1**).

One four-way priority intersection is proposed within the external road network. The location of the intersection is shown in **Figure 15**. According to *Liveable Neighbourhoods*, a standard four-way intersection would not be appropriate for this location due to the length of the approach legs. It is therefore proposed that the minor approaches (from the north and south) are offset by up to six metres, together with a combination of intersection highlighting treatments. This will stagger the intersection slightly so that right turns from the major street (east-west movements) do not overlap. An indicative layout of the intersection design is shown in **Figure 13**.

- **Figure 13 – Staggered four-way priority intersection**

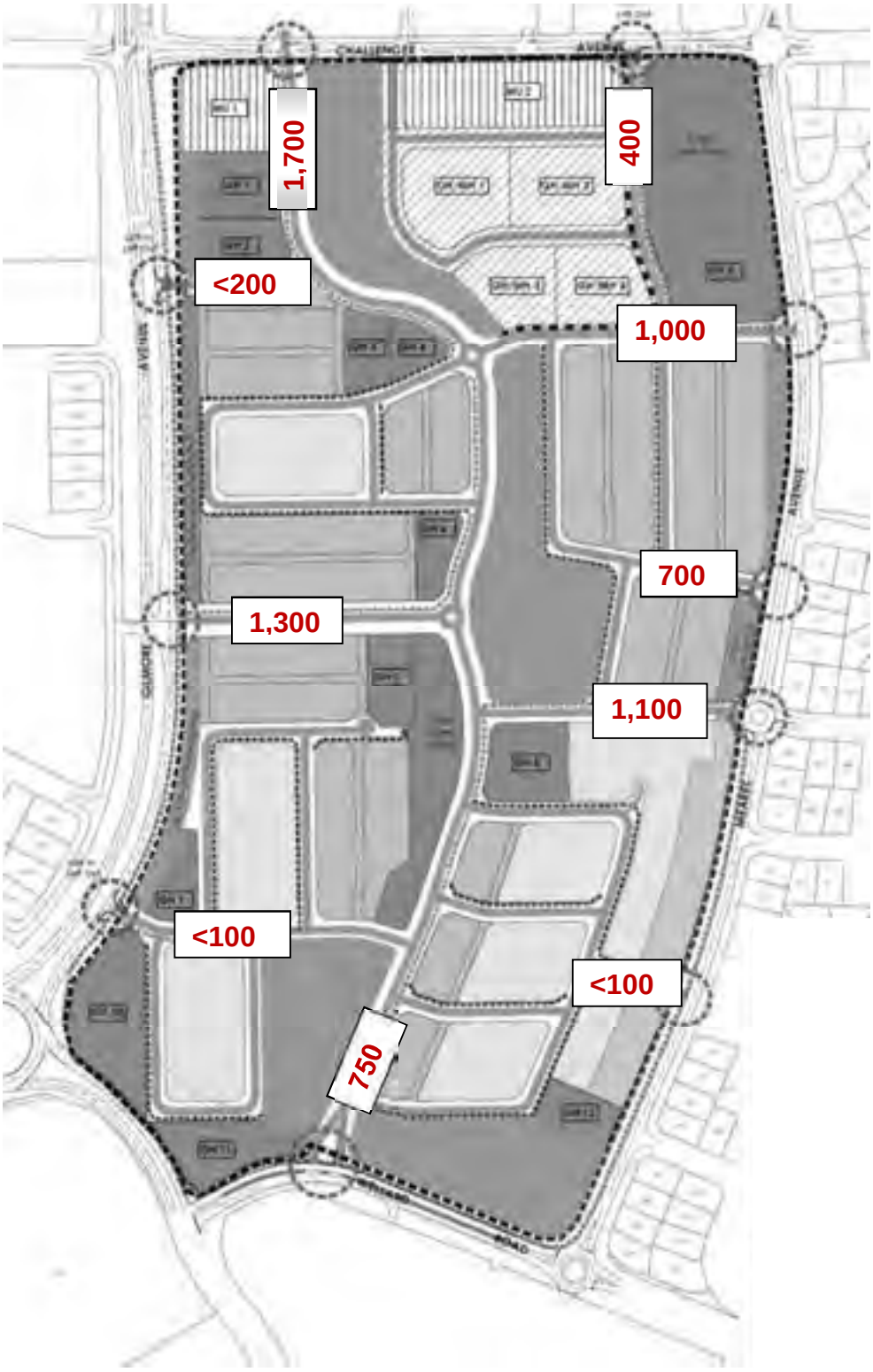


This design is outlined in Liveable Neighbourhoods Figure 29A and is appropriate for the proposed location due to the estimated low level of traffic (less than 1,500vpd) estimated to use the intersection at full development.

In general terms, it is SKM's professional judgement that daily generated development traffic will have minor impacts on the surrounding road network. Existing plus development traffic on each of the key external routes will be within their carrying capacity and should not unduly impact on levels of service.

The approximate estimated daily traffic volumes for each of the key internal access streets are shown in **Figure 14**. Proposed external intersection treatments are shown in **Figure 15**. Particular attention is drawn to the proposed roundabout at the intersection of the North-South Road and Challenger Avenue: this should also ensure efficient traffic circulation for vehicles entering/ exiting the Hub.

- **Figure 14 – Estimated daily traffic volumes for the internal access streets**



Source: Burgess Design Group 2013.

- **Figure 15 – Recommended key external and internal intersection treatments**



Source: Burgess Design Group 2013.

6.4. Peak hour traffic impacts

The analyses in **Section 6.2.2** show that the PM peak hour will be the crucial period in relation to generated vehicle movements and associated impacts on the road network, with one exception. This is at the intersection of the proposed East-West Road and Gilmore Avenue, when the majority of outbound traffic using this intersection during the AM peak is likely to turn right to access destinations to the north and sub-regional routes such as Thomas Road.

During consultation, the Town of Kwinana expressed a wish to retain the current treatment at the intersection of Gilmore Avenue and Challenger Avenue, which is considered to mitigate traffic hazards. If the current treatment is retained, development traffic wishing to decant northwards via Gilmore Avenue will be required to turn right on to Gilmore Avenue from the proposed primary East-West Road, where a full range of turning movements are proposed.

Approximately 100 vehicles may perform this movement in the AM peak hour. According to the *Austroads Guide to Traffic Engineering Practice Part 2: Roadway Capacity* (2008), given the existing volume of traffic on Gilmore Avenue and assuming five seconds for lead vehicles to perform the turn and a follow up headway of three seconds per vehicle, all forecast vehicles should be able to comfortably perform this manoeuvre. The intersection is also likely to have sufficient capacity if there is additional demand from through traffic originating/ terminating in the low density residential areas to the east of Meares Avenue.

This analysis assumes stop control on East-West Road at this intersection. The findings suggest that stop control in this location is likely to be adequate for the foreseeable future. SKM notes that the median along Gilmore Avenue has sufficient width to allow vehicles to perform two stage right-hand turns from East-West Road on to Gilmore Avenue.

To assist with traffic movements, the Town of Kwinana considers that a right turn pocket (Gilmore Avenue northbound) and a left turn slip lane (Gilmore Avenue southbound) are provided. SKM would support these provisions.

SKM also notes that there is an existing median break along Gilmore Avenue, which provides access to an adjacent service road. SKM and the Town of Kwinana agreed that this median break could be realigned with the break to provide access to the East-West Road, if required. The Town has noted that the existing right turn lane on Gilmore Avenue providing access to the service road would likewise need to be relocated.

7. Public transport

Residents in the new development should benefit from a good level of access to public transport services. Lot E26 is within the walkable catchment of the Kwinana bus station (see **Figure 5**), and is a short distance outside of the walkable catchment of Wellard train station (see **Figure 6**).

Kwinana bus station accommodates a number of bus services, including the 540, 541, 542, 543 and 920 (see **Figure 16**). These services link the Hub and surrounding area with Kwinana train station, Wellard train station, Rockingham and Fremantle. Services towards Kwinana train station operate between 5:54am and 7:38pm on weekdays and have a headway generally varying between two and 15 minutes. Services towards Wellard train station operate between 6:03am and 8:41am on weekdays and have a frequency of around 10 minutes. Weekday services between the bus station and Rockingham generally operate every 15 minutes between 7:15am and 12:21am. Weekday services between the bus station and Fremantle generally operate every 15 minutes between 5:51am and 11:02pm.

Weekday northbound train services from Wellard train station operate between 5:25am and 11:40pm, and generally have a frequency of 10-15 minutes. The journey time to central Perth – Esplanade station – is 28 minutes. Weekday southbound train services operate between 6:02am and 12:43am, and generally have a frequency of 10-15 minutes.

While proximity to public transport is important, pedestrian and cycle linkages are also required to facilitate public transport trips. Walking and cycling infrastructure is discussed in the following section.

- **Figure 16 – Public transport services in the vicinity of Central Park**



(Source: Transperth, May 2011)

8. Pedestrians and cyclists

8.1. Internal and external connections

High-quality walking and cycling infrastructure is an important characteristic of new developments, the provision of which should be treated as a priority. For pedestrians, high-quality, safe and legible infrastructure should link the development area with public transport stops and stations, thus encouraging public transport/ walking journeys rather than car driver trips. For cyclists, high-quality, safe and legible infrastructure within the area and linking the area with regional networks (i.e. clearly sign-posted, shared use paths), provide opportunities for regional travel.

The provisional LSP depicts a fine-grained and permeable pedestrian and cycling network (refer to **Figure 1**). While the provisional cross sections shown in **Section 3** may be further refined as more detailed planning progresses, it is SKM's recommendation that the general principles of providing safe and comfortable footpaths along access streets (laneways excepted); shared paths on key streets; and on-street cycle lanes on Neighbourhood Connectors should be observed.

In general, the pedestrian and cycling network has been planned to interface the new development with the Hub and existing pedestrian and cycling infrastructure on surrounding streets. To improve access to public transport stops and the convenience of north-south movement, the LSP also anticipates construction of new shared paths on the eastern side of Gilmore Avenue and the western side of Meares Avenue adjacent to the development (there are no existing paths in these locations). Moreover, a 1.8-2.0 metre footpath should be installed on the southern side of Challenger Avenue and the 1.5 metre wide footpath on the northern side of Challenger Avenue should be upgraded to a 2.5 metre wide shared path. The existing median along Challenger Avenue may potentially provide refuge for crossing pedestrians. However, more detailed planning is likely to require identification of suitable places for formalised refuges and potentially a zebra crossing.

The proposed locations of shared paths and footpaths to be provided within the LSP (including the anticipated shared paths along road surrounding the LSP), are shown **Figure 1**.

Pedestrians and cyclists will have good access to Wellard train station to the south via Henley Brook Avenue, which features on street cycle lanes and good provision for pedestrians within the verge. The existing shared path on the north side of Wellard Road may need to be realigned to accommodate the subdivision: this will be subject to more detailed assessment at the subdivision planning stage.

To enhance the walking and cycling environments, as finer-grained detail is added to the plan, the following additional design features should be included:

- Shade trees
- Street lighting
- Tactile paving, particularly at crossing points

- Safe crossing points with ramped kerbs to enable universal access
- Regularly spaced median breaks along the planned primary East-West Road to facilitate universal crossings
- Passive surveillance of public open space from all sides
- Provision of cycle parking spaces – for example, U rails – in appropriate locations throughout the precinct: particularly near to the proposed retail and adjacent to significant areas of open space that are being planned for recreation

With particular regard to existing cycling infrastructure, Lot E26 is adjacent to a number of cycle-friendly streets (indicated by the green lines on **Figure 17**), and a range of shared paths (marked with yellow dots), giving access to the north, east, west and south[2]. The routes along Meares Avenue and Wellard Road - shown in blue - are signposted.

[2] The shared path shown on the eastern side of Gilmore Avenue does not presently exist.

- **Figure 17 – Perth Bicycle Network: routes within the vicinity of Lot E26**



(Source: Department for Planning and Infrastructure, May 2011)

8.2. Safe routes to schools

There are four schools that are likely to be accessed from Lot E26. These include Kwinana Senior High School to the north, which is likely to be accessed via Meares Avenue or Gilmore Avenue; Calista Primary School to the northwest, which is likely to be accessed via Gilmore Avenue; Leda Primary School to the southwest, which is likely to be accessed via Gilmore Avenue; and Peter Carnley Anglican Community School, which is likely to be accessed via Meares Avenue or Wellard Road.

In general, the existing external infrastructure, proposed internal infrastructure, and proposed enhancements to Challenger Avenue, Gilmore Avenue and Meares Avenue should provide a good level of safety for commuting school children. In particular, the provision of pedestrian refuges

within the median along Challenger Avenue is likely to be important for school children accessing either Kwinana Senior High School or Calista Primary School.

9. Conclusions

SKM has prepared this Transport and Access report to fulfil the assessment requirements in relation to the proposed Local Structure Plan for Lot E26, Kwinana.

At ultimate development, the LSP assumes 880 residential dwellings (including dwellings within the Strategic Site) at a variety of densities; and retail and commercial uses.

The planned internal street network incorporates a north-south and east-west Neighbourhood Connector, and a permeable network of local access streets and laneways. Traffic access to and from the development is anticipated to function adequately assuming the following key intersection treatments:

- Retention of the give-way control and geometry at the Challenger Avenue/ Gilmore Avenue intersection, which disallows right turn movements from the former on to the latter.
- Full movements allowed at the intersection of the primary East-West Road and Gilmore Avenue.
- Installation of a roundabout at the intersection of Challenger Avenue and the primary North-South Road.

In general, for residential land uses, provision of car parking in accordance with the Residential Design Codes is proposed. However, given the significant opportunities for provision of public car parking within the precinct, it is proposed that most visitor car parking is provided on street, except in relation to lots accessed from laneways. SKM recommends that on-site retail car parking be limited to four bays based on opportunities for visitors to utilise on-street car parking and the extensive car parking provided in the Hub.

SKM has established that the likely traffic generation from the precinct will be about 7,100 vehicles per weekday. Given industry-accepted assumptions in relation to peak hour travel, about 488 vehicle trips could be expected in the AM peak hour and 715 in the PM peak hour. Based on the range of linkages with the external network that are proposed, development traffic should distribute fairly evenly via a variety of routes including Gilmore Avenue, Meares Avenue, Challenger Avenue and Wellard Road.

A permeable internal walking and cycling network is proposed and this is reflected in the overall development plan and indicative cross sections. It is intended that this network will be integrated with existing external infrastructure, which itself will be enhanced through the installation of shared paths on the eastern side of Gilmore Avenue, the western side of Meares Avenue and the northern side of Challenger Avenue. A new footpath should also be constructed on the south side of Challenger Avenue.

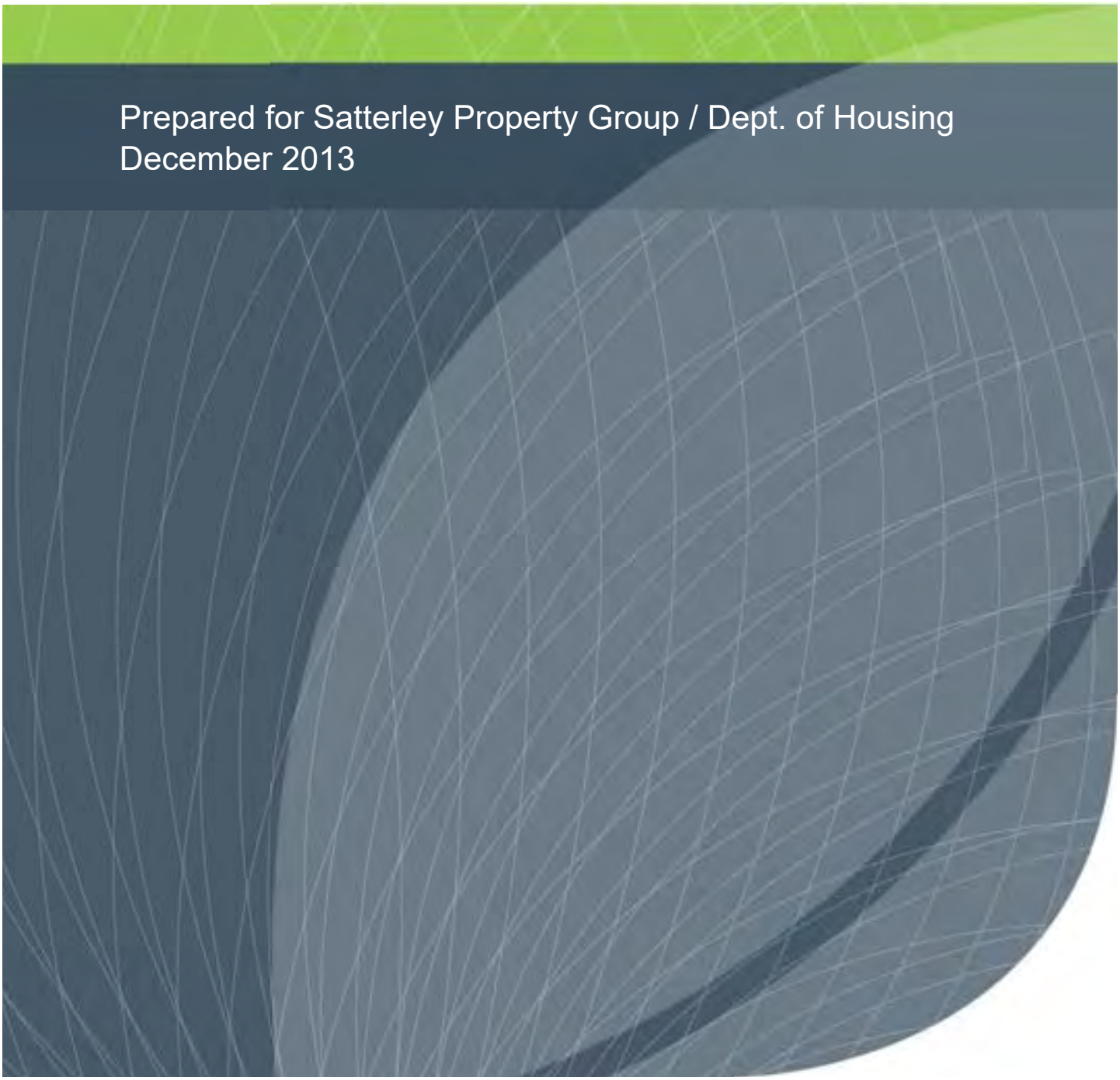
Overall, assuming the planned new infrastructure and enhancements described, there should be good multimodal access to and from Lot E26 without adverse traffic impacts on the surrounding network.

APPENDIX 5
Landscape Strategy and Master Plan

LANDSCAPE & PUBLIC OPEN SPACE STRATEGY

LOTS E26, 303 & 9014 GILMORE AVE KWINANA

Prepared for Satterley Property Group / Dept. of Housing
December 2013



Document Control

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DOC NO.	KE-01-LSP				
REVISION	DATE	AUTHOR(S)		REVIEWER	
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B	25 May 2011	Shane Caddy	SC	Shane Caddy	SC
C	4 February 2013	Shane Caddy	SC	Shane Caddy	SC
D	6 July 2013	Shane Caddy	SC	Shane Caddy	SC
	Council Amendments to reflect LSP Modifications				
E	12 December 2013	Shane Caddy	SC	Shane Caddy	SC
	Council Amendments per Officer Meeting 18th November 2013				

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Executive Summary

This report has been prepared by Emerge Associates to accompany the Local Structure Plan submission for the subject land proposed to be developed by Department of Housing and the Satterley Property Group. The report outlines the proposed Public Open Space (POS) and streetscapes landscape strategy for the Development Area.

The Development Area is bounded by Gilmore Avenue, Challenger Avenue, Meares Avenue and Wellard Road, Kwinana. All landscape concepts outlined in this report and shown on the included Landscape Concept Masterplan have been prepared based on the Local Structure Plan prepared by Burgess Design Group with detailed inputs from the Consultant Team including the Civil Engineer, Landscape Architect, Environmental Scientist, Arborculturalist and Traffic Engineer.

The report details typical POS typologies and generic landscape treatments of POS areas, including but not limited to:

- Existing Significant Tree Retention
- Typical POS Recreation facilities provided including Playspace strategies,
- Treatment of Proposed Stormwater Drainage in Landscaped Areas,
- Retention of Existing Significant Vegetation,
- Irrigation Strategy, and
- Landscape Maintenance.

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IRRIGATION STRATEGY

1 Landscape Design / Public Open Space Strategy

This section of the Local Structure Plan describes the basic principles of the overall Public Open Space (POS) strategy for Lots E26, 303 & 9014 Gilmore Avenue, Kwinana. The proposed residential subdivision is to be developed around a range of open space opportunities. There are 3 different categories of open space described which include:

- Formal Town Centre Open Space
- Central Linear Public Open Spaces
- Multiple Use / Drainage Public Open Spaces

It is envisaged that no resident will be more than approximately 400m away from an open space area. A preliminary Landscape Masterplan Concept for the Development Area is included, which outlines the landscape design for all POS areas

1.1 Public Open Space Principles

1.1.1 Generally

The landscape strategy behind public open space development is to provide a readily useable, aesthetic and liveable environment to potential residents from day one. Landscaped open space areas shall incorporate features and facilities to both encourage residential growth and to provide public, aesthetic and site character building amenities to residents. Landscape works shall contain and maximise both aesthetic and functional uses where possible.

Key to the successful delivery of aesthetic and functional POS areas will be the retention of the site's existing significant trees where possible in accordance with proposed Civil Engineering design levels. The retention of existing significant trees will be the cornerstone of establishing the site's Sense of Place through the landscape materials palette.

1.1.2 Materials Palette

It is proposed that close attention to detail will be provided in the landscape detailing and materials selection to ensure continuity with the Kwinana Civic and Hub Redevelopments to provide a cohesive whole to the Kwinana Town Centre precinct.

The inclusion and use of some the following detailing is proposed to reinforce the continuity throughout the Town Centre precinct:

- Matching paving styles and colours, such as the Kwinana 'Custom' stamped concrete paving. Paving styles and colours will be chosen to create visual interest, assist in differentiation between area uses and provide hard-wearing surfaces of varying textures.
- Matching wall detailing through the use of local stone, concrete detailing and laterite coloured limestone retaining where required.
- Durable street furniture of a style and colour palette to co-ordinate with the overall POS design.
- Tree and shrub planting palettes that are aesthetically pleasing while responding to the surrounding natural environment, incorporating water sensitive design species while creating view shafts to develop community value.

1.1.3 Planting Palette

It is proposed that the following indicative planting palette will be used in the amenity areas of the public open space and streetscape hierarchies, with an emphasis on Waterwise species selection and hydrozoning principles.

Consideration will also be given to using plant species from the Department of Environment and Conservation's (DEC) "Plants Used by Carnaby's Black Cockatoo" list. These have been included in the indicative planting palette provided below. It is important to note that the DEC's published list has a focus on tree and tall shrubs for habitat and foraging purposes and not small shrubs and groundcovers which appear not to be of interest to the bird. Therefore small plants and groundcovers have been noted as not applicable (n/a) accordingly.

INDICATIVE PLANTING PALETTE (SUBJECT TO DETAIL DESIGN & COUNCIL APPROVALS)		
LATIN NAME	**COMMON NAME**	**CARNABY'S**
NATIVE TREES		
Agonis flexuosa	WA Native Peppermint	Y
Angophora costata	Sydney Red Gum	N
Banksia attenuata	Candlestick Banksia	Y
Banksia prionotes	Acorn Banksia	Y
Corymbia calophylla	Marri	Y
Corymbia maculata	Spotted Gum	Y
Eucalyptus leucoxylon rosea	White Ironbark	N
Eucalyptus gomphocephala	Tuart	Y
Eucalyptus marginata	Jarrah	Y
Eucalyptus nicholii	Narrow Leafed Peppermint	N
Eucalyptus sideroxylon	Ironbark	N
Xanthorrhoea preissii	Grass Tree	Y
EXOTIC TREES (POS 1 ONLY)		
Citrus Lemon Eureka	Lemon Tree	N
Citrus Lime Tahitian	Lime Tree	N
Citrus Orange Valencia	Orange Tree	N
Fraxinus raywoodii	Claret Ash	N
Jacaranda mimosaefolia	Jacaranda	Y
Olea europa	Olive Tree	N
Platanus acerifolia	London Plane Tree	N
Platanus orientalis digitata	Cut Leaf Oriental Plane Tree	N
Pistacia vera	Pistachio Tree	N
Pyrus sp.	Flowering Pears	N
Ulmus parvifolia	Chinese Elm	N
SHRUBS		
Adenathos sericea	Albany Woolly Bush	n/a
Acacia lasiocarpa	Panjang	n/a
Agonis flexuosa 'nana'	Dwarf Willow Peppermint	n/a
Agonis linearifolia	Swamp Peppermint	n/a
Allocasuarina humilis	Dwarf She-oak	n/a
Anigozanthos sp	Kangaroo Paws	n/a
Callistemon 'Little John'	Dwarf Bottlebrush	n/a
Callistemon phoenicius	Lesser Bottlebrush	n/a
Calothamnus quadrifidus	One-sided Bottlebrush	n/a
Conostylis candicans	Grey Cottonheads	n/a
Dianella 'Little Jess'	Dwarf Flax Lily	n/a
Dianella revoluta	Flax Lily	n/a

INDICATIVE PLANTING PALETTE (SUBJECT TO DETAIL DESIGN & COUNCIL APPROVALS)		
Dianella revoluta variegata	Variegated Flax Lily	n/a
Hypocalymma angustifolium	White Myrtle	n/a
Leucophyta brownii	Silver Cushion Bush	n/a
Melaleuca lateritia	Robin Red-breast	n/a
Melaleuca 'Little Nessie'	Dwarf Nesophila	n/a
Melaleuca teretifolia	Banbar	n/a
Melaleuca uncinata	Broom Bush	n/a
Melaleuca viminea	Monah	n/a
Olearia 'Little Smokie'	Coastal Daisy Bush	n/a
Patersonia occidentalis	Purple Flag	n/a
Pimelea sp.	Rose Banjine	n/a
Verticordia plumosa	Plumed Feather Flower	n/a
Westringia fruticosa	Native Rosemary	n/a
Westringia fruticosa variegata	Variegated Native Rosemary	n/a
GROUNDCOVERS		
Acacia drummondii	Drummond's Wattle	n/a
Acacia cognata 'Limelight'	Acacia	n/a
Casuarina glauca 'Cousin It'	Casuarina	n/a
Dampiera diversifolia	Dampiera	n/a
Dryandra nivea	Honeypot Dryandra	n/a
Eremophila glabra	Emu Bush	Y
Eremophila 'Kalbarri Carpet'	Emu Bush	n/a
Grevillea bipinnatifida	Fuchsia Grevillea	n/a
Grevillea crithmifolia	Coastal Grevillea	n/a
Grevillea 'Gin Gin Gem'	Grevillea	n/a
Grevillea thelemanniana	Spider Net Grevillea	n/a
Kennedia prostrata	Running Postman	n/a
Myoporum parvifolium	Creeping Boobiala	n/a
Scaevola sp.	Fan Flower	n/a
Westringia 'White Rambler'	Prostrate Native Rosemary	n/a
RUSHES / GRASSES		
Carex appressa	Tall Sedge	n/a
Carex fascicularis	Tassel Sedge	n/a
Ficinia nodosa	Knotted Club Rush	n/a
Juncus pallidus	Pale Rush	n/a
Juncus pauciflorus	Loos Flower Rush	n/a
Lomandra longifolia	Mat Rush	n/a
Lomandra 'Seascape'	Fine Leaf Mat Rush	n/a
Lomandra 'Tanika'	Mat Rush	n/a

Table 1: Indicative Public Open Space & Streetscapes Planting Palette

1.2 Significant Tree Retention

A comprehensive Arboricultural Report has been previously prepared for the Development Plan area by Arbor Logic to identify trees for retention in public open space and landscape areas. The proposed areas of public open space in particular are dense areas of native tree vegetation. The retention of significant trees will be a primary focus of the landscape response and the project's overall character.

The age, health and structural condition of the vegetation varies throughout the nominated POS areas, and many trees have clearly been affected by recent bushfire activity. The majority of the identified significant trees were considered to be suitable for inclusion in POS and a number of good quality mature tree specimens were identified in the proposed POS areas. Retention of as many of the better quality trees as possible has been highly recommended in the Arboricultural report.



Plate 1: Examples of Significant Tree Retention in Public Open Space.

However, the Arboricultural report also notes that retention of all of the trees is not likely to be a viable or achievable outcome unless the landscape response in areas of POS is proposed to be minimal to none at all. In addition, some trees identified within proposed POS areas will be subject to cut or fill operations to tie into the proposed subdivision's civil engineering design and construction.

In some instance retention of some of the trees even in areas of POS may still be considered to be questionable, primarily due to their structural condition. The retention of trees will be very much dependent on detailed landscape design and more specifically if any potential targets (people, structures, carbays etc) are proposed to be introduced into the projected fall zone by the way of the landscape and / or residential development.

Significant trees proposed for retention in POS areas, subject to detailed design have been clearly shown on the Landscape Masterplan. The landscape plans provided to the City at detailed landscape approval stage will identify all trees proposed for retention. Of critical importance in maintaining the Kwinana vernacular is the retention of the existing trees along the eastern verge of Gilmore Ave. Similarly the significant trees located on the western verge of Meares Ave in POS 2 form a significant existing buffer to the existing residential area to the east of the development site and also proposed for retention.

1.3 Formal Town Centre Open Space

A 1.14ha formal Town Centre / Village Green open space (POS 1) is proposed as an entry focal point into the development area from Challenger Avenue and to smooth the transition of character from the Civic / Commercial sub-area of Kwinana into the development.

The open space is characterised by a strong axis' onto feature public art and / shelters with shaded hardscape areas providing overflow passive recreation opportunities for people to gather and sit, for example during a lunch break, before returning to work in the civic / commercial sub area. An amphitheatre or performance space is proposed to reinforce the civic nature of this open space.

The materials palette within this area of the open space are proposed to strongly resemble the materials used within the Town Centre and Hub developments to create the continuity and reinforce the pedestrian linkage between the Town Centre and the Wellard Train Station through the development area.

The open space is to become more informal as it progresses into the development area in a southerly direction to reinforce the landscape transition of formal to informal to cater for the retention of the better quality vegetation and significant trees in the southern open space areas.

A large adventure playground is proposed within this POS as a major drawcard to the area. This playspace will cater for a range of age groups and abilities and be closely linked to passive recreation amenity elements, including possible picnic shelters, BBQ's and park furniture.



Plate 2: Character Images for a Formal Town Centre Open Space

1.4 Central Linear Public Open Spaces

A series of Central Public Open Spaces will be developed as the defining point of the project. This system of parklands (identified as POS 3, 4, & 5 on the attached Landscape Masterplan) will be approximately 3.41ha in total across the three (3) open space areas (being approximately 1.63ha, 0.68ha and 1.1ha in size respectively) running in a north south direction for the entire length of the Development area. These POS areas are to be located with a range of adjoining and adjacent residential lot sizes and the existing Kwinana Town Centre to the north of the Development Area on Challenger Avenue.

Of primary importance of the proposed Central Linear Public Open Space system is the pedestrian connectivity that will be provided through the site from the existing Kwinana Town Centre on Challenger Avenue to the Wellard Train Station to the south of the Development Area. To cater for this proposed pedestrian movement, a 2.5m wide dual use path will be constructed throughout the POS areas following the approximate alignment of the proposed primary north south road connection through the Development Area. All other paths within POS areas are to be a minimum 2.1m wide in accordance with City of Kwinana requirements.

All POS areas shall incorporate dual use and pedestrian path systems with built in vehicular crossing and access points for landscape maintenance purposes. Dual use and pedestrian systems shall provide smooth and easy access to all features of the open space and link accordingly into residential and other areas adjacent. Disability access will be given a high priority and will be designed in accordance with relevant Australian Standards.



Plate 3: Character Images for the Central Linear Public Open Spaces

The Central Open Spaces will be parkland areas which will offer a range of recreation and community facilities. These parkland areas will serve both as informal active and passive recreation functions. The parkland shall consist of open grassed spaces bounded and defined by both feature avenue trees, native tree clumpings, retention of existing significant trees and retention of remnant bushland where viable.

Shrub plantings are planned to strategic areas to provide spatial definition and colour where required. Shrub planting shall primarily consist of lower growing species to enable clear vision and security through passive surveillance. It is proposed that the shrubs will consist of a mix of exotic and native species, with consideration and adherence to Waterwise principles.

Through the development of manicured landscaped areas and its associated facilities will be provision for picnic settings and informal gathering spaces. Public Art is proposed for incorporation within major POS areas to assist in establishing a sense of place for the Development. Playgrounds, public art and / or feature shelters are to be located on strong views and vistas lines of the proposed road network to draw users into the open spaces and the development from the surrounding road system.

BBQ's and picnic shelters within smaller open areas suitable for informal active recreation will exist. These open areas will vary in size from 80m dia to 20m dia. Vista views and formal path systems to the parkland areas will connect each smaller space generally. All spaces are intended to have views from surrounding lots and streets for passive surveillance.

POS 3 and 5 will be required to accept some stormwater runoff from the surrounding development area in an attractive grass swale. Where possible existing significant trees will be retained with the grass swale areas through battering or small retaining walls to provide instant impact and shade amenity.

1.5 Multiple Use / Drainage Public Open Spaces

Two Public Open Spaces areas will be designated to accept major stormwater drainage events. Refer to POS 2 & 6 on the attached Landscape Masterplan. These drainage basins will be constructed to provide a multiple use - drainage / landscaped response which will be critical to establishing an immediate informal active and passive recreation opportunity.

To facilitate this multiple use, it is proposed (subject to further detail design) to store the 1:1yr storm event in underground storage tanks under the grassed kickabout space utilising Atlantis TM type product or similar approved by the City of Kwinana. Refer to the Civil Engineering component of the Local Structure Plan for further information in this regard. The implementation of subsurface stormwater storage systems will allow for a greater retention of existing trees and understorey vegetation in other areas of the open space by concentrating the first flush events to designated areas, rather than across the entire open space site.



Plate 4: Character Images of Drainage Areas within Public Open Spaces.

The 1:10 year and 1:100 year stormwater events will be contained within landscaped drainage swales within the POS through bubble up structures. These drainage swales will typically be grassed areas with maximum side slopes of 1:8 grade to allow for ongoing maintenance activities and safe egress in the event of a large stormwater event. All outlet structures into POS areas will incorporate stabilised water entry points, smooth and even grading of contours and mass planting of suitable native water tolerant tree and shrub species for maintenance minimisation.

All associated landscape infrastructure such as picnic shelters, playgrounds, footpaths and the like will be constructed above the 1:10 year stormwater flood levels. The 1:10 year stormwater levels will not exceed 900mm deep in POS areas and similarly the 1:100 year stormwater flood levels will not exceed 1100mm deep when full.

1.6 Playspace / Playground Strategy

1.6.1 Generally

Every residential area needs to provide a diverse range of landscape settings in open space in order to meet the wide range of needs within any population. Ideally residential areas should have access to one play space within approximately 400 to 500 metres, or approximately 10 minutes walk from home. Diversity of play space equipment is crucial to achieving successful activation of open spaces and fostering community ownership.

1.6.2 Playspace Design

A series of public open spaces is proposed across the Development Plan as outlined on the Landscape Masterplan, three (3) of which are proposed to contain designated play spaces. These play spaces will be designed within the overall landscape character for the project and with an appreciation of the Kwinana vernacular, and they will also need to provide for pre-school, primary and older children with some multi-aged elements.

In addition, each of the proposed open spaces will differ slightly from each other in style, character and content. Similarly, the play spaces proposed will vary from one another. That means no two play spaces will be the same:

- In character and setting, and the actual materials chosen,
- In what there is to do
- In the degree of emphasis on any particular age group, and in
- The way the activities might be expressed.

Play space design will:

- Consider environmental sustainability and social well-being
- Consider the place and role of the play space within a greater open space network
- Protect and enhance local natural and cultural features
- Contribute to the enhancement of distinctive local character
- Maximize community safety
- Together with other play spaces within its network, provide a diverse range of play opportunities for a diverse range of users
- Be of high quality, meet the play and recreation needs of their communities and enable access to the entire community
- Explore opportunities for innovation
- Encourage community involvement in the planning, development and management



Plate 5: Character Images of Playspaces / Playgrounds.

Play spaces will also be designed to complement other recreation and play opportunities within the neighbourhood and take into account the local context, i.e. usage patterns, movement and traffic, neighbouring land uses. Play spaces will designed to suit the characteristics of individual sites and optimize the opportunities and constraints each site offers whilst being robust enough and flexible enough to cater for the local community over time, in a way that can be realistically managed to suit the available resources available both now and in the future.

Given the site's overall emphasis on connection to the natural environment, a Nature Play opportunity will also be proposed for one of the POS areas. Natural playgrounds have the additional benefit of providing children with more opportunities than typical pre-formed playgrounds to develop gross motor skills (e.g. climbing etc). Contact with nature has been associated with a number of health benefits for

children, such as improved cognitive function, increased creativity, and improved interaction with adults, reduced attention deficit hyperactivity disorder symptoms and reduced rates of aggression.

Final play space structure locations and equipment included within open spaces will be resolved and detailed landscape approval stage in consultation with the City's Landscape Architect and other interested stakeholders.

1.7 Streetscapes

Streetscapes throughout the development shall incorporate a variety of treatments in response to the road hierarchy system. In all cases landscape works shall incorporate tree planting in accordance with accepted traffic standards. Treatments may include soft works such as street trees, hedge planting and groundcovers.

Tree species are yet to be selected however it is anticipated that exotic species be selected for major roads and focal points with native species for residential streets. The timing of installation street trees is proposed to occur at the completion of housing construction as part of the landscape incentive package offered by the Developer at the point of sale, with the exception of major boulevards and neighbourhood connectors, where the Developer may seek to install street trees upfront as part of a marketing strategy. Street trees shall be allocated at one per lot and three per lot for corner blocks.



Plate 6: Character Images for Streetscapes

It is envisaged that some of the stormwater runoff from proposed residential and existing roads will be contained in a 12m wide landscaped drainage corridor which will run almost the length of the Development Area at the interface of Gilmore Avenue, noted as areas L1 – L3 on the Development Plan. This drainage corridor will be achieved through flush kerbing on the proposed residential side and verges that are grassed and occasionally planted. Additional landscape buffer / drainage swales are proposed along Meares Avenue, just south of POS 2 and within the proposed development area heading east to west from POS 1 towards Gilmore Avenue.

The retention of existing significant trees within the current Gilmore Avenue road reserve is of critical importance to the project's landscape theme. The trees will serve an important visual buffer and amenity function from Gilmore Avenue. The road reserve on the internal Development Area side has been increased from five (5) metres wide to twelve (12) metres wide to cater for the proposed drainage swales and tree retention.

1.8 Irrigation Strategy

1.8.1 Generally

In general terms the project is committed to undertaking water sensitive design with minimal impact on good quality groundwater sources and preserving water quality.

1.8.2 Existing Irrigation Systems

It is acknowledged by the Developer that existing irrigation systems are located within the verges of the surrounding Gilmore Ave, Meares St and Wellard Rd that could be affected by the subdivision works proposed within the Development Plan.

The project team have liaised with the City of Kwinana's Technical Officers who were unable to provide As Constructed information relating to existing irrigation works within these verges. The Developer's Landscape and Irrigation Contractors will need to working closely with the City's Irrigation Maintenance Officers at the time of construction to ensure flows to other areas are not interrupted.

1.8.3 Proposed Irrigation Systems

It is anticipated that irrigation water will be provided through a series of deep aquifer groundwater bores constructed across the open space areas. Standalone bores are proposed to be located in POS 1, POS 3 and POS 6, which are to be connected via a mainline.

The use of large droplet format sprinklers within turf areas and subsurface drip line irrigation within garden beds will assist in reducing evaporation and aid water conservation.

All irrigation shall be installed to the local authorities' standard specifications and industry best practice. Maintenance minimisation processes will apply in all circumstances. Controllers shall be keyed and accessed in accordance with the local authorities standards. Irrigation shall be designed to incorporate stations that can be terminated as agreed upon planting establishment and maintenance handover to the Council in accordance with relevant policies.

As per the bore / mainline irrigation strategy included within Appendix B, all bores are proposed to be placed away from housing boundaries, typically with road reserve separation to prevent any concerns with vibration or noise pollution. Typically poorly maintained equipment could potentially cause noise concerns in relation to bore pumps. Provided the velocity of water within the mainline pipes remains below design levels then there shouldn't be any noise aside from minor noise from the bore pump's associated electrical cabinet (e.g. internal fan or Sine wave filter if within a 10m vicinity of the bore infrastructure).

1.8.4 Water Efficiency

The project proposes to employ a number of water efficiency measures from the macro to mirco scale. The following is an example of some of these techniques :

- Retention of Existing Bushland areas in POS areas in lieu of created garden beds.
- Predominantly native tree and shrub species selection for POS and Streetscape landscaping that has an emphasis on being Waterwise.
- Hydrozoning of plant species in accordance with their irrigation requirements to prevent wholesale overwatering of garden beds.
- Turf areas proposed in POS areas that are functional and usable only, rather than ornamental.
- Turf species selection that is drought tolerant in accordance with the City's current landscape specifications.

- Irrigation Systems in accordance with the City's current Irrigation Specification, which utilises large droplet emitters to prevent water loss through evaporation. (Note : The City does not allow the use of Sub-Surface Dripline Irrigation)
- Installation of Soil Amendments & Conditioners to all landscape areas to promote water retention within the soil structure per Water Corporation guidelines.
- Installation of Mulch to garden beds to a minimum depth of 75mm to add water retention within the soil structure per Water Corporation guidelines.

1.9 Landscape Maintenance

The industry accepted standard Developer funded and managed landscape and irrigation maintenance period is typically two (2) summers as outlined in Liveable Neighbourhoods and currently forming the basis of West Australia Planning Commissions Standard Subdivision Conditions. Following this period, the landscape and irrigation maintenance will be handed over to the City of Kwinana to manage, unless otherwise negotiated.

Typically the first year is an establishment period, followed by a second year of consolidation. Irrigation requirements are to be scheduled to be wound back during this period to a point of almost self-sufficiency at the time of handover to the Council.

Waste management is often a concern for Councils. Rubbish bins are to be proposed for POS areas where there is associated infrastructure such as BBQ's or picnic areas. Bins are to be located close to road carriageways and / or POS carparking bays to enable ease of emptying by the Council. Final bin locations will be determined in conjunction with the City at landscape detailed design stage.

As part of the ongoing approval process, every public open space landscape and irrigation design will be submitted to and approved by City of Kwinana for Landscape Approval prior to construction commencing allowing for input from the Council on items to be installed within open space and therefore likely ongoing maintenance requirements following handover.

The Landscape Design will incorporate recreation and environmental requirements, whilst focusing on maintenance minimisation principles and techniques. The developer is committed to working with the local authority to deliver outcomes in this process to reflect best practice throughout the development.

APPENDIX A

LANDSCAPE MASTERPLAN



NOTE: TREE RETENTION TO OCCUR IN ROAD RESERVES WHERE POSSIBLE.

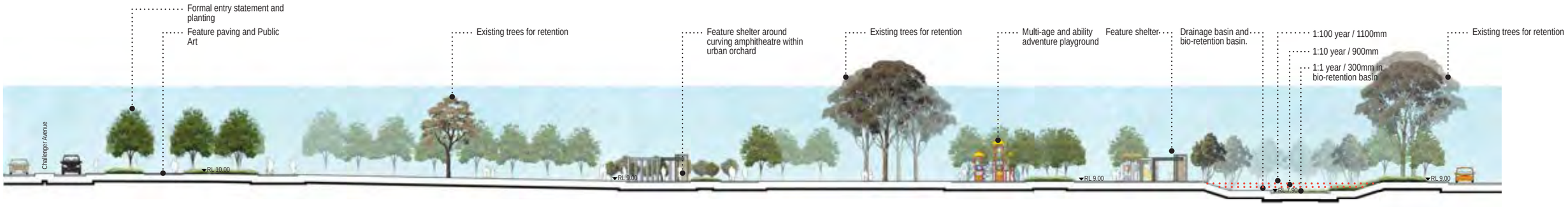
NOTE: NOISE ASSESSMENT MAY BE REQUIRED FOR ANY POTENTIAL NOISE IMPACTS FROM BORES.

LOTS E26, 303 & 9014, GILMORE AVENUE, KWINANA
landscape masterplan

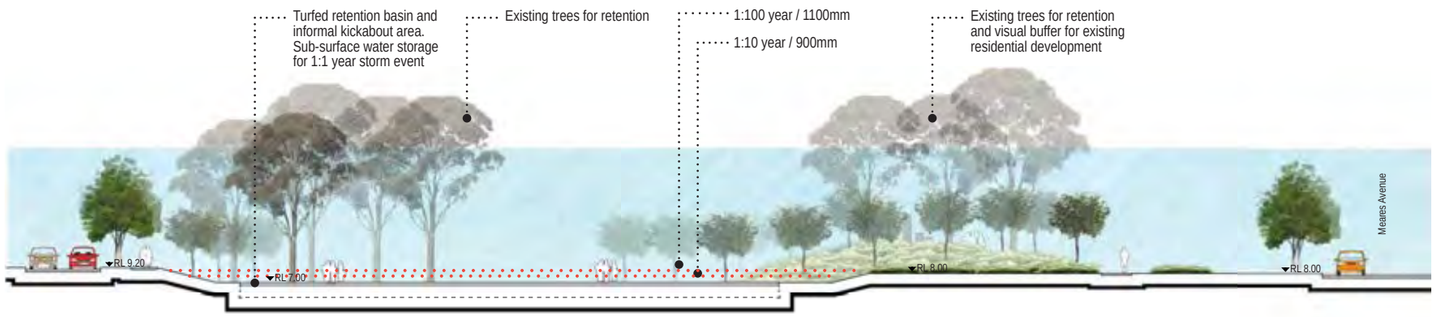
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Government of Western Australia
Department of Housing

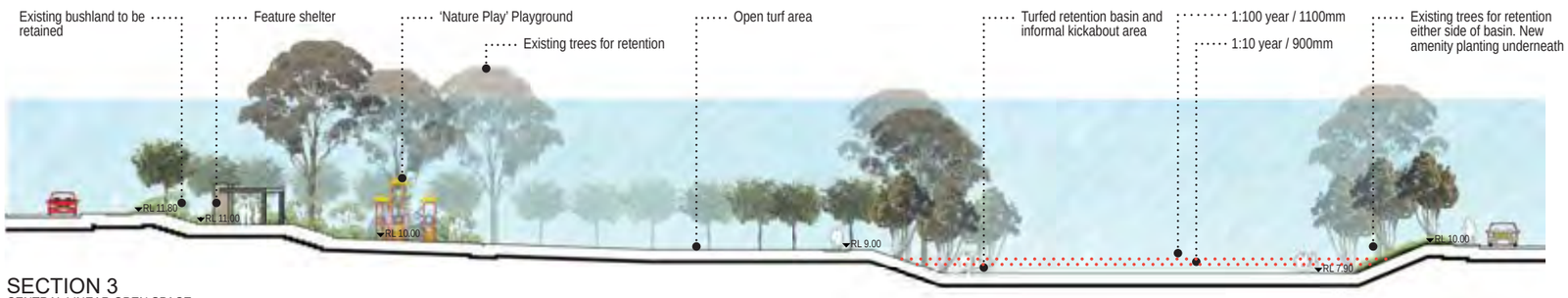
Satterley
Cossill & Webley CONSULTING ENGINEERS
SKM
360 environmental
burgess design group
emerge ASSOCIATES



SECTION 1
FORMAL TOWN CENTRE OPEN SPACE



SECTION 2
MULTIPLE USE / DRAINAGE PUBLIC OPEN SPACE



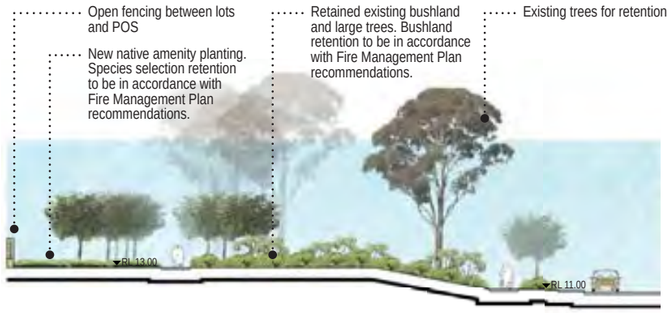
SECTION 3
CENTRAL LINEAR OPEN SPACE

LOTS E26, 303 & 9014, GILMORE AVENUE, KWINANA
landscape sections

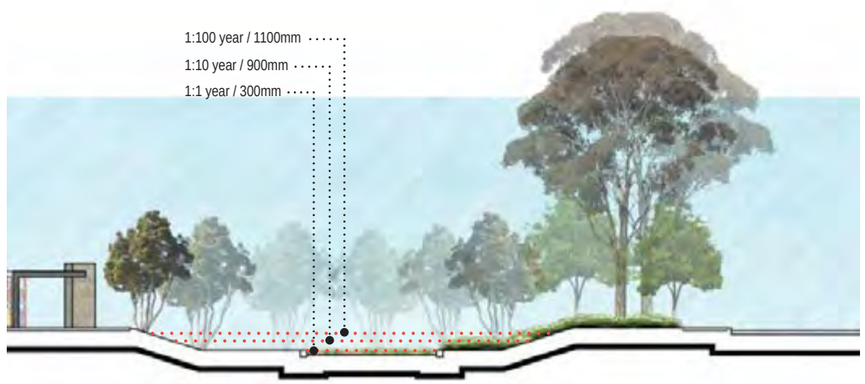
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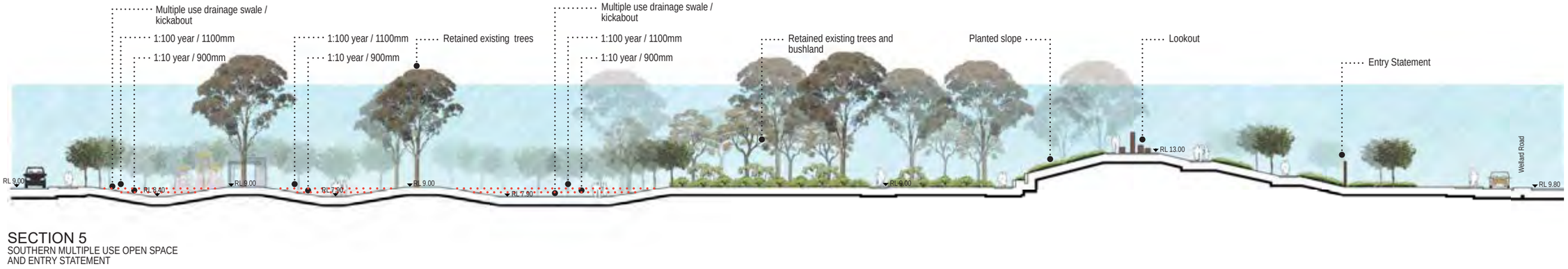
Satterley
Cossill & Webley
SKM
360
emerge ASSOCIATES
Integrated Science & Design



SECTION 4
CENTRAL LINEAR OPEN SPACE RETAINED BUSHLAND



SECTION DETAIL
TYPICAL BIO-RETENTION BASIN



SECTION 5
SOUTHERN MULTIPLE USE OPEN SPACE AND ENTRY STATEMENT



SECTION 6
MULTIPLE USE / DRAINAGE PUBLIC OPEN SPACE & RETAINED BUSHLAND

LOTS E26, 303 & 9014, GILMORE AVENUE, KWINANA
landscape sections

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20.01.2014

Government of Western Australia
Department of Housing

Satterley
Cossill & Webley
SKM
360
emerge ASSOCIATES
Integrated Science & Design

APPENDIX B

IRRIGATION STRATEGY

SANPOINT PTY LTD ABN 62 052 314 682
64 Mill Point Road, South Perth WA 6151
P: (08) 6436 1111 F: (08) 9367 2034
E: admin@ldtotal.com.au W: ldtotal.com.au

WATER MANAGEMENT STRATEGY

LOTS E26, 303 & 9014 GILMORE AVE, KWINANA

1. BRIEF STRATEGY OUTLINE

Based on the irrigated area, we propose three (3) bores to service the site with an average of each bore producing 7.5 litres per second. The stage 1 bore will house the Master Irrigation Cubicle and Hunter ACC 99D 2-wire controller. The other two (2) bores will be controlled via the stage 1 master cubicle with common mainline network interconnecting all three (3) bores.

Having a network of mainlines enables a backup for each of the areas if a bore was to go down due to fault for a period of time.

As the area has high iron content and susceptible to staining we have included Iron filtration on each of the three (3) bores. This will protect the Landscape infrastructure from staining. More information on the type of filtration is provided below.

2. WATER ALLOCATION

The below table shows water usage based on the POS areas being staged approximately with two (2) to three (3) POS areas per bore. Water usage is based on 7500 kilolitres per hectare as outlined by the Department of Water.

Bore No:	Required Flow	POS Areas	Hectares per bore	Kilolitres Per Annum
1	6.5 LPS	POS 5 & POS 6	2.3353	17,514.75
2	7.2 LPS	POS 3 & POS 4	2.5879	19,409.25
3	7.9 LPS	POS 1, POS 2 & POS 7	2.8688	21,516.00

Estimated Annual Water Usage: 58,440 Kilolitres per year
Estate Irrigated Area: 7.79ha

Seasonal Adjustments will need to be made accordingly to conserve water allocation and allowed for within the irrigation design.

3. IRON FILTRATION

The filter system would be designed to reduce the iron content of the bore water; down to less than 0.3ppm. The filtration process is made up of two (2) keys procedures:

a. Oxidation - Air is injected through a Venturi via a booster pump into the raw bore water. This starts the oxidation process.
b. Filtration - The oxidised water then passes through a media filter which catches the precipitated iron.

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FILTER SCHEMATICS



KEY

1 48" Tank
2 80mm Flushgal Valve
3 80mm B/Fly Valve
4 50mm FIP Ball Valve
5 50mm 100 Series Valve
6 100mm Class 15 ABS Pipe
7 Grundfos CHV4-80
8 25mm Venturi
9 50mm Class 15 ABS Pipe
10 25mm ARI Air Release Valve
11 80mm Wafer Check Valve
12 80mm Post Filter
13 Inlet Water Flow
14 Outlet Water Flow

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4. FINANCIAL BUDGET

Below shows a cost estimate broken down into each POS area along with Bore and Filtration Infrastructure:

Irrigation Financial Budget		
Infield Irrigation Infrastructure		
Location	Hectares	per POS ($)
POS 1	0.8942ha	$107,304.00
POS 2	1.1187ha	$134,244.00
POS 3	2.1229ha	$254,748.00
POS 4	0.4650ha	$ 55,800.00
POS 5	1.1145ha	$133,740.00
POS 6	1.2198ha	$146,376.00
POS 7	0.8559ha	$102,708.00
Major Irrigation Infrastructure Components		
Location	Type	$
POS 1	Bore, Iron Filtration & Electrical	$125,000.00
POS 3	Bore, Iron Filtration & Electrical	$125,000.00
POS 6	Bore, Iron Filtration & Electrical	$130,000.00
	TOTAL EXCLUDING GST	$1,314,920.00

5. MAINTENANCE

As part of the Irrigation infrastructure running efficiently, it's vital to maintain the system regularly. Below are items along with frequency of service requirements:

Iron Filtration:
Filter maintenance should be carried out quarterly by the filter manufacturer / installer.

Check should include:

- Test system backwash
- Record number of system backwashes since previous visit
- Check media level
- Check Air release valve working correctly
- Check Iron content level
- Check booster pump and venturi

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IMAGE: IRON STAINING ALONG MEARES AVENUE SHOWN ON PATHWAYS

Bore Hole, Pump & Head works:
This should be carried out every two (2) years with the bore hole being chemically treated or air developed during this time.

Bore Pump Cabinet:
The bore pump cabinet shall be checked every three (3) months including a wiring check, spider webs removed and all debris also removed.

Water Meters:
Checked every two (2) years

Check, Adjust & Report:
The overall operation of the system shall be checked, adjusted and a report provided once per week during the spring and autumn period, twice per week during summer and once per month during winter. This includes the unblocking of nozzles, broken parts replaced and sprinkler arcs adjusted if required.

6. STRATEGY DESIGN

See the attached drawings for the approximate bore locations and mainline network.

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7. EXISTING IRRIGATION INFRASTRUCTURE

Existing Town of Kwinana irrigation infrastructure shall tie into the new works where possible. There is a section of mainline that runs through the new development which can be seen on the drawing sheet 1 of 2.

Portions of this mainline will need to be re-routed once lot 9024 is developed to enable continual watering of the median strip. As for irrigation to the verges along Gilmore, Meares and Challenger Avenue verges, we are currently unsure of existing infrastructure and do not have “As Constructed” records. During the construction phase of the project, the construction team will need to work closely with the Town of Kwinana maintenance officers to ensure minimal interruption to existing infrastructure.

SHEET 2
SHEET 1

Rhodes Park

BORE 2

Ø150

Ø100

1.0324ha

SHEET 2
SHEET 1

L5

1594m²

Ø100

Ø100

L5

Ø100

4

6873m²

Ø150

Ø100

5

1.0878ha

Ø150

Ø100

6

1.1629ha

BORE 3

Ø100

Ø100

CONNECT INTO EXISTING
MAINLINE AT THIS LOCATION

EXISTING M/L

EXISTING M/L

CONNECT INTO EXISTING
MAINLINE AT THIS LOCATION

NOTE:
EXISTING MAINLINE SHOWN WITHIN THE CLOUDED AREA WILL NEED TO BE RE-ROUTED ONCE LOT 9024 IS DEVELOPED

C661
C662
C663
Left In/
Left Out
303
9024
3001
116
121
122
115
123
124
125
445
444
443
446
447
448
449
513
512
511
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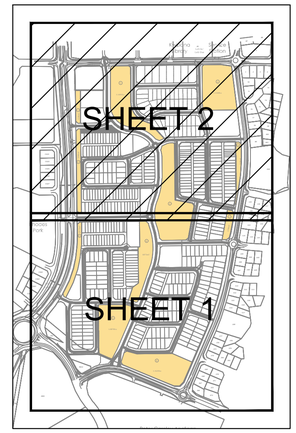
SYMBOL	DESCRIPTION
	BORE LOCATIONS
	IRON FILTRATION
	MASTER BORE CUBICLE WITH HUNTER ACC 99 STN DECODER CONTROLLER
	BORE PUMP CUBICLE
	Ø100 uPVC (CLASS 9) RRJ MAINLINE PIPE (INSTALLED WITH 25mm CONDUIT FOR 2 WIRE PATH)
	Ø150 uPVC (CLASS 9) RRJ MAINLINE PIPE (INSTALLED WITH 25mm CONDUIT FOR 2 WIRE PATH)
	50mm CONDUIT FOR PUMP START WIRES

NOTES:
1. PIPE WORK TO BE INSTALLED AT A DEPTH OF 450mm SOIL COVER FOR MAINLINE & 300mm SOIL COVER FOR LATERALS.
2. BORE POSITIONS AND FLOWS ARE AN ESTIMATE ONLY AND TAKES INTO CONSIDERATION IRRIGATION TO POS, MEDIAN STRIPS AND ROUNDABOUT AREAS ONLY. NO ALLOWANCE HAS BEEN MADE FOR STREET TREES OR INTERNAL VERGE PLANTING.
3. ISOLATION VALVES, MAINLINE FLUSHING VALVES AND AIR RELEASE VALVES ARE INTENTIONALLY NOT SHOWN ON THIS STRATEGY PLAN.

BORE DATA

BORE NO.	REQUIRED FLOW (LPS)	EST. ANNUAL WATER USAGE
1	6.5	17,514.75 kL
2	7.2	19,409.25 kL
3	7.9	21,516.00 kL
	TOTAL SITE:	58,440.00 kL

SHEET KEY:



REV	DATE	DWN	DESCRIPTION
A	28-02-2012	T.F	BORE & MAINLINE STRATEGY ONLY
B	26-03-2012	T.F	UPDATED BORE DATA
C	02-03-12	T.F	INCLUDED EXISTING T.O.K. MAINLINE LOCATION
D	28-06-13	TF	REVISED TO SUIT NEW MASTERPLAN

LD TOTAL
64 MILL POINT ROAD, SOUTH PERTH WA 6151
P: (08) 6436 1111 F: (08) 9367 2034

PROJECT:
LOTS E26, 303, 9024 GILMORE AVE

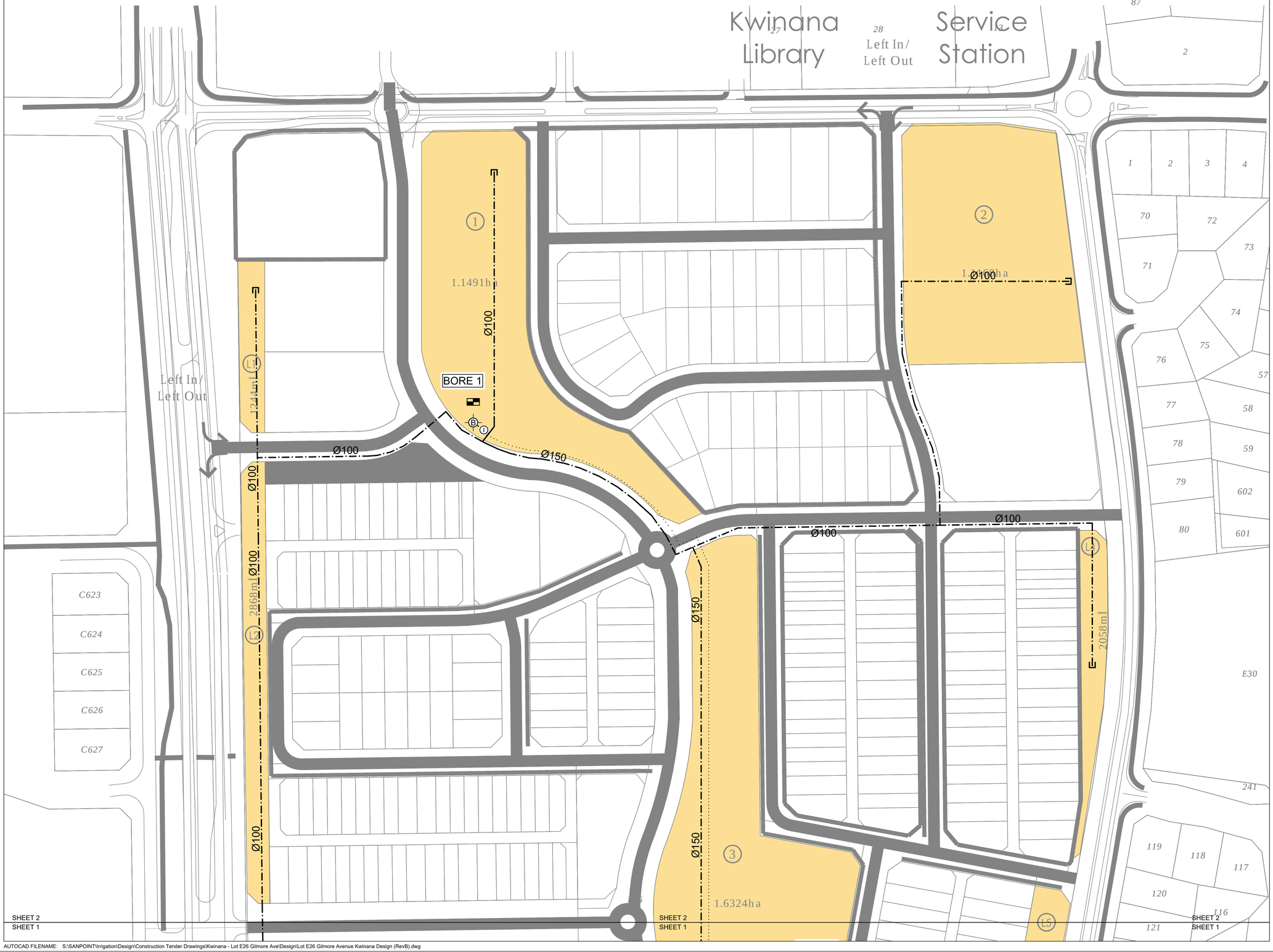
CLIENT:
EMERGE ASSOCIATES

TITLE:
IRRIGATION BORE & MAINLINE STRATEGY

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SCALE:	1:1000 @ A1 SHEET		
DESIGNED:	T.F		
DRAWN BY:	T.F		
APPROVED BY:	T.F		
DATE: 27-02-2012	DWG NO: GIL-IRR-01	SHEET NO: 1 OF 2	REV: D

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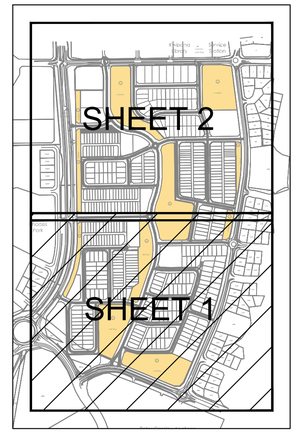


SYMBOL	DESCRIPTION
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	IRON FILTRATION
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	BORE PUMP CUBICLE
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D	28-06-13	TF	REVISED TO SUIT NEW MASTERPLAN

LD TOTAL
64 MILL POINT ROAD, SOUTH PERTH WA 6151
P: (08) 6436 1111 F: (08) 9367 2034

PROJECT:
LOTS E26, 303, 9024 GILMORE AVE

CLIENT:
EMERGE ASSOCIATES

TITLE:
IRRIGATION BORE & MAINLINE STRATEGY

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SCALE:	1:1000 @ A1 SHEET		
DESIGNED:	T.F		
DRAWN BY:	T.F		
APPROVED BY:	T.F		
DATE: 27-02-2012	DWG NO: GIL-IRR-02	SHEET NO: 2 OF 2	REV: D

AUTOCAD FILENAME: S:\SANPOINT\Irrigation\Design\Construction Tender Drawings\Kwinana - Lot E26 Gilmore Ave\Design\Lot E26 Gilmore Avenue Kwinana Design (RevB).dwg

Shane Caddy

From: Nele Wykhoff <Nele.Wykhoff@Kwinana.wa.gov.au>
Sent: Tuesday, 21 February 2012 5:02 PM
To: Shane Caddy
Subject: E26 Irrigation
Attachments: 20120221144840488.pdf; Henley Irrigation Ascon IRR03.pdf; Henley Irrigation Ascon IRR01.pdf; Henley Irrigation Ascon IRR02.pdf

Shane,
as discussed the other day please find attached some drawings for existing retic around the E26 lot, the quality of the Meares Ave one is not very good though (I had to scan an A2 paper copy) and unfortunately we do not have any information on the system along Gilmore Ave.

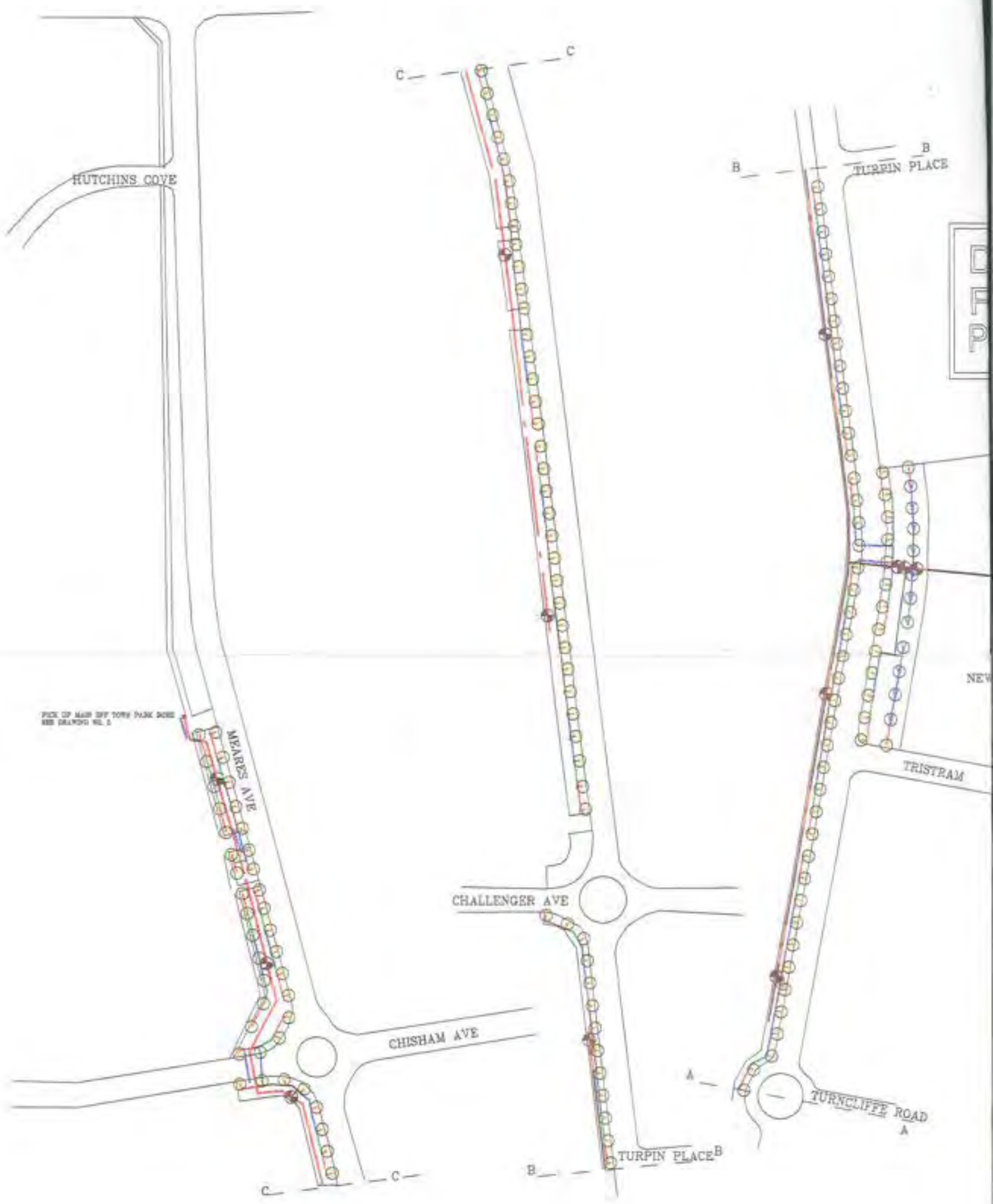
Should you have any further queries please let me know.

Regards,
Nele Wykhoff | Landscape Architect
(T) 08 9439 0240 | (F) 08 9439 0222 | (M) 0457 604 113

Town of Kwinana
www.kwinana.wa.gov.au
Corner Gilmore Ave & Sulphur Rd : Kwinana : WA 6167
PO Box 21 : Kwinana : WA 6966

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TOTAL EDEN



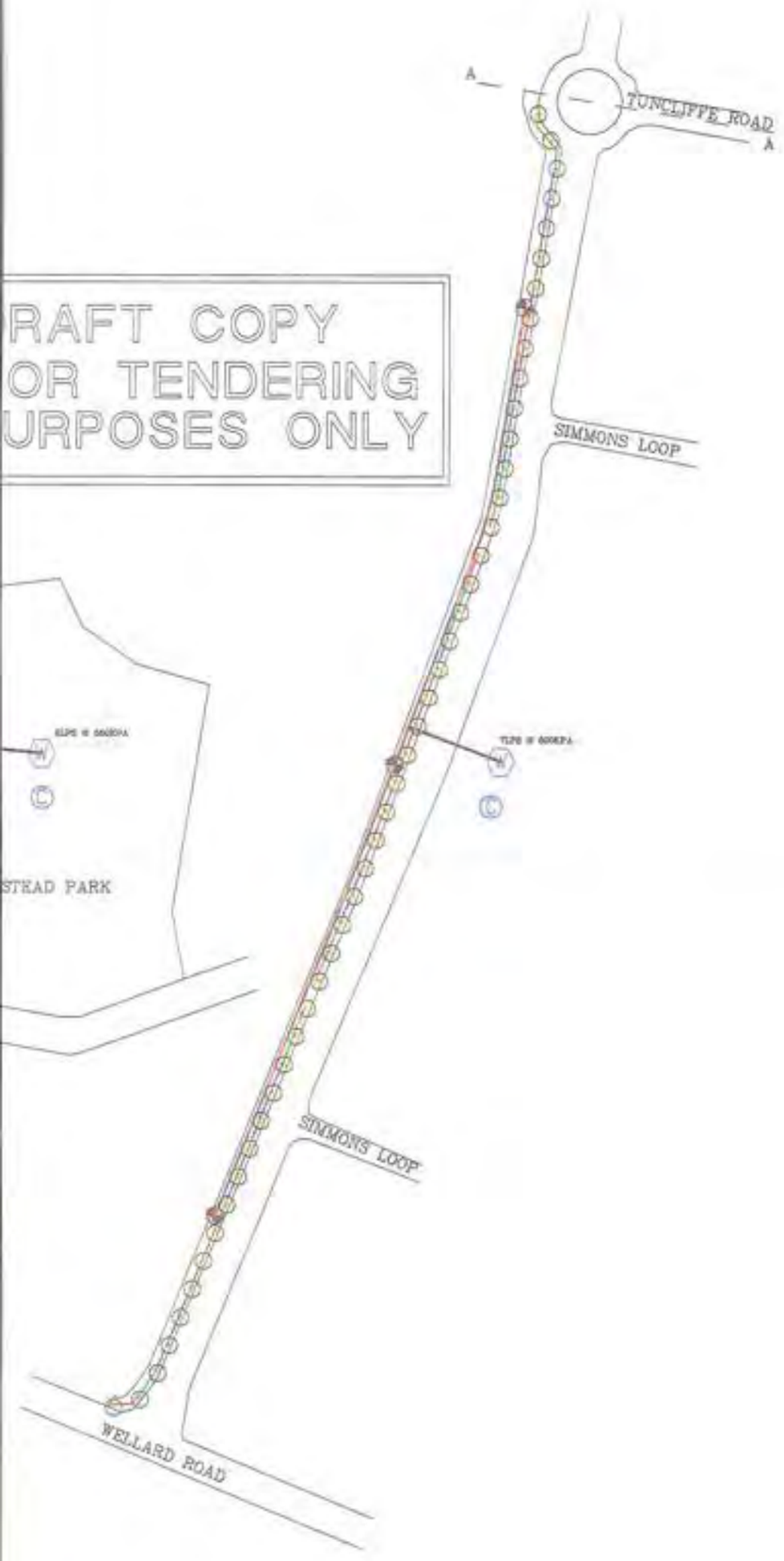
REV	DATE	DESCRIPTION	DWN	CHK

TO

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LEGEND

- 100mm Class 9 PVC
- 100mm CL9 RRJ Pvc Pipe
- 80mm CL9 RRJ Pvc Pipe
- 80 mm Class 9 PVC
- 50 mm Class 9 PVC
- 40 mm Class 9 PVC
- 25 mm Class 9 PVC
- 20 mm Class 12 PVC
- SLEEVE 150mm
- (C) IRRI-TROL AB-16
- (C) IRRI-TROL AB-11
- (T) Hunter PGP-360 Popups 11 360.0
- ○ Hunter PGP-ADJ Part Circle 4" Pop-Up 9LA
- Bermad 50mm Angle Valve D201
- (W) Water Supply



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WN OF KWINANA
MEARES AVE

NOTES:

TOTAL EDEN
WATERING SYSTEMS
PH: 08 9434 3611 FAX: 08 9434 3622

Design/Drawn By:	RJ CHARLES
Checked By:	
Date:	1.8.96
Scale:	1 : 2000
Design No.	8
Flow/Pressure:	AS SHOWN

Agrifood TECHNOLOGY

Your link with quality

ANALYSIS REPORT

Western Irrigation
211 Barrington Street
BIBRA LAKE W.A 6163

ATTENTION	Andrew Ogden
FAX NUMBER	08 9434 5777
PURCHASE ORDER	C095015
PROJECT NUMBER	B1109-0040

DATE RECEIVED	14 September 2011
OUR SAMPLE NUMBER	B2011-01385
YOUR REFERENCE	52991 PEET SOUTHERN J/V WELLAR
SAMPLE TYPE	Water
SAMPLE DESCRIPTION	52991 PEET SOUTHERN J/V WELLARD STH BORE2

TEST		Result
General Appearance		
	Appearance	pale yellow
	Odour	odourless
pH		
	pH	7.2
Electrical Conductivity		
	Electrical Conductivity (mS/cm)	1.50
TDS (calculation)		
	Total Dissolved Salts (mg/L)	900
Total Alkalinity		
	Bicarbonate (mg/L)	355
	Alkalinity (mg CaCO3/L)	290
	Carbonate (mg/L)	<5
Hardness		
	Hardness (mg CaCO3/L)	325
Iron		
	Iron (mg/L)	5.1
Dissolved Carbon dioxide		
	Dissolved Carbon Dioxide (mg/L)	38

Comment : Neutral in reaction, contains moderate salinity, suitable for irrigation of slightly to moderately salt tolerant plants. Use on salt sensitive species is not recommended. Limit direct contact with plant foliage. Bicarbonate, total alkalinity and total hardness are high, calcium carbonate deposits likely to form, may have an alkaline effect on soils. Total iron is high, likely to cause staining. Combination of calcium carbonate and iron oxide deposits may cause blockages of sprinklers and/or parts of the irrigation system

Note: **All samples are analysed on an as received basis.**
This report is not to be reproduced except in full.

Final Report

Report Number: 55743

Invoice No. : 55823

Australian Wool Testing Authority Ltd
Trading as Agrifood Technology
ABN 43 006 014 106
www.agrifood.com.au

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TRIM D13/6026

Irrigation Guidelines 2013

(Excerpt from Public Open Space & Streetscape Development Guidelines 2013)



Irrigation Excerpt Only

Public Open Space & Streetscape Development Guidelines 2013

(Complete guideline TRIM D12/11708)

Revision B – March 2013

Document Control					
Document ID: TRIM D13/6026					
Rev No	Date	Revision Details	Author	Reviewer	Approver
V1	29 Jan 2013	First version	TM	KH	
B	21 Mar 2013	Clarification of approved sprinklers & std. drawings	TM	KH	

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Introduction

The following Irrigation Guidelines have been developed with the aim of ensuring appropriate plant, equipment and materials as well as industry best practice methods and workmanship are employed. The objective of which is the reduced risk of premature asset failure and the minimisation of maintenance requirements.

In addition, the City of Kwinana aims to achieve consistency of irrigation assets throughout the City in order to enable ease of maintenance, ease of operator training and effective and adequate stocking of standard parts.

1. Irrigation System Design

1.1. All irrigation system designs must be approved by the City of Kwinana as part of the development approval process.

1.2. Design plans for irrigation systems shall contain a list of approved sprinklers, valves, bore, electrical switch gear and other equipment as specified in this Document.

1.3. An 'as constructed' plan of the irrigation system is required at time of Practical Completion.

1.4. All parks and gardens will be subject to any and all water restrictions as indicated by the relevant Water Authority.

1.5. All bores are to be fitted with water meters and must meet the Department Of Water acceptability requirements under the Rights in Water and Irrigation (Approved Meters), refer to Department Of Water guidelines.

1.6. All irrigation systems are to incorporate hydro-zoning between turf, planted beds and trees. Tree irrigation must be independently hydro-zoned to allow decommissioning after two to three seasons without affecting the irrigation of turf and garden bed areas.

1.7. MP Rotator type sprinklers shall not be used, unless specifically approved in writing by the City of Kwinana.

1.8. Inline drip emitter hose type systems (commonly known as 'Drip-Eze' or similar) should be avoided unless deemed absolutely necessary and approved in writing by the City of Kwinana. Inline drip type systems shall never be accepted in turf areas.

1.9. Where an approved inline drip hose type system is proposed, the garden design must consider suitable plant species and subsoil to allow the inline drip station/s to be decommissioned within a maximum of three seasons. The decommissioning of any such station shall not affect the remaining irrigation system.

1.10. Conventional poly pipe drip emitters, whilst not prohibited by the City, shall not typically be used within a system design unless specifically required and approved in writing by the City of Kwinana.

1.11. All irrigation systems shall provide efficient and adequate reticulation regardless of location, plant size or species. Irrigations systems shall perform >85% Coefficient of Uniformity and >75% Low Quarter Distribution Uniformity.

1.12. All irrigation regimes will take into consideration the water requirements of the targeted plants.

1.13. The watering window on any bore or irrigation system shall not exceed six (6) hours per day and must occur within the hours of 2300 to 0600. Due to vandalism trends within the City, irrigation operation on Friday and Saturday nights is to be avoided where possible, particularly for streetscape stations.

1.14. Any and all irrigation assets are to be installed and maintained by suitably accredited and qualified irrigation contractors.

1.15. **The City of Kwinana will not accept Practical Completion of any irrigation system that has not had the mainline installation and back fill inspected**, at the time of works, as

specified within this Document, by the City's Representative. It is the responsibility of the Developer to arrange this inspection.

2. Iron Bacteria Filtration Systems

2.1. Where water analysis confirms that an unacceptable concentration of iron bacteria are present, as determined by the City, an iron bacteria filtration system shall be installed as part of the irrigation system. **Sub-surface irrigation shall not be considered a solution to any anticipated staining.**

2.2. The iron system is to include the iron filtration unit, booster pump and associated electrical components, concrete pad and all backwash components.

2.3. The system is to be housed in an appropriate lockable compound, which complements the site landscape. The compound should not exceed two (2) metres in height and ideally comprise of a galvanised steel framework with a suitable screen material. Garden sheds, or similar type structures, will not be accepted. The area surrounding the compound shall be planted to soften visual impact on the landscape.

2.4. The technical specification and design of any proposed iron bacteria filtration system is to be approved by the City of Kwinana during the development approval process outlined in this Document.

2.5. The filtration system is to be maintained as per manufacturer recommendations during the maintenance consolidation period and, where appropriate, training provided to the City's representative at time of handover.

2.6. All drawings, manuals, procedures and warranties are required to be submitted to the City of Kwinana for irrigation system handover to take place.

3. Bore Hole

Diameter

3.1. The diameter of the holes to be drilled shall be adequate for the installation of 200mm casings, including a 40mm annulus of gravel pack material surrounding the bore casing.

Materials

3.2. **Production Casing:** 200mm Class 12 AS1477 PVC casing in accordance with the Schedule of Rates.

3.3. **Screen Assembly:** 200mm bores shall be equipped with 85/8" API standard duty stainless steel screens. Screen lengths, for tendering purposes only, shall be in accordance with the Schedule of Rates.

3.4. Aperture sizes will be established, in consultation with Principal's Contract Authority, after analysis of sand samples during construction of each bore. The Contractor shall include the cost of sand sampling, and sieve analysis of the samples, in his tendered schedule of rates. All screens shall have stainless steel base plates and suitable PVC or ABS casing to screen adapters.

3.5. **Centralisers:** Shall consist of spring steel or plastic bow centralisers to fit a minimum 40mm annulus (as manufactured by Weatherford or Kwik-Zip).

3.6. **Gravel Pack:** Shall consist of washed, screened, and graded river sand, graded +1.6 mm – 3.2 mm

4. Bore Pump & Head-Works

General

4.1. All works shall be performed under the control of a Quality Management System accredited to ISO 9001-2000.

Borehole Pump

4.2. Any borehole pump supplied by the Contractor shall have both the pump-wet end and pump motor constructed from 316 stainless steel.

4.3. The City of Kwinana typically utilises one of two preferred borehole pumps, as outlined in the table below. Any borehole pump supplied by a Contractor must, to the written satisfaction and approval of the Principal, meet or exceed the specifications of the preferred pumps listed in the table below:

TABLE: **City of Kwinana Preferred Borehole Pumps**

Brand Name	Type	Model	Stages	KW
Grundfos	Submersible	SP46-9	9	15
Lowara	Submersible	Z646/10	10	15

4.4. Contractors must quote/tender on the supply and installation of the above mentioned pumps or a suitable alternative submersible pump (as approved in writing by the Principal) to deliver water at the minimum rate of 12.0 litres per second to a total dynamic head of 80.0 metres.

Submersible Drop Cable

4.5. The Contractor shall supply and install, with the submersible pump unit, submersible electrical drop cable (Hydro firm or Eucahydro or equivalent) sized in accordance with the motor manufacturer's recommendations. This shall terminate at the bore head with a metal junction box, with a minimum of two metres of cable looped under the bore head within the bore.

Discharge Column

4.6. The pump and motor unit shall be installed on 100mm threaded and coupled Class 18 PVC pump column with stainless steel sockets and two stainless steel safety cables, as per manufacturer recommendations or as approved by the City.

4.7. Where required, a separate rate shall be requested for the use of 80mm threaded and coupled Class 18 PVC pump column with stainless steel sockets and two stainless steel safety cables, as per manufacturer recommendations or as approved by the City.

4.8. A 25mm PVC probe conduit shall be installed, terminating level with the top of the pump. The top end shall terminate with a 25mm PVC Cat. 17-valve socket, screwed into the 25mm socket provided in the bore head discharge flange. The bottom of the drawdown tube is to be level with the top of the pump.

4.9. Column centralisers shall be installed at the pump and at 12-metre intervals of column, to protect electrical cables and drawdown tube.

Borehead & Discharge Flange

4.10. The pump and discharge column shall be connected to the PVC flange on the bore casing and suspended in the bore casing by a matching hot dipped galvanised discharge flange and socket.

4.11. The bore head and discharge flange will be in accordance with the drawing.

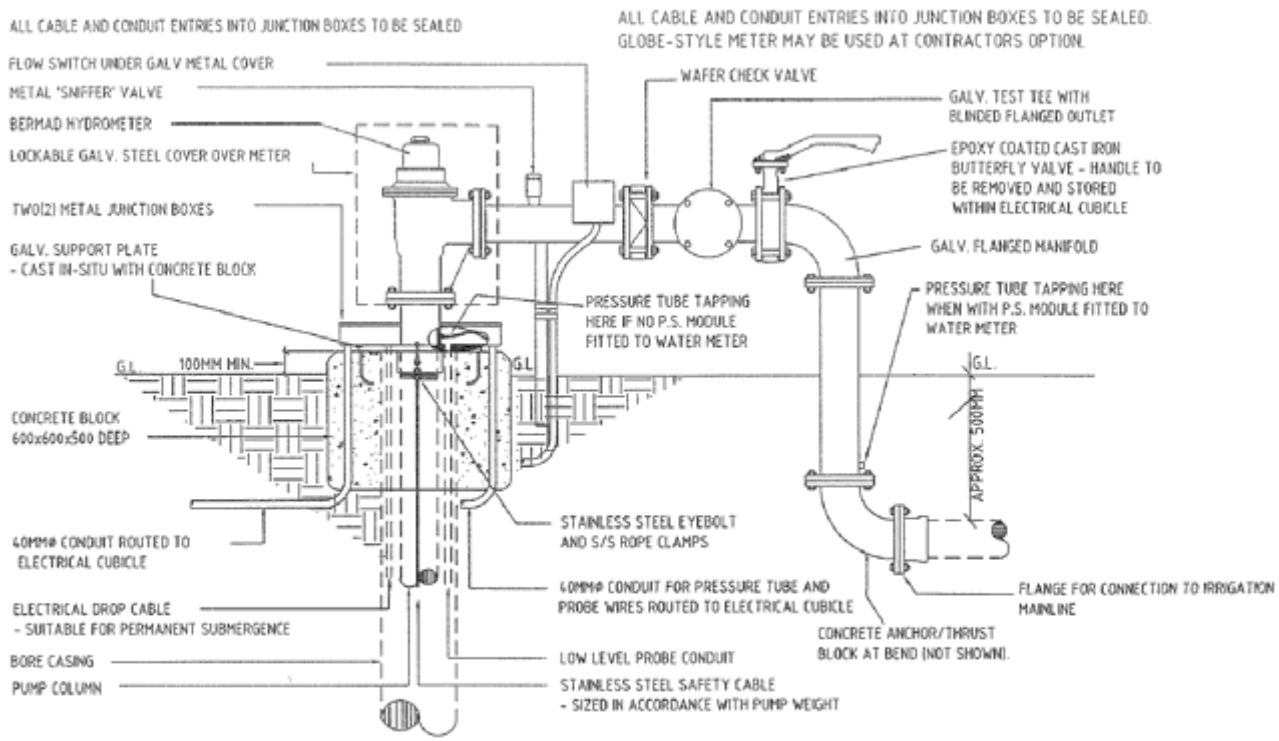
Discharge Assembly

4.12. All surface discharge pipe work shall be hot dipped galvanised Schedule 40 ERW fabricated steel and fittings shall be butt weld flanged type.

4.13. All butt weld elbows for this Contract shall be of the long radius type and the complete assembly shall be in accordance with the attached drawing.

4.14. The Contractor shall include in the discharge assembly the following:

- Bermad IR 900 - M series flow meters. Sizes include 50mm, 80mm and 100mm. Conduit and wiring to be installed from flow meter back to irrigation controller. Certificate of calibration to be submitted to the Principal by the Contractor.
- Sniffer valve.
- Sustaining pressure valve as required and as authorised by the Principal.
- 100mm (or 80mm) diameter dual flap check valve (Mission HVAC or equivalent).
- 100mm (or 80mm) diameter butterfly isolation valve (Mindeco Fig. VF 735T - GO or equivalent). A padlock and galvanised chain shall also be supplied to lock this valve in position.
- 100mm (or 80mm) diameter hot dip galvanised butt weld flanged test tee with blank matching flange.
- 100mm (or 80mm) diameter hot dip galvanised butt weld flanged s-bend discharge to a nominal 450mm below site ground level.



BORE HEAD CONNECTION DETAIL
SUBMERSIBLE PUMP (WITH WATER METER & FLOW SWITCH)

Mounting

4.15. The casing string and pump discharge assembly is to be supported by a concrete block with minimum dimensions of 750mm x 750mm with a depth of 600mm.

4.16. The top of the concrete block shall finish 100mm above finished ground level.

4.17. All electrical conduits shall be set into the concrete block. Conduits attached over the surface of the block will not be permitted.

Circuit Breaker

4.18. The Contractor shall allow for the supply and installation of a circuit breaker as recommended by the manufacturer of the submersible motor.

Testing

4.19. The Contractor shall allow for returning to the site upon completion of all works and carry out running tests in the presence of The Principal's Contract Authority.

4.20. The Contractor shall provide and set up all necessary test apparatus to determine the pumps capacity at the designed pressure. Water level readings will also be required.

4.21. The Contractor shall also provide any necessary equipment to dispose of water discharge during the testing.

4.22. The Contractor shall provide all testing documentation and reports to the Principal as specified.

5. Electrical Components

General

5.1. All workmanship and materials shall comply with current SAA wiring rules, the *State Electrical Act*, Office of Energy requirements, Uniform Building Bylaws, and other regulations as may be applicable.

Power Supply

5.2. The Contractor shall allow extending cable and conduiting from a Western Power underground supply pillar to the new bore cubicle – allowing a distance of 15 metres.

5.3. The Contractor shall allow adequate ducting through the concrete plinth for entry to the cubicle of the supply cabling, together with two spare 50mm conduits with bends exiting towards the rear of the cubicle.

5.4. All underground conduits shall be heavy duty PVC, laid in straight lines in accordance with the manufacturer's instructions.

Control Cabinet

5.5. The Contractor shall supply and install a control cabinet to house all electrical equipment associated with this contract, including automatic control, Variable Frequency Converter Drive (VFD) and Western Power metering.

5.6. The cabnet shall be installed approximately 2 metres from the bore on a concrete plinth (the top of which shall finish 100mm above final ground level).

5.7. The cabinet shall have nominal dimensions of 1500mm high, 900mm wide and 500mm deep.

5.8. The cabinet shall be freestanding and lockable, with a 2 or 3 point locking system and keyed to a City of Kwinana locking system.

5.9. The cabinet shall be weatherproof and constructed from heavy duty, high-grade aluminium (Comalco 5005/H34 or equivalent) or galvanised steel, as approved by the City.

5.10. Sufficient space in the top section of the cubicle shall be allowed for the installation of an irrigation controller, as specified, with the approximate dimensions of 400mm high, 400mm wide, and 180mm deep.

5.11. The Variable Frequency Converter Drive (VFD) shall be supplied, as specified, and installed with appropriate EMI/RFI filters as required by Western Power Corporation.

5.12. The electrical cubicle shall be fitted with a ventilation fan to assist in air flow which will be operated by an adjustable thermostat installed in the cubicle.

5.13. Installation of three (3) GPO [General Power Outlets] 2 x 10 amps, 1 x 15 amps. All wiring to be wired through an RCD.

5.14. Provision for an A3 holder to be included inside cabinet.

Circuit Breaker

5.15. The Contractor shall allow for the supply and fitting of a motor rated circuit breaker in the submersible pump control cabinet, as recommended by the motor manufacturer.

Variable Frequency Converter Drive (VFD)

5.16. The pump shall be controlled by a Variable Frequency Converter Drive (VFD), [otherwise known as Variable Speed Drive or 'VSD'] supplied and installed by the Contractor, to vary the speed of the pump motor to maintain a constant set pressure within the mainline.

5.17. The pump shall maintain a set pressure (as specified by the Principal for each site) by increasing or decreasing the speed as necessary to meet the flow demand of normal irrigation.

5.18. Any VFD equipment supplied by the Contractor must, to the satisfaction and approval by the Principal, meet or exceed the specifications outlined in this document.

5.19. The VFD shall be sized according to the maximum rated amperage draw of the pump (not the nominal power consumption), as published by the pump manufacturer.

5.20. The VFD shall be coupled to a 4-20mA signal pressure transducer connected to the pump headworks or mainline (downstream of any pressure sustaining valves if fitted).

5.21. The VFD unit shall be furnished with an appropriate Sine Wave Filter as recommended and supplied by the manufacturer of the VFD.

5.22. For manual speed control in the manual setting of the pump selector switch the VFD must be controlled by a manual POT located on the hinged escutcheon of the electrical cubicle.

Motor Starter

5.23. The Contractor shall allow for all necessary motor protection equipment and switchgear as specified by the motor manufacturer, whether stated or not in these specifications.

5.24. Western Power shall approve the motor starter for starting and running a submersible electric motor of the size tendered.

5.25. The motor starter supplied shall be suitable for operating under the prevailing site conditions.

5.26. Both a 'run' light, 'trip/overload' light and reset button for the motor shall be installed and clearly marked within the electrical cubical.

Selector Switch

5.27. In addition to the main isolation switch, the Contractor shall install an auto - manual - off switch for the control cabinet. The selector switch shall be wired such that:

5.28. The auto position allows for automatic start and stop of the pump unit by the (future) irrigation controller.

5.29. The off position provides for isolation of all controls.

5.30. The manual position allows the pump to be controlled by separate on / off push buttons, independent of the irrigation controller.

Pressure Switch

5.31. A high-pressure and low-pressure switch shall be supplied and installed in a separate enclosure within the cabinet, and associated equipment shall include a time delay and latching lockout relay, clearly labelled "high pressure" fault light, and a reset button.

5.32. The pressure tubing to the pressure switch shall commence from the upstream side of the isolation valve in the pump discharge assembly. The tube shall be approved for use in high-pressure installations, and only approved brass fittings shall be used with the tube.

5.33. In addition, the Contractor shall allow for supply and installation in the cabinet of a 0-1000kPa liquid filled pressure gauge, connected to the pressure tube line, and mounted in a prominent position within the cabinet.

5.34. The high-pressure protection shall be operational in both the automatic and manual mode.

5.35. The independent second pressure line required for variable speed (Variable Frequency Drive) application is to be installed on the downstream side of the isolation valve in the pump discharge assembly. The tube shall be approved for use in high-pressure installations, and only approved brass fittings shall be used.

5.36. Current Western Power / Office of Energy regulations regarding installation of pressure switches, tubes, gauges, and other pressure equipment within the electrical control cabinet shall be strictly adhered to. All electrical equipment to be adequately protected from any potential source of water damage.

Low Level Probe

5.37. The Contractor shall supply and install an approved two-wire low-level probe and probe relay. The relay shall be installed in the pump cabinet, and wired with a lockout relay, clearly labelled “low level” indicator light and fault reset button. The bottom of the probe shall be positioned within the range of 0.5 to 1.0 metres of the top of the pump, within the 25mm PVC probe conduit. The low-level protection shall be operational in both the automatic and manual mode.

Ancillary Equipment

5.38. The Contractor shall install a suitable ammeter. The maximum full load running current of the motor shall be marked with a red line on the face of the ammeter.

5.39. An hour run meter shall be fitted. The switchboard shall include a single-phase GPO switch with RCD, and fuse block. All fuses for electrical control shall be HRC type. A pump run lamp shall be installed and operational in both the automatic and manual mode.

5.40. A lamp test button shall be installed to enable testing of fault indicator and pump run lamps.

Labelling

5.41. All equipment installed within the cubicle shall be identified with precise easy to read engraved labels. Labels shall be secured with screws or rivets and not glued.

Circuit Diagrams

5.42. The Contractor shall provide two hard copies and a soft copy on CD of an as-built circuit diagram showing all wire numbers, ratings and settings necessary for operation, maintenance and replacement of installed equipment.

5.43. Circuit diagrams shall be presented on a minimum A3 size-drawing sheet. One copy of a laminated circuit diagram shall be placed in the cubicle, and a second hard copy and soft copy on CD is to be presented with the Contractor’s invoice for the works.

6. Irrigation Controllers

General

6.1. The Developer shall allow for installing an irrigation controller, as specified, in the cubicle.

Preferred Irrigation Controllers

6.2. Any controller supplied must, to the written satisfaction and approval of the City of Kwinana, meet or exceed the specifications of the preferred controllers outlined in this document.

6.3. The City of Kwinana typically utilises one of three specific irrigation controllers, as outlined in Table below.

TABLE: **City of Kwinana Preferred Irrigation Controllers**				
Item	**Brand Name**	**Type**	**Model**	**Stations**
1	Hunter	Modular	ACC-1200	12-24
2	Rain Bird	Modular	ESP-24 MC	24
3	SD Systems	Two-wire	SDS-50	12-24

6.4. The City shall only accept such commercial quality irrigation sequencing controllers for irrigation systems. Any system must have the following minimum features;

- Capacity to meet or exceed a minimum of 24 stations unless otherwise approved
- 14 day irrigation cycle
- 4 programs, able to operate concurrently
- 4 cycle starts per program (minimum)
- Simultaneous activation of 2 to 4 solenoid valves plus master valve
- Integral transformer, approved by local power authority

6.5. Where the controller is required to activate more than two (2) solenoid valves simultaneously, a separate relay output board shall be installed to activate these valves.

7. Pipe-works

City of Kwinana Inspections of Pipe-works

7.1. The City of Kwinana will not accept Practical Completion of any irrigation system that has not had the mainline installation and back fill inspected, at the time of works, as specified within this Document, by the City's Representative.

7.2. It is the responsibility of the Developer to arrange inspections as specified; namely:

- The relevant Council Officer shall be present at time of mainline backfill to inspect workmanship and compliance to the standards outlined in this document.
- No backfill of mainline pipeworks is to occur without the consent of the relevant Council Officer and shall only occur following an inspection.
- The Contractor shall give the Principal seven (7) days notice of intent to backfill mainline pipeworks and confirm the inspection appointment a minimum of 24 hours prior to the inspection time.

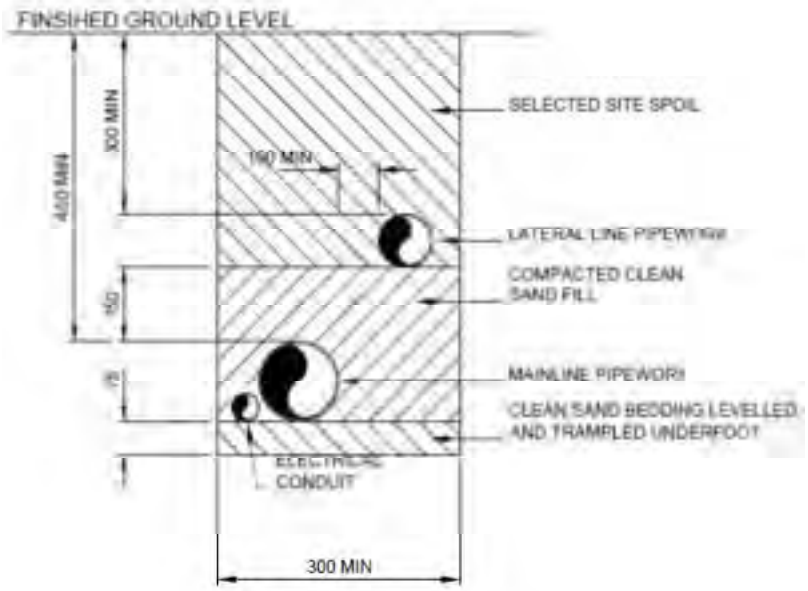
Excavation and Trenching

7.3. Where ever possible, piping shall be laid in parallel straight lines. The trench bottom shall be flat, firm, smooth and free from rocks. Care shall be taken so that no rocks, rubble or sharp objects are laid in contact with the pipe.

7.4. Where ever possible, piping shall be laid under softscape areas, with piping under areas to be concreted, asphalted or built on to be avoided in all instances.

7.5. It shall be at the Council Officer's discretion whether excavated spoil is suitable for backfill.

7.6. Lateral clearance between any pipes in a common trench shall be a minimum of 100mm.



MULTIPLE PIPES IN COMMON TRENCH

Sleeves

7.7. PVC sleeves shall be installed under all paved surfaces for the installation of any mainline or lateral pipe. The sleeve shall be a minimum of Class 9 uPVC SW and of the diameter noted in the relevant drawings and, where possible, installed prior to the installation of paving.

7.8. Mainline sleeves in excess of 8 metres in length shall be high density poly pipe and butt welded, unless otherwise approved by the City.

7.9. Any sleeve installed via horizontal boring methods must not to be curved on any axis. Pipes shall be cut at level and change of direction achieved through use of 45 or 90 degree elbows only.

Mainlines

7.10. The irrigation mainlines of 100mm NB size or larger, which are to be used for the bore water irrigation system, shall be Modified PVC (mPVC/PVC-M) Series 1, manufactured in Australia to AS 4765, having a minimum pressure rating of PN9, and shall utilise the Rubber Ring method of Jointing (RRJ) being of a size as shown on the relevant drawings.

7.11. All mainlines of 80mm NB size attached to the bore water supply shall be uPVC manufactured in Australia to AS 1477, having a minimum pressure rating of Class 9, and shall utilise the Rubber Ring method of Jointing (RRJ).

7.12. All mainlines shall be installed in a trench which is free of debris and other large or hard objects which may damage or deform the pipe.

7.13. The base of the trench should be as uniform as possible relative to both grade (slope) and compaction so as to support the mainline pipes uniformly over their length and where practicable, the width of mainline trenches should be maintained at between 3 and 6 times the mainline pipe diameter.

7.14. Mainlines shall be installed with 600mm minimum soil cover, and shall be bedded and backfilled.

7.15. Where mainlines are to be installed under sealed driveways or other paved trafficable areas, they shall be installed within a PVC duct (sleeve) being a minimum of two (2) sizes larger than the nominal size of the mainline, provided that the inside diameter of the sleeve is greater than the maximum outside diameter of the mainline pipe coupling (socket).

7.16. Where mainlines are to be installed under unsealed driveways or other unsealed trafficable areas, they shall be installed with a minimum soil cover of 750mm.

7.17. Curves in mainlines are to be avoided in all instances and will not be accepted unless sufficiently justified, and approved, in writing, by the City's Representative. Where a mainline curve is deemed absolutely necessary and approved, the following minimum radius arcs are to be adhered to:

Size	Radius of Arc
80mm	24m
100mm	30m
150mm	45m

7.18. In addition, it is important that all joints in curved lines be thoroughly supported by compacted soil. No 'Tapping Band' connection will be permitted in a mainline curve, however, cast iron irrigation tees may be utilised for this purpose.

7.19. All Rubber Ring Joints (RRJ) are to be installed in accordance with the manufacturer's recommendations, including (but not limited to);

- Chamfering of spigot
- Use of recommended ring lubricant
- Cleanliness during ring insertion
- Pipe 'witness mark' to remain just visible
- Care to prevent over insertion of previous pipe joints by successive joint completion

Backfill and Compaction

7.20. The bedding, overlay and back filling of all pipe work trenches shall be accomplished with material previously excavated from the site trenches, provided it is free from rock and other hard objects, in accordance with AS 2032.

7.21. The relevant Council Officer, namely the Irrigation Supervisor, shall be present at time of backfill to inspect workmanship and compliance to the standards outlined in this document. **Practical Completion and/or Handover will not be accepted unless this inspection has occurred.**

7.22. No backfill of pipeworks is to occur without the consent of the relevant Council Officer and shall only occur following an inspection.

7.23. The Contractor shall give the Principal seven (7) days notice of intent to backfill pipeworks and confirm the inspection appointment a minimum of 24 hours prior to the inspection time.

7.24. If the material excavated from the site trenches is unsuitable or insufficient to accomplish the bedding and back filling operation to the satisfaction of Superintendent, then clean sand fill for this purpose is to be utilised.

7.25. The trench work shall then be compacted to the Superintendents satisfaction so as to minimise the future subsidence of the soil in the trench.

7.26. All surplus soil excavation, including rocks removed from backfill material, shall be removed from the site.

Laterals – PVC

7.27. All uPVC laterals shall be manufactured in Australia to AS 1477, having a minimum pressure rating of Class 9, and shall utilise the Solvent Weld method of Jointing (SWJ) being of the sizes as shown on the drawings.

7.28. All laterals shall be installed in a trench which is free of debris and other large or hard objects which may damage or deform the pipe and the base of the trench should be as uniform as possible relative to both grade (slope) and compaction so as to support the lateral pipes uniformly over their length.

7.29. The lateral pipes shall be installed with 300mm minimum soil cover, and shall be bedded and backfilled.

8. Fittings

Cast Iron Fittings

8.1. All fittings of 80NB and larger, that are to be used on the mainlines, with the exception of approved uPVC Bends and Tapping Bands, shall be of Cast Iron material with RRJ or flange connection, manufactured to AS 2280 or equivalent.

8.2. Where Rubber Rings differ from those of the PVC mainline, the Contractor shall exercise all due care to use the correct ring with the correct fitting. All RRJ fittings shall be thrusted in accordance with this specification.

8.3. Any Cast Iron Flanged fittings shall be flanged in accordance with the British Standard Table 'E' configuration.

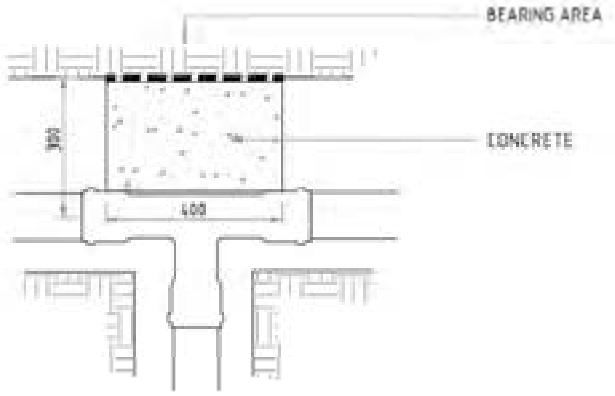
Thrusting Requirements

8.4. All the fittings on the uPVC mainlines jointed with rubber ring joints require concrete thrust blocks to prevent movement of the pipeline when a pressure load is applied. The thrust block transfers the load from the fitting, around which it is placed, to the larger bearing surface of the solid trench wall.

8.5. A thrust block should bear firmly against the side of the trench and to achieve this, it may be necessary to hand trim the trench side or hand excavate the trench wall to form a recess. The thrust acts through the centre line of the fitting and the thrust block should be constructed symmetrically about this centre line.

8.6. In any event, concrete thrust blocks shall be installed to satisfy the intent as noted, and in accordance with the pipe & fitting manufacturer's recommendations.

8.7. Concrete shall be thoroughly mixed on the surface prior to installation. Dry concrete mix and water shall not be mixed in the trench.

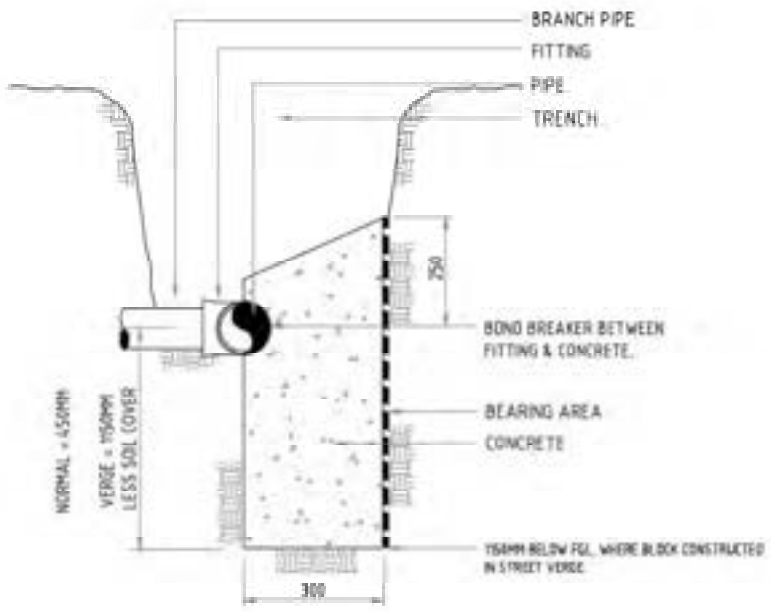


BLOCK DIMENSIONS TYPICAL FOR ALL FITTINGS, INCLUDING TEES, ELBOWS, BENDS & BLANK ENDS (PIPE CAPS).

PLAN VIEW OF PIPE TEE PIECE

THRUST BLOCKS - CONCRETE

CONSTRUCTION DETAIL



TYPICAL SELECTION

THRUST BLOCKS - CONCRETE

CONSTRUCTION DETAIL

Tapping Bands

8.8. Tapping Bands (Saddles) shall be utilised to facilitate the connection of lateral pipes, via a valve assemble, to the irrigation mainlines, which shall be of a type designed for use with PVC, being manufactured of De zincification Resistant Gunmetal (bronze) material, with a minimum pressure rating of 2000kPA, having a tapping size corresponding to the size of the valve fitted.

8.9. Due care shall be taken in the installation of tapping bands and ensure that all holes are accomplished utilising a sharp and appropriately sized hole saw.

uPVC Fittings

8.10. The only uPVC pipe fittings which are approved for use on irrigation mainlines of 80mm and over, are RRJ long radius bends, being a one piece fitting manufactured from pipe being a minimum of one (1) pressure class higher than the pressure class of the mainline to which they are to be attached. The bend shall be thrusted in accordance with this specification.

8.11. All uPVC fittings used in pipe laterals (down stream of solenoid valve) shall be manufactured to AS/NZS 1477 being designated as Class 18 pressure rating. Solvent Weld joints shall be accomplished in accordance with the pipe/fitting manufacturer's recommendations.

Brass Fittings – Threaded

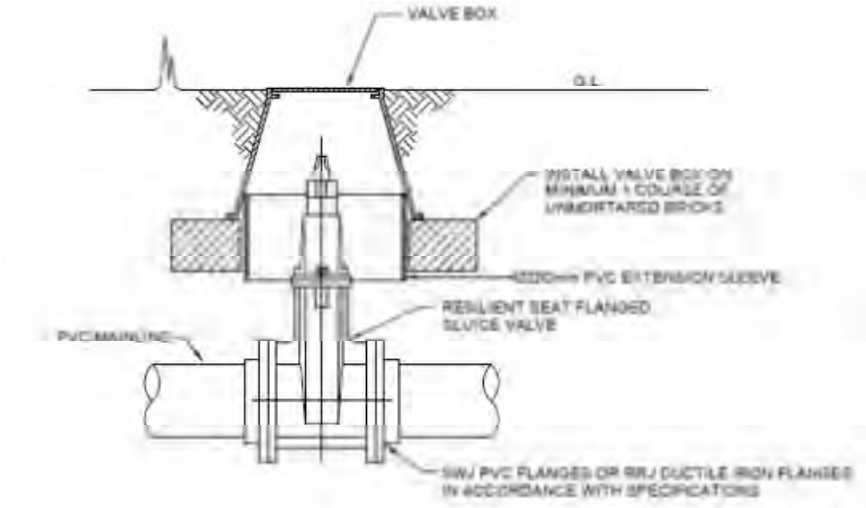
8.12. Only brass dezincification resistant (DR) pipe fittings, threaded BSP are to be utilised to facilitate the connection from the mainline fitting/tapping to the solenoid isolation valves, as shown in the drawings, they shall be manufactured to a standard which would allow the fitting to be acceptable to the Water Corporation of WA.

9. Valving

Isolation Valves

9.1. Every solenoid valve and air release valve location (where used) shall be isolated from the irrigation mainline utilising an equivalent sized isolation valve.

9.2. Mainline isolation valves will be required to be installed at the location shown in the drawings, and unless otherwise shown shall be of the Cast Iron Gate (Sluice) valve type with Table 'E' flanged connections conforming to Australian Standard AS-2638 having a stainless steel stem and Gunmetal (Bronze) trim and shall be installed in a vertical orientation being perpendicular to the surface of the ground in which they are installed, with the valve operators being no farther than 300mm below ground level.



TYPICAL MAINLINE ISOLATION VALVE DETAIL

Solenoid Valves

9.3. The solenoid valves are required to be installed at the approximate positions as shown on the relevant drawings.

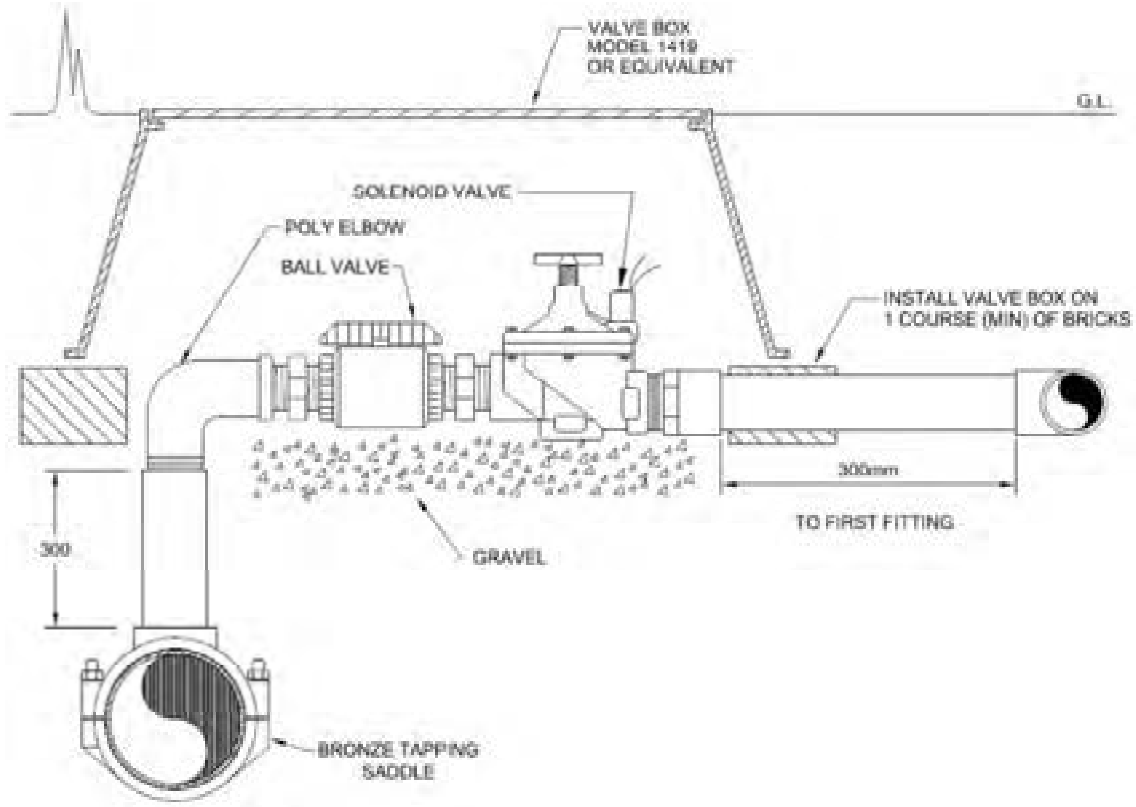
9.4. 2-wire system valves to be as per manufacturer recommendations, as approved by the City.

9.5. Conventional system valves shall be of glass reinforced nylon construction, threaded BSP of a size in accordance with the drawings and shall be installed utilising threaded fittings and isolation valve as shown on the valve detail drawing and conform with this specification.

9.6. The solenoid valve shall incorporate a coil having a nominal operating voltage of 24 VAC and a peak inrush current of 0.3 amperes when required to operate at a pressure equivalent to the maximum rated operating pressure of the solenoid valve.

9.7. The City of Kwinana preferred solenoid valve is Bermad electric control 200 series, normally closed 24 volt, 50 Hertz solenoid operated diaphragm valves with flow control stem and manual bleed facility.. Any alternative solenoid valve proposed or supplied must, to the written satisfaction and approval of the City, meet or exceed the specifications of the preferred product.

9.8. The Contractor shall undertake the flow (pressure) adjustment of all solenoid valves in accordance with the nominal operating pressure of the sprinklers attached to the particular solenoid valve.



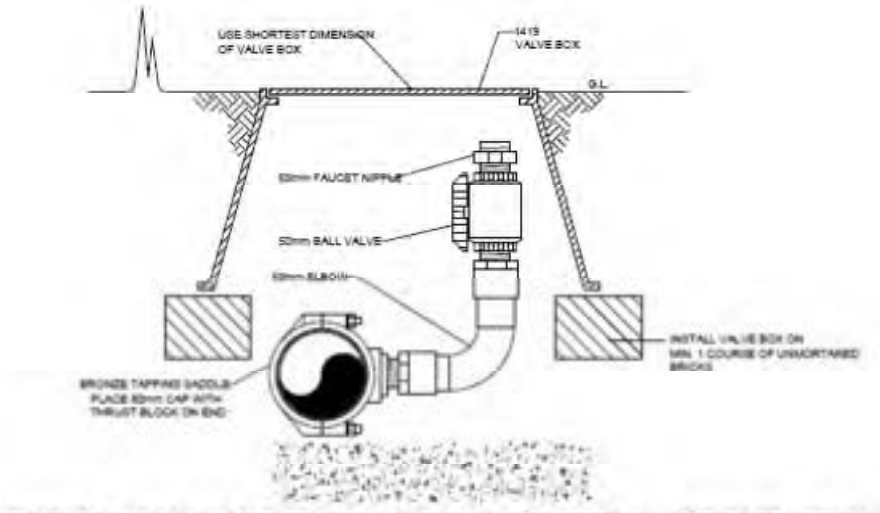
BERMAD 200 SERIES - 50mm GLOBE TYPE

TYPICAL SOLENOID VALVE INSTALLATION DETAIL

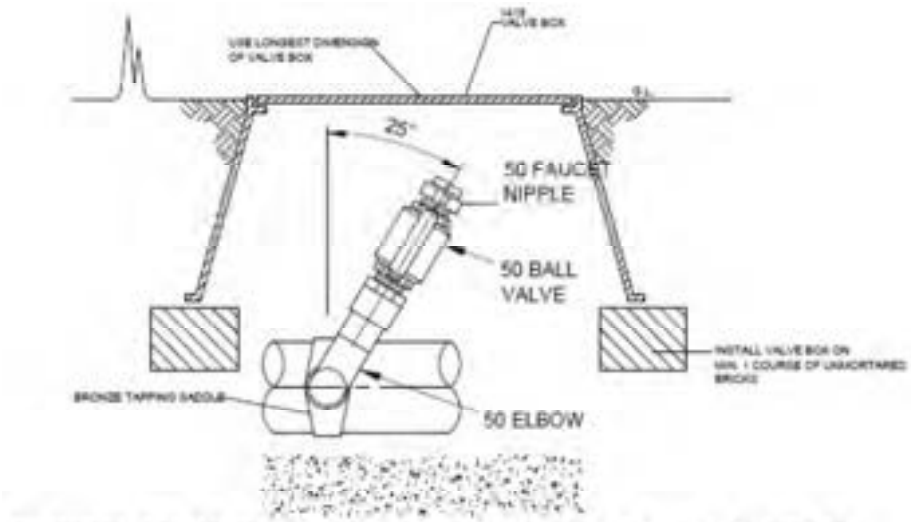
NOT TO SCALE

Flushing Valves

9.9. Manual flushing valves shall typically be a 50mm Philmac Ball valve on a suitable diameter articulated riser and housed in a valve box.



TYPICAL MAINLINE FLUSHING VALVE DETAIL - FRONT VIEW



TYPICAL MAINLINE FLUSHING VALVE DETAIL - SIDE VIEW

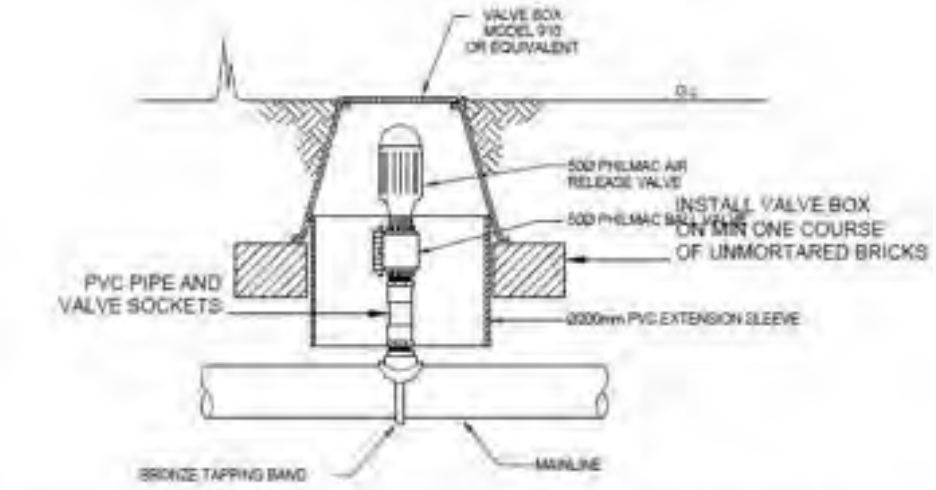
Air Release Valves

9.10. Air release valves shall be installed at high points in the mainline in the approximate locations as shown in the drawings, or as determined by site conditions, such that any trapped air in the mainline is able to be readily exhausted whilst minimising the risk of water hammer in the system.

9.11. The precise location shall be subject to the approval of the Superintendent.

9.12. Air/Vacuum release valves shall be 50mm diameter ARI non corroding valve inlet to be fitted with isolation ball valve.

9.13. Air release valves shall be installed in a Model 910 valve box with top of valve box set at ground level. A 50mm ball valve shall be located immediately beneath the air valve and the ball valve shall be left in the open position.



TYPICAL MAINLINE/SUBMAIN AIR RELEASE VALVE DETAIL

Conduits & Conduit Pits

9.14. All solenoid valve wiring shall be installed in the design specified conduit, which shall be run in the same trench as the irrigation mainline and installed so as to maintain a 150mm separation between the mainline and conduit.

9.15. The Contractor shall install FC05 (560x330x525) fibre cement conduit pits at every change in conduit direction being more than 45 degrees and at all junctions.

Solenoid Wiring

9.16. 2-wire system wiring to be as per manufacturer recommendations, as approved by the City.

9.17. Any and all electrical joints of 2-wire systems are to be soldered and suitably insulated, as per the manufacturer recommendations.

9.18. All common solenoid wiring shall be of 2.5sqmm multi strand construction, HDPE insulation, with active wring being of a similar construction but 1.5sqmm in cross sectional area.

9.19. In addition to the use of colour coded wiring to accomplish the connection of each solenoid valve to the irrigation controller, the Contractor shall utilise 'Legrand' CAB-3 or similar (non perishable) cable identification markers at the solenoid valve location and at the solenoid wire terminal block located within the electrical cubicle.

9.20. Where practicable, solenoid wiring from the valves to the controller shall be installed in one continuous (non jointed) run. Where joints must be made in cable runs, they shall be undertaken in a conduit pit.

9.21. Four (4) spare solenoid wires, coloured white, shall be installed with the entire route of the mainline. Where the wires are installed with a ring main, there will be a total of eight (8) spare wires entering the electrical cubicle.

9.22. All conventional system underground electrical joints to the solenoid valves shall be accomplished using;

- '3M' brand gel filled connectors Model 'DBY' or Model 'DBR', depending upon the number/size of cores to be joined.
- 'Tyflo' brand CAPS, heat shrink mastic line caps.
- PVC tape shall NOT be used to insulate any connection of solenoid

Valve Enclosures

9.23. All valves which are to be installed on the project shall be housed in a heavy duty valve box manufactured from a glass filled nylon material, sized in accordance with the below;

- Solenoid Valves – 430 x 300 x 305 rectangular
- Solenoid Isolation Valves – inside solenoid valve box
- Mainline Isolation Valves, in planted areas – 430 x 300 x 305 rectangular
- Mainline Isolation Valves, in paved areas – 250mm diameter circular

9.24. All valve boxes will require an extension to the valve cavity, to a point where the valve box will bear upon the 'footing' and prohibit the entry of the surrounding soil into the valve cavity; spiral wound tubing shall not be used to form this cavity.

9.25. In the installation of the valve box, standard concrete 'leach drain' spacers of 600 x 400mm dimension are to be installed, to form a 'footing' for the valve box, so as not to allow the application of pressure on the mainline, which may be caused by the passage of a vehicle or machinery directly over the valve box. The number of footing spacers required will vary in accordance with the manufactured depth of each spacer.

9.26. For circular valve boxes, the footing may be formed using standard sized clay bricks.

9.27. Valve enclosures shall be installed in softscape areas (excluding active playing surfaces), unless otherwise approved, in writing, by the City of Kwinana. Enclosures approved for installation within a hardscape shall have a suitably fastened lid.

9.28. Valve enclosures shall be installed so as the lid is flush with finished ground level.

10. Sprinklers

Sprinkler Selection

10.1. The City of Kwinana typically utilises sprinkler products from only Hunter and Toro brands, as outlined in the table below. Any alternative sprinkler proposed or supplied must, to the written satisfaction and approval of the City, meet or exceed the specifications of the preferred sprinklers listed in the table below:

City of Kwinana Preferred Sprinklers		
Brand Name	**Type**	**Series**
Hunter	Pop-up gear drive	'I' series
Toro	Pop-up fixed head	'570' series
Toro	Tree bubbler	'570' Flood Bubbler

10.2. In most applications the City does not require stainless steel stem risers for gear drive sprinklers. However, stainless steel stem riser sprinklers should be used where appropriate, such as in fine sandy type soils for example.

10.3. Garden (planted) areas shall be irrigated with pop-up fixed head sprinklers, perimeter sprinklers to typically have a minimum 150mm popup height, whilst non-perimeter (full circle) areas shall have a minimum 300mm popup height.

10.4. The pop-up height and head selection of pop-up spray sprinklers in garden beds must sufficiently account for spray clearance over the landscape design and selected plant species to be installed in the planted area. Effective spray coverage must be able to be maintained as the selected plant species mature.

10.5. **The City of Kwinana prohibits the use of MP Rotator type sprinklers.** Should there be a specific and adequately warranted requirement for such sprinklers within a particular system design, then prior approval, in writing, must be obtained from the City of Kwinana.

10.6. **The City of Kwinana prohibits the use of inline dripper type emitter systems (commonly known as 'Drip-Eze' or similar).** Should there be a specific and adequately warranted requirement for systems within a particular design, then prior approval, in writing, must be obtained from the City of Kwinana. Inline drip systems shall typically never be approved for use within turf areas.

10.7. Conventional poly pipe drip emitters, whilst not prohibited by the City, shall not typically be used within a system design unless specifically required and approved in writing by the City of Kwinana.

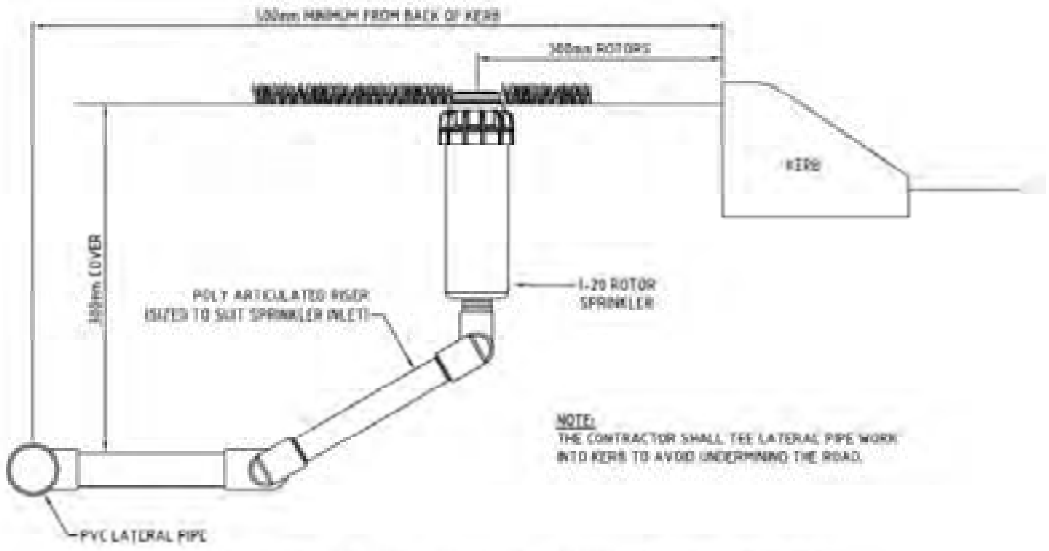
Sprinkler Spacing

10.8. The Contractor shall pay due consideration to the effects of localised prevailing wind conditions upon the spacing of sprinklers. In any event, the maximum design spacing of all sprinklers shall be 50% of the sprinkler performance diameter.

10.9. All sprinklers adjacent to any hardscape shall be set 150mm off the hardscape edge, including any kerbing.

Connection

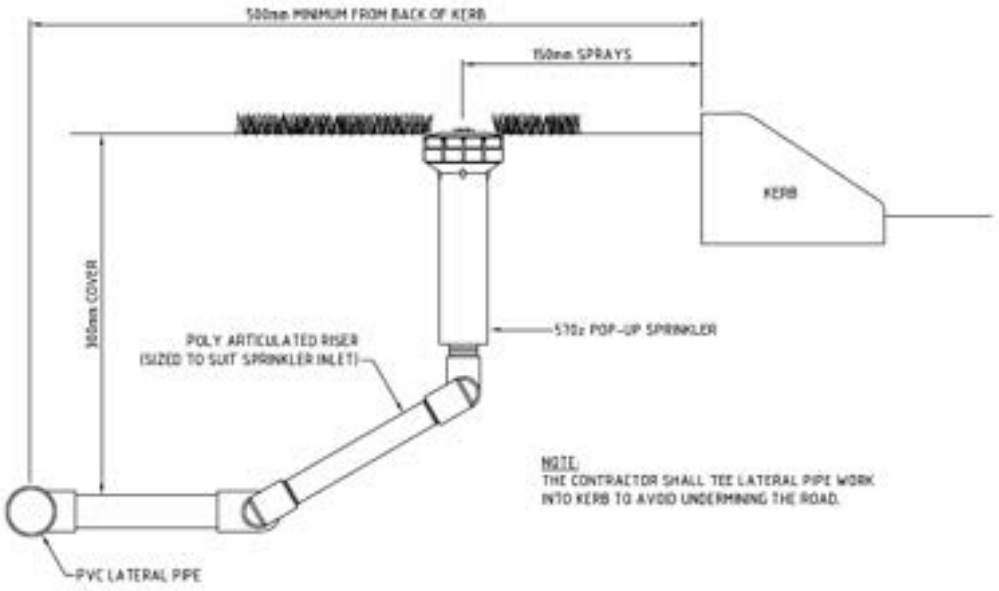
10.10. All rotor sprinklers shall be installed on 20mm x 250mm and/or 25mm x 300mm polyethylene articulated riser assemblies in accordance with the base connection size of the sprinklers and the associated detail drawings for each site, and shall be installed flush or no more than 10mm below the finished turf level.



TYPICAL HUNTER I-20 ROTOR SPRINKLER DETAIL

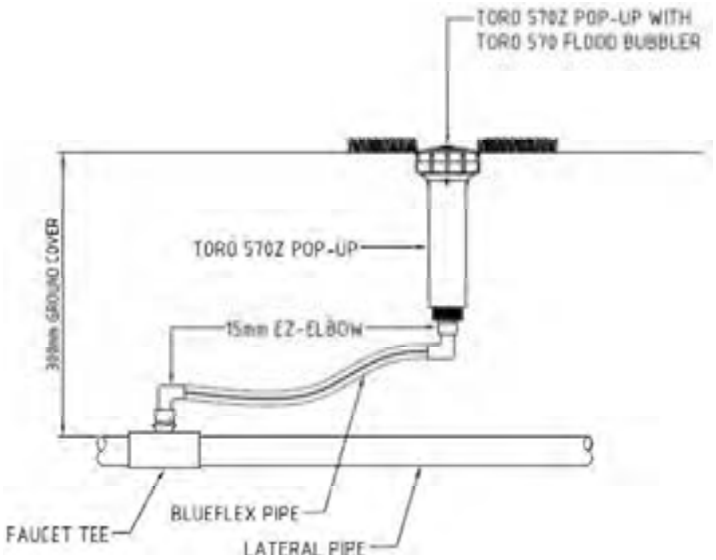
DO NOT SCALE

10.11. All popup spray sprinklers & bubblers shall be installed on 500mm of 15mm Super-flex flexible riser tubing fitted with appropriate E-Z compression elbow connectors or articulated riser.



TYPICAL TORO 570z SPRINKLER DETAIL

DO NOT SCALE



TYPICAL POP-UP BUBBLER DETAIL

DO NOT SCALE

10.12. All sprinklers shall be installed plumb, with the exception of sprinklers installed adjacent or on an embankment with has a gradient, above the horizontal, which is greater than the trajectory of the sprinkler head/nozzle. In the latter case, part circle sprinklers may be angled to avoid water erosion of the embankment.

Matched Precipitation Rate

10.13. All sprinklers shall only be grouped in accordance with the calculated precipitation rate of sprinklers. Only sprinklers with a matched precipitation rate shall be grouped to operate together on a valve section, with the exception of tree 'bubbler' irrigation, which may be grouped with any irrigation, provided that bubblers flow rates have been calculated as shown.

10.14. Similarly, only valve sections with similar precipitation rates may be grouped to operate as a station on the irrigation controller.

Arc Selection

10.15. In ALL cases of diverse planting (turf, garden, temporary), the Contractor shall minimise over-spray onto paving and adjacent areas by utilising part circle spray head patterns to the perimeter of all such areas.

10.16. Over-sprayed areas will increase water consumption and required flow rate of the bore water supply.

Nozzle Selection

10.17. When selecting nozzles for use with approved sprinklers, the Contractor shall endeavour to utilise a nozzle which has a performance which falls midway between the manufacturers published minimum and maximum performance specification for the nominal operating pressure specified.

10.18. Selection of sprinkler nozzle performances which are either the minimum or maximums so published, will not be permitted.

10.19. The designer shall consider the prevailing weather conditions when irrigation will be required to take place. Nozzles with higher flow rates, higher precipitation rates and lower angles of trajectory will perform significantly better in windier conditions.

10.20. In any event, the Contractor shall utilise low angle nozzles along the perimeter boundaries of the project property which abut any residential properties.

11. Drawings & Documentation

Drawings & Survey

11.1. At the completion of the project, the Developer shall provide an ‘As Constructed’ Survey plan and DXF & DWG data disk, showing the location and routes of all mainlines, conduits, solenoid valves, isolation valves, valve boxes and cable pits. The Survey data is to be collected by a qualified Surveyor with previous experience in the digital ‘pick up’ of irrigation systems.

11.2. In addition, the Developer shall amend the 'As Designed' irrigation plan, to accurately reflect changes in quantity and location of sprinkler heads and changes in routes of lateral pipe work, with the plan/s shall be titled ‘Irrigation-As Constructed Detail’. Four (4) sets of these drawings shall be supplied in both A1 sized hard copies and digital data disk in AutoCAD format.

11.3. The Contractor shall show the irrigation system data on the drawing, presented in a tabular format, showing valve & station flow rates, precipitation rates, valve number, minutes duration to apply 10mm of precipitation and a seasonal watering guide, indicating the irrigation duration (minutes per day) for various months, based upon historical climatic data.

Manual

11.4. Upon completion of the project, the Contractor shall provide four(4) sets of Operation and Maintenance manuals to include the following information on the entire system, as follows or previously noted in this specification;

- Project title, Head Contrator and Installation Contractor details including addresses, telephone numbers and contact names
- As-Constructed drawings
- Details of Routine and breakdown maintenance callout procedure
- Date of Practical completion and details of warranty/guarantees
- General description of system
- Normal Operating Procedure of pumps & controls
- Troubleshooting Guide of all possible faults of pumps & controls
- Controller operating instructions
- Maintenance instructions
- Fault finding procedures
- List of special tools required
- List of spare parts
- List of settings for protective devices
- Full details of name brand, model, rating of pumps, including performance curves and configuration settings of the variable speed drive
- Bore completion report, including copy of Groundwater Well Licence, Lithology, step flow tests, constant rate test, recovery test, water analysis etc

11.5. The manuals shall be provide in hard cover, A4 ‘D’ ring folders, with each page of information being inserted into a clear plastic A4 sheet protector, and shall be accomplished to the satisfaction of the Superintendent. All written documentation shall be provided in Microsoft Word format.

12. Requirements for Practical Completion

Works Inspections Required Prior to Practical Completion Application

12.1. Developers are advised that the City of Kwinana will require a pipe-work back-fill inspection during project works to enable acceptance of Practical Completion to take place.

Requirements for Practical Completion

12.2. Works inspections to have taken place.

12.3. Submission of a 'City of Kwinana Practical Completion & Handover Application Package' including:

- Details of installation contractor/s
- Date of pipework backfill inspection by City Representative
- Details of proposed consolidation period maintenance contractor/s
- As constructed drawings
- Itemised asset list
- O-Spec data
- Proposed date for PC inspection (minimum 7 days notice)

12.4. Practical completion inspection including 1hr mainline pressure test, at which time the City shall compile a listing of defects. At its discretion, the City of Kwinana may engage a professional irrigation consultant to undertake the inspection of the works and provide a defects list.

12.5. The Developer shall be responsible for carrying out the remedial works as noted on the defect list.

12.6. Defect rectification re-inspection (where applicable).

12.7. Practical completion acceptance and commencement of consolidation period.

13. Consolidation Period & Maintenance Expectations

13.1. The consolidation period for irrigation assets is 24 months from the date of acceptance of practical completion, unless otherwise specified and agreed upon.

13.2. Consolidation period maintenance shall include:

- Weekly irrigation system checks for adjustments and repairs
- Weekly iron bacteria filter maintenance, unless otherwise specified by the iron bacteria filtration system manufacturer
- Monthly watering schedule checks and adjustments
- Monthly reporting of flow meter readings to the City's Representative

14. Requirements for Handover

General

14.1. Submission of 'City of Kwinana Practical Completion & Handover Application Package' including:

- All associated documentation including manuals, warranties, guarantees as specified
- Maintenance expenditure history
- Proposed date for handover inspection (minimum 30 days notice)

14.2. Handover site inspection including:

- Ensuring all assets are present, in good condition and fully functional
- Undertaking of a one (1) hour mainline pressure test

14.3. Compliance with defect list (where applicable).

14.4. Defect rectification inspection (where applicable) and acceptance of handover.

Handover of Bores & Groundwater Licenses

14.5. Handover of bores, associated filtration assets and groundwater allocation licenses will not be accepted by the City until such time as the City has already accepted handover of at least 50% of the total in ground irrigation infrastructure to be serviced by the bore.

14.6. Proposed handover of a bore whereby the City has not yet accepted handover of 100% of the total in ground irrigation infrastructure to be serviced by the bore, a shared maintenance cost agreement between the Developer and the City will apply. It shall be the responsibility of the Developer to arrange any such agreement to enable handover to occur.

14.7. The Groundwater Allocation License shall be transferred to the City of Kwinana in conjunction with handover acceptance of the bore assets. It shall be the responsibility of the Developer to undertake the license transfer.

14.8. The City of Kwinana will only accept handover of a bore which has been redeveloped within the previous 12 months and all associated documentation submitted to the City, unless otherwise agreed upon in writing.

15. Warranties, Guarantees & Workmanship

15.1. The Developer is advised that guarantees and warranties for equipment, materials and workmanship shall be for a 12 month period commencing upon the date of the written acceptance (handover) of the irrigation works by the City of Kwinana.

15.2. The Developer shall warrant that the installation of all equipment supplied and installed was done so in accordance with standard industry practice and the equipment/material manufacturers recommendations and specifications.

16. Australian Standards

16.1. AS/NZS 1477: 2006 – PVC pipes and fittings for pressure applications

16.2. AS/NZS 4765: 2007 – Modified PVC (PVC-M) pipes for pressure applications

16.3. AS 2032: 2006 - Installation of PVC pipe systems

16.4. As/NZS 2280: 2004 – Ductile iron pipes and fittings

16.5. AS/NZS 2638: 2011 – Gate valves for waterworks purposes

END OF DOCUMENT



APPENDIX 6

Local Water Management Strategy

360 environmental

Lots E26, 303 and 9014
Gilmore Ave, Kwinana

Local Water Management Strategy

Prepared for:
Satterley Property Group
and Department of Housing

February 2014

people • planet • professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
665-3 AC	A: Internal Draft	JT	TC	-	-
665-3 AC	B: Client Draft	JT	TC	1 Electronic (email)	24/11/09
LD008-2 AC	C CLIENT FINAL	RH	BP	2 Hardcopies 1 Electronic (CD)	14/07/11
LD008-2 AC	C CLIENT FINAL	RH	BP	2 Hardcopies 1 Electronic (CD)	18/08/11
LD008-2 AD	C CLIENT FINAL	KV	RH	1 Electronic (CD)	9/07/13
27 AE	C CLIENT FINAL	KV	RP	1 Electronic (CD)	12/12/13
27 AF	C CLIENT FINAL	KV	RP	1 Electronic (CD)	23/01/14
27 AG	C CLIENT FINAL – City of Kwinana and Department of Water comments addressed	KV	RP	1 Electronic	25/02/14

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Executive Summary

The Kwinana Town Centre Structure Plan Area is comprised of Lots E26, 303 and 9014 Gilmore Avenue, Kwinana. In total the site covers an area of approximately 31 hectares (ha). The site is bounded by Gilmore, Challenger and Meares Avenues and Wellard Road. The majority of the site is uncleared bushland.

The Local Structure Plan (LSP) for the site proposes creation of residential and mixed-use residential lots with public open space strategically placed through a central, linear public open space area. It is envisaged that no resident be further than 400 m away from an open space area. This Local Water Management Strategy (LWMS) describes the way in which water in the structure plan area will be managed.

Water will be supplied to individual properties through Water Corporation's reticulated potable water network. Wastewater transfer from each individual property will be via Water Corporations reticulated sewer network.

Stormwater will be managed onsite with no offsite stormwater flows proposed. Stormwater from the site will be collected from impervious areas through an integrated network of collection pits and pipes discharging into drainage swales located in public open spaces throughout the site. In total, approximately seven drainage swales are proposed for the site. Storm events equal to or greater that a 1 in 10 year event will discharge into the drainage swales, with water from smaller storm events contained within the collection pits and pipes.

The stormwater drainage swales will be landscaped to create functional, passive recreational areas when not in use for drainage.

The soils of the site are classified as Spearwood S2a Phase soils and are described as lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop (360 Environmental 2009). The soils have been assessed as having low to no risk of salinity, waterlogging, water erosion, phosphorus loss and wind erosion (360 Environmental 2009). Accordingly, the site soils are considered well suited to infiltration drainage.

There are no watercourses or wetlands in the vicinity of the site that require particular attention in this strategy. Further there are no conservation areas (such as Bush Forever sites, Regional Parks and Nature Reserves) in the vicinity of the site that require particular attention through this strategy.

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1 Introduction

1.1 Background

360 Environmental Pty Ltd (360 Environmental) was engaged by Satterley Property Group to prepare a local water management strategy (LWMS) to accompany the submission of a local structure plan (LSP) for Lots E26 Gilmore Avenue, 303 and 9014 Wellard Road, Kwinana (the site) (Figure1). In total the site covers an area of approximately 31 hectares (ha) and is proposed to be developed for residential land use. The LSP details the proposed development areas including road networks, housing sites, commercial areas, public open space and the landscape masterplan.

This LWMS provides a strategy for the implementation of water management for the proposed development of the site. This LWMS has been written in accordance with the Department of Water (DoW) *Interim: Developing a local water management strategy* (2008) and the Western Australian Planning Commission's (WAPC) *Better Urban Water Management* (2008).

1.2 Total Water Cycle Management – Principles and Objectives

There is no regional or district water management strategy for the general area or the site. Therefore, the DoW recommends developing the LWMS based on the principles and objectives outlined in *Better Urban Water Management* (WAPC 2008). These principles and objectives have been considered during the development of the LSP to provide the best outcome for water management at the site.

1.3 Planning Background

The site is zoned 'Urban' under the Metropolitan Region Scheme (MRS) and 'Kwinana Town Centre' under the City of Kwinana's Town Planning Scheme No. 2 (TPS 2). The site is also identified as Policy Area 20 and directly abuts an 'Other Regional Road' reservation (Gilmore Avenue). The south west portion of the site is not included within a zone and as such is identified as 'No Zone' under TPS 2.

1.4 Previous Studies

Seasonal groundwater monitoring was initiated by the LSP process in July 2009. Four groundwater monitoring bores were specifically installed across the site to support the development of the LWMS.

2 Proposed Development

2.1 Structure Plan, Zoning and Land Use

The LSP proposes various uses for the site including public open space (POS), residential, residential/mixed use and drainage (Appendix A). The LSP is comprised of a large range of residential densities ranging from low density (R30) single residential allotments through to higher density (R80) masionettes.

2.2 Key Landscape Features

The key landscape features of the site include POS locations in north-east, south-east and south-west corners and running approximately through the centre of the site from north to south (Appendix A). There are no creeklines or wetlands within or adjacent to the site and the nearest wetland is approximately 280 m to the south of the site (Figure 1).

The site undulates between approximately 4 m Australia Height Datum (mAHD) and 16 mAHD (Figure 2).

2.3 Previous Land Use

There are no known significant land uses that have previously been undertaken at the site. Brief site history details are summarised as follows:

- The site has not been significantly cleared since 1953;
- The site has remained in the ownership of the State Housing Commission since the Crown granted it the parcel of land in 1979;
- A portion of the land on the eastern boundary was transferred to the former Water Authority of Western Australia for sewerage infrastructure purposes n 1987; and
- The site appears to be used as an area for road drainage and nearby shopping centre carpark drainage.

2.4 Landscape

2.4.1 Public Open Space

The landscape of the proposed development generally constitutes an urban residential development. This includes six areas of POS within the site totalling approximately 7.9 ha. The POS distribution equates to a total POS of over 20% of the site. Specifically, five of the six areas of POS offer a drainage component. Table A summarises the POS areas and their drainage component with respect to flood events.

Table A: Summary of drainage associated with public open space areas.

POS	Total Area (ha)	1 in 1 storm event (m^2)	1 in 5 storm event (m^2)	1 in 100 storm event (m^2)
POS 1	1.1447	529	480	576
POS 2	1.1123	*	5,688	5,776
POS 3	1.6324	3,600	3,240	4,225
POS 4	0.6873	0	0	0
POS 5	1.0867	1,024	945	1,156
POS 6	1.1814	*	2,025	3,969
TOTAL	**6.85**	**5,153**	**12,378**	**15,702**

* denotes contained below ground via Atlantis Cell System or similar approved

Cross sections for the basins are provided as Appendix B.

2.4.2 Water Source

The water source for the development will be scheme water from Water Corporation's reticulated system and bore water for irrigations of POS.

It is anticipated that irrigation water will be provided through a series of groundwater bores constructed across the POS areas. The flow rate of the production bores will determine the number of bores required, however, it is envisaged that as a maximum, one bore per POS will apply (MNLA 2009).

All irrigation shall be installed to the local authority's standard specifications and industry best practice. Maintenance minimisation processes will apply in all circumstances. Controllers shall be keyed and accessed in accordance with the local authority's standards. Irrigation shall be designed to incorporate stations that can be terminated as agreed upon planting establishment and maintenance handover to City of Kwinana in accordance with relevant policies.

3 Design Criteria

3.1 Design Objectives

The various design objectives outlined in the LSP that are relevant to the LWMS include:

- Drainage will be accommodated in a useable landscaped manner to create an amenity for residents as well as allowing for natural nutrient stripping and infiltration processes to occur.
- Natural vegetation retention will be maximised for conservation purposes.
- Sensitive urban design principles will be implemented into planning and design features of the development.

4 Pre-Development Environment

A number of assessments have been undertaken for the site. These include the following:

- Desktop environmental assessment;
- Flora and vegetation survey undertaken in spring 2006;
- Targeted Black Cockatoo survey undertaken in March 2009;
- Site survey for contour information; and
- Groundwater well installation and groundwater monitoring from August 2009 until August 2010.

4.1 Site Conditions

The site currently features an undulating surface with existing ground levels ranging between approximately 4 mAHD and 16 mAHD (Figure 2). Regional geological mapping identifies the site as comprised of sands derived from Tamala Limestone (360 Environmental 2009). They feature pale yellow brown, fine-to-coarse grained, sub-angular to well rounded quartz with high-to-medium permeability and contribute to groundwater infiltration. Site observations confirm the sandy nature of the site soils (Appendix C).

The majority of the site features undeveloped bushland. On the western boundary there are a number of road drains that enter the site and flow into several sump areas. A large drainage sump is present northern boundary which appears to take stormwater runoff from the adjacent Kwinana Hub Shopping Centre car park.

The site surface contours several drainage features on the western and northern sides. Some uncontrolled fill, predominantly comprising of soils, has been stockpiled in the southern and northern portions. The site vegetation generally appears to be in good condition, however, there is a significant amount of general rubbish and several weed species. The site has several dirt paths and tracks throughout.

4.2 Flora and Vegetation

A flora and vegetation survey of the site was undertaken on 20 September and 9 October, 2006. During the survey there were no Declared Rare Flora (DRF), Priority Flora or species of conservation significance recorded (360 Environmental, 2006).

110 species of native flowering plants and two native *Gymnosperms* (one native cycad (the Zamia Palm, *Macrozamia riedlei*) and one native pine (*Callitris canescens*) were recorded from the survey area. In addition, a high number of weed species (37) were recorded from the survey area. A relatively low number of annual or ephemeral native plants (particularly herbs) were recorded during the survey. The significant weed cover

in most parts of the survey area would have impacted on the presence or abundance of these plants.

No DRF species were recorded in the survey area during the survey work carried out for this report. No Priority species were recorded during the survey. None of the species recorded in the survey area were considered to be "Significant Flora of the Perth Metropolitan Region" (360 Environmental 2006). No other species recorded in the survey area were considered of special conservation significance.

Nine vegetation units were defined and mapped for the survey area. These could be classified into four broader vegetation groups: Jarrah Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands. The tuart woodlands included Jarrah and Banksia elements and are therefore closely related to the Jarrah Banksia woodlands group. The Jarrah-Banksia vegetation units covered the largest part of the survey area.

The condition of vegetation in the survey area was mostly in the range of 'Good' to 'Very Poor'. Some 'Completely Degraded' areas were also recorded. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover. Perennial veldt grass (**Ehrharta calycina*) formed a grassland and sometimes a closed grassland over most of the survey area and was the most dominant and widespread weed. Some physical disturbance occurred in various places in the survey area.

It was noted that the crowns of many of the jarrah trees in the survey area were very brown and the trees appeared to be in poor health. This was due to what appeared to be intensive Jarrah leafminer damage (caused by the larvae of the moth, *Perthida glyphopa*).

Dead Banksia trees were recorded at four sites in the survey area. Between 1 and 6 dead trees were recorded at each location. One group of deaths was around a sump and the deaths may be related to the sump. No other obvious signs of dieback were noted. An accredited dieback interpreter would need to survey the dead Banksia sites to determine if dieback was in the survey area.

No DRF or Priority taxa were recorded in the survey area and no species were recorded that would be considered to be 'Significant Flora of the Perth Metropolitan Region' (360 Environmental 2006) and it was concluded the conservation value for species of conservation significance in the survey area could be considered low.

With regard to the regional significance of the survey area vegetation, it belonged to the Cottesloe Complex – Central and South. The remaining area of the Cottesloe Complex – Central and South is 41.1%, while its remaining area in secure tenure is 8.8 percent (360 Environmental 2006).

The site contains one landform unit, with a modest diversity of vegetation units and could therefore be considered as having moderate values for diversity. Therefore, the overall

vegetation conservation value for the site was considered to be moderate to high. While there are no Threatened Ecological Communities (TEC's) in the survey area, the vegetation has additional value because of the presence of tuart vegetation units (albeit in generally poor condition) and the fact that less than 15% of the Cottesloe Complex – Central and South is in secure tenure.

4.3 Wetlands

There are no Ramsar wetlands or Directory of Important Wetlands on the site (SEWPAC 2011). Three wetlands of international significance were identified as occurring within 10 km of the site (SEWPAC 2011), the nearest is Forrestdale and Thomsons Lake approximately 9.7 km to the north of the site. The nearest Directory of Important Wetlands site is located approximately 2.6 km to the north-east of the site and is known as "Spectacles Swamp" (SEWPAC 2011).

There are no wetlands mapped as occurring on the site, however there is a CCW wetland located approximately 280 m south of the site. This distance is outside any separation distance guidelines (EPA 2008).

4.4 Fauna

A search of the DPaW's (2009) Threatened and Priority Fauna database has indicated several threatened or priority fauna have been recorded within a 5 km radius of the site. The majority of the listed species are unlikely to be found on site as they are most often associated with wetlands, swamps, waterways or a dense understory. However, of those listed the following are the most likely to be present:

- *Neelaps calonotos* (Black-striped Snake) – Priority 3.
- *Lerista lineata* (Lined Skink) – Priority 3.

Black-striped snakes are known to be distributed along the lower west cost between Port Denison south to Mandurah and inland to Bullsbrook (360 Environmental 2009).

Lined Skinks are often found on coastal heaths and shrublands from Perth to Mandurah. They prefer sandy areas and it is likely that they use this site for habitat purposes (360 Environmental 2009).

The Cockatoo species are the most likely to be present as there are mature eucalypts and banksias present on the site. These trees are utilised by cockatoo species for nesting and feeding habitat.

A targeted black cockatoo survey was undertaken across the site in March 2009. The survey included traversing the site to identify and confirm the presence/absence of site usage by black cockatoos. The results indicate the site is utilised by both Carnaby's Black Cockatoo and the Forest Red-Tailed Black Cockatoo (*Calyptorhynchus banksii naso* – listed as "Rare or likely to become extinct" under Schedule 1 of the Wildlife

Conservation Act 1950) for feeding and potentially also for nesting. The level of use though was not as high as was expected based on the flora and vegetation present.

4.5 Contamination

The site is not listed as contaminated on the DER contaminated sites database (DEC 2011).

4.6 Conservation Areas

The site is outside any Bush Forever Protection Areas, environmentally sensitive areas (ESA) and wetlands of conservation significance.

The proposed development site is situated outside conservation reserves and parks, including the Leda Nature Reserve.

4.7 Surface Water

There are no natural surface water features on the site. There are a number of artificial surface water drains enter the site from surrounding uses such as the road, and shopping centre. There are no waterways occurring adjacent to the site and the site is not within the mapped 100 year floodway and flood fringe areas (360 Environmental 2009).

4.8 Groundwater

The Perth Groundwater Atlas indicates that groundwater ranges between approximately 4 metres below ground level (mbgl) and 10.5 mbgl, or at approximately 3 mAHD (DoW 2009). Groundwater monitoring wells installed to monitor the groundwater at the site indicate depth to groundwater varies between approximately 5.9 mbgl and 10.5 mbgl. It is expected that groundwater will generally flow in an approximate west, south-west direction.

Well locations are shown in Figure 2 overlayed with surface contour information.

Ongoing groundwater monitoring is currently being undertaken at the site seasonally for the following parameters.

- Depth to groundwater;
- Appearance;
- Temperature;
- pH;
- Electrical conductivity;
- Dissolved oxygen;
- Oxidation/reduction potential;

- Total phosphorus; and
- Total nitrogen (including TKN, NO2, NO3 and NH3).

The first round of groundwater monitoring was undertaken in August 2009 and groundwater monitoring conducted every three months until May 2010. Groundwater monitoring are presented at Appendix D.

4.9 Soils

The soils of the site are porous and well drained. The soils of the site are classified as Spearwood S2a Phase soils and are described as lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop (360 Environmental 2009). The soils have been assessed as having low to no risk of salinity, waterlogging, water erosion, phosphorus loss and wind erosion (360 Environmental 2009).

DER acid sulphate soil (ASS) mapping (Landgate 2011) indicates the site has a no-to-low risk of Actual Acid Sulfate Soils (AASS) and Potential Acid Sulfate Soils (PASS) occurring generally at depths greater than three metres.

Site soil samples were collected and analysed for phosphorus retention index (PRI) in July 2009. The soils were collected during the installation of groundwater monitoring bores. The results indicate that the PRI of soils collected ranges from 3.5 to 8.6 indicating the soils are in the moderate phosphorus sorption category. All soils bought onto site will have a PRI of at least 10. As fill material will be required at the site is acknowledged that there will be more soil on site available for phosphorus retention than currently available.

4.10 Regional Geology and Hydrogeology

Regional geological mapping identifies the site as comprised of sands derived from Tamala Limestone (360 Environmental 2009). They feature pale yellow brown, fine-to-coarse grained, sub-angular to well rounded quartz, with high-to-medium permeability and contribute to groundwater infiltration. Site observations confirm the sandy nature of the site soils. The site is not located in a Public Drinking Water Source Protection Area (DoW 2009).

5 Water Use Sustainability Initiatives

5.1 Water Efficiency Measures

Water efficiency measures incorporated into the design and planning for the site include the following:

- Retention of native vegetation where practicable;
- Use of drought-tolerant flora species for landscaping;
- Retention and infiltration of stormwater onsite in POS;
- Flush curbing around POS;
- Bottomless drainage pits to facilitate source infiltration; and
- Underground storage devices will be considered during detailed design.

5.2 Water Supply

Planned water supply for the proposed development of the site includes scheme water sourced from extension of nearby water supply pipelines and groundwater sourced from the construction of groundwater bores within POS areas of the site.

It is expected scheme water will be used for domestic, household and garden purposes and bore water will be used for irrigation purposes within areas of POS.

5.3 Wastewater Management

Household wastewater will be removed from site using Water Corporation's conventional sewerage system. Each property will have a connection to the sewer. The majority of the site will be served by reticulated sewer to the existing Type 40 wastewater permanent sewage pumping station on Mears Avenue and the remainder of the site will gravitate north-west to the existing Barrick Road sewage pumping station.

It is not expected any other wastewater will be generated by any other activities undertaken at the proposed development.

6 Stormwater Management Strategy

6.1 Flood Protection and Serviceability Management

The proposed strategy to manage the drainage within the site involves incorporating the drainage discharge into the various public open space areas via gross pollutant traps and bubble-up structures. This will alleviate the need for fenced drainage sumps and provides better use of land as well as better aesthetic values for the community. The water from a 1-in-1 year ARI event is designed to be contained within the stormwater infrastructure (pipes and pits) below grassed POS areas. The stormwater from 1-in-10 year ARI event and above will discharge into specifically designed POS or drainage swales via bubble-up pits. These drainage swales will typically be grassed with maximum side slopes of 1:8 grade to allow for ongoing maintenance. The POS water depth during a 1:10 year will not exceed 900 mm and will not exceed 1,100 mm deep in a 100 year event. The catchment plan and cross-sections (Appendix B) provide further details of stormwater volumes and levels.

Surface drainage within the subdivision areas will be via a conventional system of road gullies and underground pipes draining to the detention basins within the POS. The pipe system will be designed to cater for run-off from minor storms with a frequency of up to 1-in-5 years. Flows from less frequent major events (up to 1-in-100 years) will be provided for in overland floodways comprising road reserves, drainage channels and swales in POS. Given the topography at the site and distance from major rivers and waterways it is unlikely that the site will be significantly impacted during a 1-in-5 and 1-in-100 flood event. Flow paths for 1-in-5 year flow paths and 1-in-100 year flow paths are provided as Appendix E.

It is proposed that the construction of a stormwater management system will both visually enhance the proposed development and provide biological treatment of stormwater and irrigation runoff water from the development.

A total of seven landscaped drainage swales are proposed throughout the site (Appendix A).

6.2 Ecology Protection

There are no existing wetlands or waterways within the site that require ongoing management. Therefore the water retention systems designed for the site are designed to ensure minimal retention times by allowing the water to drain freely through the site's sandy soils. These areas of POS will be vegetated, however, due to the high permeability of the soils and the relative depth to groundwater retention times are not expected to cause a significant impact to the vegetation.

The areas of POS proposed to be utilised for retention basins are likely to require some earthworks and subsequent removal of the vegetation present. The revegetation of these areas will consider suitable species based on the anticipated drainage regime.

6.3 Public Open Space Drainage Summary

The extent of vegetated bio retention areas within basins / swales is as follows, based on the Drainage Plan produced by the project engineers (Appendix B). The Drainage Plan assumes a maximum 0.3m deep swale for 1:1yr event only.

- POS 1 – Approximately 23 x 23m^2 area;
- POS 2 – No Bio Retention Areas proposed, 1:1yr events to be captured below ground in Atlantis Cell System or similar approved;
- POS 3 – Approximately 60 x 60m^2 area;
- POS 4 – No drainage proposed in this POS;
- POS 5 – Approximately 32 x 32m^2 area; and
- POS 6 – No Bio Retention Areas proposed, 1:1yr events to be captured below ground in Atlantis Cell System or similar approved.

The extent of Inundation at the site is as follows:

- POS 1 – Approximately 25 x 25 m^2 area;
- POS 2 – Approximately 76 x 76 m^2 area;
- POS 3 – Approximately 64 x 64 m^2 area;
- POS 4 – No drainage proposed in this POS;
- POS 5 – Approximately 35 x 35 m^2 area; and
- POS 6 – Approximately 63 x 63 m^2 area.

7 Groundwater Management Strategy

It is not expected that dewatering will be required during construction activities, minimising the potential for initial impacts to the groundwater and/or its quality to occur. Subsequently it is also expected that no ongoing dewatering will be required.

Preliminary earthworks design does indicate the need to import material to obtain the required levels due to the undulating nature of the site. The objectives are to minimise the material requirements in order to keep landforms where possible.

Post-development groundwater levels across the site are not expected to alter significantly from pre-development levels as there is currently no infrastructure or disturbance expected to occur below the groundwater level. There may be localised groundwater mounds associated with the retention basins during rain events however these are not expected to significantly alter subsurface hydrological conditions.

8 The Next Stage – Subdivision and Urban Water Management Plans

Once the LWMS has been approved and the proposed development of the site progresses, an urban water management plan (UWMP) will be developed to provide specific guidance for the detailed designs required at the subdivision stage.

The objectives of the UWMP will be to:

- Conduct an overview of the surrounding environment;
- Describe how stormwater will be retained and managed;
- Describe how nutrients, pollutants and sediments will be managed;
- Describe the monitoring and maintenance of drainage areas in the long term; and
- Identify requirements and best practice as outlined in Better Urban Water Management (DoW 2008) document.

The UWMP will be developed in accordance with DoW guidance to ensure it meets all requirements and ensure appropriate urban water management and will include information on the following:

- Existing environment;
- Regional drainage strategies;
- Water management strategies;
- Construction management; and
- Implementation and planning.

9 Water Quality Monitoring Program

9.1 Pre-Construction

Groundwater monitoring wells were installed across the site on 2 July 2009. The first round of groundwater sampling was undertaken in August 2009 and these results are summarised in Table 1. Additional groundwater sampling was undertaken during November 2009, March 2010 and May 2010.

The following groundwater quality monitoring program was undertaken to collect at least two winters worth of groundwater quality data prior to the commencement of construction.

Table B. Pre-construction groundwater monitoring programme.

Monitoring Location	Frequency	Parameters
Four groundwater monitoring bores located at the site.	Seasonally (summer, autumn, winter, spring) over two years	**In situ:** pH, EC, DO and temperature. **Lab sample:** TN, TP

9.2 During construction

It is recommended to undertake the same groundwater quality monitoring programme during construction to monitor for changes to groundwater quality potentially as a result of construction activities.

Table C. Groundwater quality monitoring programme recommended to be undertaken during construction.

Monitoring Location	Frequency	Parameters
Four groundwater monitoring bores located at the site.	Seasonally (summer, autumn, winter, spring) during construction	**In situ:** pH, EC, DO and temperature. **Lab sample:** TN, TP

9.3 Ongoing Monitoring Requirements

It is recommended to undertake a further two years of groundwater quality monitoring following the same methodology if there are significant changes to the groundwater quality observed as a result of construction activities. However, if there are no significant changes observed during construction, further groundwater monitoring should not be required. Any requirement for additional monitoring after this will be the responsibility of the City of Kwinana.

10 Implementation

10.1 Developer Commitments

The developer commits to the following actions:

- Implementation of the strategies outlined in this LWMS into the LSP and subsequent planning documents.
- Development and implementation of an UWMP to provide further detail on the responsibilities and water management plan options during the subdivision design stage.

10.2 Roles, Responsibilities, Funding for Implementation

The key roles and responsibilities for the implementation of this LWMS are outlined in Table D below.

Table D: Roles and Responsibilities for LWMS Implementation

Issues	Responsibility and Funding	Timing
Inclusion of water sensitive urban design principles into design and planning	Satterley Property Group	During the planning phase of the project.
Site development utilising water sensitive urban design principles	Satterley Property Group	During earthworks
Pre-development groundwater monitoring	Satterley Property Group	2 years pre- development
Construction groundwater monitoring	Satterley Property Group	During earthworks
Post Development Water Monitoring:	Satterley Property group - if changes to groundwater quality detected as a result of construction and development activities. City of Kwinana (if no changes to groundwater quality detected as a result of construction and development activities.	2 years post development Ongoing (post development)

10.3 Contingency Measures

In the event that the any of the measures outlined within this LWMS are considered to be inadequate or insufficient, the developer commits to ensuring that the appropriate contingencies are agreed to with the City of Kwinana. Specific contingency measures will be developed as a part the UWMP.

10.4 Review

Review of the LWMS implementation will be undertaken by the City of Kwinana in their assessment of application documentation.

11 Limitations

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

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

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

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

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TABLES

Lots E26, 303 and 9014 Gilmore Avenue, Kwinana
Local Water Management Strategy
Table 1: Summary of Groundwater Monitoring Results

			Aug-09				Nov-09				Mar-10				May-10				Aug-10			
Analyte	**Units**	**LOR**	**GW1**	**GW2**	**GW3**	**GW4**	**GW1**	**GW2**	**GW3**	**GW4**	**GW1**	**GW2**	**GW3**	**GW4**	**GW1**	**GW2**	**GW3**	**GW4**	**GW1**	**GW2**	**GW3**	**GW4**
Temp (in situ)	°C		2.80	21.20	19.61	19.99	20.84	20.29	19.22	19.67	21.46	21.19	20.56	21.69	20.80	21.58	19.72	-	20.73	20.70	19.54	19.89
pH (in situ)	pH units		7.69	7.44	7.45	7.20	7.40	7.28	7.37	7.02	6.07	6.29	5.59	5.00	7.17	6.73	6.60	-	7.13	7.17	2.31	6.44
EC (in situ)	ms/cm		6733.00	737.00	518.00	1130.00	814.00	664.00	510.00	1201.00	819.00	587.00	481.00	1152.00	823.00	673.00	556.00	-	0.83	0.70	0.58	1.16
D.O (in situ)	% sat		37.60	41.50	31.10	86.00	40.30	50.20	47.70	39.20	3.00	3.70	3.70	4.50	-	-	-	-	35.80	56.10	41.20	30.90
D.O(in situ)	mg/L		3.09	3.77	3.04	2.47	3.60	4.59	4.55	3.64	0.27	0.32	0.33	0.39	-	-	-	-	3.41	5.65	4.47	3.33
Redox (in situ)	mV		122.00	176.00	165.00	88.00	31.00	31.00	23.00	66.00	138.30	139.40	142.10	149.60	81.10	79.00	9.50	-	100.00	85.00	110.00	127.00
Ammonia as N	mg/L	0.01	0.16	0.04	0.05	0.05	0.11	0.02	0.04	0.06	0.02	0.01	0.01	0.02	0.20	0.20	0.20	-	0.23	0.03	0.02	0.03
Nitrite + Nitrate as N	mg/L	0.01	0.72	2.90	1.61	1.07	3.33	2.67	1.38	0.90	6.06	3.12	0.95	0.75	5.63	5.00	1.90	-	5.54	4.80	2.00	0.06
Total Kjeldahl Nitrogen as N	mg/L	0.1	2.90	0.70	0.40	0.20	0.70	2.60	1.00	1.80	2.40	2.40	1.10	0.80	-	-	-	-	-	-	-	-
Total Nitrogen as N	mg/L	0.1	3.60	3.70	2.00	1.30	4.00	5.30	2.40	2.70	8.50	5.50	2.00	1.60	7.20	7.00	3.60	-	7.20	5.80	2.80	2.00
Total Phosphorus as P	mg/L	0.01	6.28	0.48	0.18	0.02	1.07	3.50	4.42	1.82	8.43	9.17	7.71	2.05	8.50	8.80	6.40	-	0.21	0.19	0.16	0.16

FIGURES



Legend

- Site Boundary
- Cadastral Boundary and Site Structure Plan

Acid Sulfate Soil Risk (<3 m from surface)

- High to moderate ASS disturbance risk
- Moderate to low ASS disturbance risk
- No known ASS disturbance risk

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- CADASTRAL BOUNDARY SOURCED FROM LANDGATE 2011
- ASS MAPPING SOURCED FRMO DEC 2007
- LOCALITY MAP SOURCED FROM LANDGATE 2007

SCALE

0 25 50 100 150 200 250

Metres

1:7,091 @ A4

LOCALITY MAP



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METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
TJ	RH	BP
DATE	**REVISION**	**DRAWING ID**
08/07/2011	0	LD008-2.01

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING
LOT E26 GILMORE AVE, KWINANA

Urban Water Management Strategy
Site Location and Environmental Features
Figure 1

Z:\3. LD\3.2 Projects\LD008-2 KTC UWMS (665-3)\LD008-2 Drafting\Figures



Legend

- Groundwater Monitoring Well
- Site Boundary
- Groundsurface Contours
- Major Roads

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- LOCALITY MAP SOURCED FROM LANDGATE 2007

SCALE

0 30 60 120 180 240 300

Metres

1:7,500 @ A4

LOCALITY MAP



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100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

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DATE	**REVISION**	**DRAWING ID**
08/07/2011	0	LD008-2.02

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING
LOT E26 GILMORE AVE, KWINANA

Urban Water Management Strategy
Site Contours and Groundwater Well Locations
Figure 2

Z:\3. LD\3.2 Projects\LD008-2 KTC UWMS (665-3)\LD008-2 Drafting\Figures



Legend

- **211SpW_SWAMP**: Swamp
- **211Sp__S1b**: Dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%.
- **211Sp__S2a**: Lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop.
- **211Sp__S2b**: Lower slopes (1-5%) of dune ridge with shallow to deep siliceous yellow-brown sands and common limestone outcrop.
- **211Sp__S3**: Inter-dunal swales and depressions with gently inclined side slopes and deep rapidly drained siliceous yellow-brown sands.
- Site Boundary
- Major Roads

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- LOCALITY MAP SOURCED FROM LANDGATE 2007

SCALE

0 35 70 140 210 280 350

Metres

1:10,000 @ A4

LOCALITY MAP



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METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
TJ	RH	BP
DATE	**REVISION**	**DRAWING ID**
08/07/2011	0	LD008-2.03

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING
LOT E26 GILMORE AVE, KWINANA

Urban Water Management Strategy
Site Soils
Figure 3

Z:\3. LD\3.2 Projects\LD008-2 KTC UWMS (665-3)\LD008-2 Drafting\Figures



Legend

Site Boundary

Drainage Areas

Landscaped Buffer

Landscaped Parkland

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
- LOCALITY MAP SOURCED FROM LANDGATE 2007

SCALE

0 25 50 100 150 200

Metres

1:6,223 @ A4

LOCALITY MAP



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METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	**HEIGHT DATUM**
GDA 94	N/A

CREATED BY	CHECKED BY	APPROVED
TJ	RH	BP
DATE	**REVISION**	**DRAWING ID**
08/07/2011	0	LD008-2.04

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING
LOT E26 GILMORE AVE, KWINANA

Urban Water Management Strategy
Site Drainage Areas
Figure 4

Z:\3. LD\3.2 Projects\LD008-2 KTC UWMS (665-3)\LD008-2 Drafting\Figures

APPENDIX A

Proposed Landscape Masterplan for Lot E 26 Gilmore Ave, Kwinana



LOTS E26, 303 & 9014, GILMORE AVENUE, KWINANA
landscape masterplan

scale 1:1000 @ A0
18.11.2013
0 10 20 30 40 50

Government of Western Australia
Department of Housing

Satterley
Cossill & Webley CONSULTING ENGINEERS
SKM
360 environmental
burgess design group
emerge ASSOCIATES

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WATER MANAGEMENT STRATEGY

LOTS E26, 303 & 9014 GILMORE AVE, KWINANA

1. BRIEF STRATEGY OUTLINE

Based on the irrigated area, we propose three (3) bores to service the site with an average of each bore producing 7.5 litres per second. The stage 1 bore will house the Master Irrigation Cubicle and Hunter ACC 99D 2-wire controller. The other two (2) bores will be controlled via the stage 1 master cubicle with common mainline network interconnecting all three (3) bores.

Having a network of mainlines enables a backup for each of the areas if a bore was to go down due to fault for a period of time.

As the area has high iron content and susceptible to staining we have included Iron filtration on each of the three (3) bores. This will protect the Landscape infrastructure from staining. More information on the type of filtration is provided below.

2. WATER ALLOCATION

The below table shows water usage based on the POS areas being staged approximately with two (2) to three (3) POS areas per bore. Water usage is based on 7500 kilolitres per hectare as outlined by the Department of Water.

Bore No:	Required Flow	POS Areas	Hectares per bore	Kilolitres Per Annum
1	6.5 LPS	POS 5 & POS 6	2.3353	17,514.75
2	7.2 LPS	POS 3 & POS 4	2.5879	19,409.25
3	7.9 LPS	POS 1, POS 2 & POS 7	2.8688	21,516.00

Estimated Annual Water Usage: 58,440 Kilolitres per year
Estate Irrigated Area: 7.79ha

Seasonal Adjustments will need to be made accordingly to conserve water allocation and allowed for within the irrigation design.

3. IRON FILTRATION

The filter system would be designed to reduce the iron content of the bore water; down to less than 0.3ppm. The filtration process is made up of two (2) keys procedures:

a. Oxidation - Air is injected through a Venturi via a booster pump into the raw bore water. This starts the oxidation process.
b. Filtration - The oxidised water then passes through a media filter which catches the precipitated iron.

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FILTER SCHEMATICS



KEY

1 48" Tank
2 80mm Flushgal Valve
3 80mm B/Fly Valve
4 50mm FIP Ball Valve
5 50mm 100 Series Valve
6 100mm Class 15 ABS Pipe
7 Grundfos CHV4-80
8 25mm Venturi
9 50mm Class 15 ABS Pipe
10 25mm ARI Air Release Valve
11 80mm Wafer Check Valve
12 80mm Post Filter
13 Inlet Water Flow
14 Outlet Water Flow

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4. FINANCIAL BUDGET

Below shows a cost estimate broken down into each POS area along with Bore and Filtration Infrastructure:

Irrigation Financial Budget		
Infield Irrigation Infrastructure		
Location	Hectares	per POS ($)
POS 1	0.8942ha	$107,304.00
POS 2	1.1187ha	$134,244.00
POS 3	2.1229ha	$254,748.00
POS 4	0.4650ha	$ 55,800.00
POS 5	1.1145ha	$133,740.00
POS 6	1.2198ha	$146,376.00
POS 7	0.8559ha	$102,708.00
Major Irrigation Infrastructure Components		
Location	Type	$
POS 1	Bore, Iron Filtration & Electrical	$125,000.00
POS 3	Bore, Iron Filtration & Electrical	$125,000.00
POS 6	Bore, Iron Filtration & Electrical	$130,000.00
	TOTAL EXCLUDING GST	$1,314,920.00

5. MAINTENANCE

As part of the Irrigation infrastructure running efficiently, it's vital to maintain the system regularly. Below are items along with frequency of service requirements:

Iron Filtration:
Filter maintenance should be carried out quarterly by the filter manufacturer / installer.

Check should include:

- Test system backwash
- Record number of system backwashes since previous visit
- Check media level
- Check Air release valve working correctly
- Check Iron content level
- Check booster pump and venturi

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IMAGE: IRON STAINING ALONG MEARES AVENUE SHOWN ON PATHWAYS

Bore Hole, Pump & Head works:
This should be carried out every two (2) years with the bore hole being chemically treated or air developed during this time.

Bore Pump Cabinet:
The bore pump cabinet shall be checked every three (3) months including a wiring check, spider webs removed and all debris also removed.

Water Meters:
Checked every two (2) years

Check, Adjust & Report:
The overall operation of the system shall be checked, adjusted and a report provided once per week during the spring and autumn period, twice per week during summer and once per month during winter. This includes the unblocking of nozzles, broken parts replaced and sprinkler arcs adjusted if required.

6. STRATEGY DESIGN

See the attached drawings for the approximate bore locations and mainline network.

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7. EXISTING IRRIGATION INFRASTRUCTURE

Existing Town of Kwinana irrigation infrastructure shall tie into the new works where possible. There is a section of mainline that runs through the new development which can be seen on the drawing sheet 1 of 2.

Portions of this mainline will need to be re-routed once lot 9024 is developed to enable continual watering of the median strip. As for irrigation to the verges along Gilmore, Meares and Challenger Avenue verges, we are currently unsure of existing infrastructure and do not have “As Constructed” records. During the construction phase of the project, the construction team will need to work closely with the Town of Kwinana maintenance officers to ensure minimal interruption to existing infrastructure.

Agrifood TECHNOLOGY

Your link with quality

ANALYSIS REPORT

Western Irrigation
211 Barrington Street
BIBRA LAKE W.A 6163

ATTENTION	Andrew Ogden
FAX NUMBER	08 9434 5777
PURCHASE ORDER	C095015
PROJECT NUMBER	B1109-0040

DATE RECEIVED	14 September 2011
OUR SAMPLE NUMBER	B2011-01385
YOUR REFERENCE	52991 PEET SOUTHERN J/V WELLAR
SAMPLE TYPE	Water
SAMPLE DESCRIPTION	52991 PEET SOUTHERN J/V WELLARD STH BORE2

TEST		Result
General Appearance		
	Appearance	pale yellow
	Odour	odourless
pH		
	pH	7.2
Electrical Conductivity		
	Electrical Conductivity (mS/cm)	1.50
TDS (calculation)		
	Total Dissolved Salts (mg/L)	900
Total Alkalinity		
	Bicarbonate (mg/L)	355
	Alkalinity (mg CaCO3/L)	290
	Carbonate (mg/L)	<5
Hardness		
	Hardness (mg CaCO3/L)	325
Iron		
	Iron (mg/L)	5.1
Dissolved Carbon dioxide		
	Dissolved Carbon Dioxide (mg/L)	38

Comment : Neutral in reaction, contains moderate salinity, suitable for irrigation of slightly to moderately salt tolerant plants. Use on salt sensitive species is not recommended. Limit direct contact with plant foliage. Bicarbonate, total alkalinity and total hardness are high, calcium carbonate deposits likely to form, may have an alkaline effect on soils. Total iron is high, likely to cause staining. Combination of calcium carbonate and iron oxide deposits may cause blockages of sprinklers and/or parts of the irrigation system

Note: **All samples are analysed on an as received basis.**
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Final Report

Report Number: 55743

Invoice No. : 55823

Australian Wool Testing Authority Ltd
Trading as Agrifood Technology
ABN 43 006 014 106
www.agrifood.com.au

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Werribee, VIC 3030
Freecall 1800 801 312
Telephone 03 9742 0555
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APPENDIX B

Drainage Plan and Cross Sections

CATCHMENT 2
GROSS AREA = 0.45Ha
NET AREA = 0.36Ha
EXTERNAL NET AREA = 0.55Ha
CATCHMENT 3
GROSS AREA = 0.96Ha
NET AREA = 0.76Ha
TOTAL NET AREA = 1.67Ha
STORAGE VOLUMES
1 IN 1 YEAR - 102m³
1 IN 5 YEAR - 229m³
1 IN 10 YEAR - 274m³
1 IN 100 YEAR - 527m³
STORAGE ALLOWANCE
UNDERGROUND 1 IN 1 YEAR - 102m³
ABOVEGROUND - 425m³

EXISTING INFLOW 0.55ha (NET)

CHALLENGER AVENUE

SWALE BASE AREA = 4063m²
SWALE TWL AREA = 6141m²
BASE LEVEL RL6.60
1 IN 100 YEAR TWL7.80

EXISTING INFLOW 12.25ha (NET)

CATCHMENT 1
GROSS AREA = 0.95Ha
NET AREA = 0.76Ha
EXTERNAL NET AREA = 0.70Ha
EXTERNAL NET AREA = 12.25Ha
TOTAL NET AREA = 12.71Ha
STORAGE VOLUMES
1 IN 1 YEAR - 1904m³
1 IN 5 YEAR - 3607m³
1 IN 10 YEAR - 4184m³
1 IN 100 YEAR - 7513m³
STORAGE ALLOWANCE
UNDERGROUND 1 IN 1 YEAR - 1904m³
ABOVEGROUND - 5909m³

MIXED USE SITE

SWALE BASE AREA = 126m²
SWALE TWL AREA = 682m²
BASE LEVEL RL7.60
1 IN 100 YEAR TWL8.80

G.H.S.

PUBLIC OPEN SPACE

POS

PUBLIC OPEN SPACE

MEARES AVENUE

V-DRAIN LENGTH 120m
SIDE SLOPES 1 IN 4
DEPTH 0.3m
TWL AREA = 288m²
BASE LEVEL VARIES RL9.00 (NOM)
MAX TWL9.50

EXISTING INFLOW (UNKNOWN)

CATCHMENT 4
GROSS AREA = 1.34Ha
NET AREA = 1.07Ha
EXTERNAL NET AREA = 1.33Ha
TOTAL NET AREA = 2.40Ha
PLUS UNKNOWN EXTERNAL CATCHMENT
STORAGE VOLUMES
1 IN 1 YEAR - 764m³
1 IN 5 YEAR - 1310m³
1 IN 10 YEAR - 1488m³
1 IN 100 YEAR - 2621m³
STORAGE ALLOWANCE
ABOVEGROUND 1 IN 1 YEAR - 50m³

EXISTING INFLOW 1.33ha (NET)

EXISTING INFLOW 5.9ha (NET)

OVER FLOW FROM CATCHMENT 4
TO BE DIRECTED INTO CATCHMENT 7

GILMORE AVENUE

CATCHMENT 5
GROSS AREA = 1.01Ha
NET AREA = 0.81Ha
EXTERNAL NET AREA = 5.90Ha
CATCHMENT 6
GROSS AREA = 1.15Ha
NET AREA = 0.92Ha
TOTAL NET AREA = 7.63Ha
STORAGE VOLUMES
1 IN 1 YEAR - 630m³
1 IN 5 YEAR - 1297m³
1 IN 10 YEAR - 1531m³
1 IN 100 YEAR - 2968m³
STORAGE ALLOWANCE
UNDERGROUND 1 IN 1 YEAR - 630m³
ABOVEGROUND - 2338m³

SWALE BASE AREA = 1410m²
SWALE TWL AREA = 2851m²
BASE LEVEL RL7.00
1 IN 100 YEAR TWL8.20

V-DRAIN LENGTH 195m
SIDE SLOPES 1 IN 4
DEPTH 0.3m
TWL AREA = 468m²
BASE LEVEL VARIES RL9.00 (NOM)
MAX TWL9.50

CATCHMENT 7
GROSS AREA = 0.42Ha
NET AREA = 0.33Ha
EXTERNAL NET AREA = 0.98Ha
TOTAL NET AREA = 1.31Ha
STORAGE VOLUMES
1 IN 1 YEAR - 186m³
1 IN 5 YEAR - 341m³
1 IN 10 YEAR - 393m³
1 IN 100 YEAR - 685m³
STORAGE ALLOWANCE
ABOVEGROUND 1 IN 1 YEAR - 70m³

EXISTING INFLOW 0.98ha (NET)

PROPOSED PUMP STATION LOCATION

OVER FLOW FROM CATCHMENTS 4 AND 7 TO BE DIRECTED INTO CATCHMENTS 8 AND 9

EXISTING PUMP STATION TO BE DECOMMISSIONED

EXISTING INFLOW (UNKNOWN)

EXISTING INFLOW 8.85ha (NET)

SWALE BASE AREA = 1809m²
SWALE TWL AREA = 3324m²
BASE LEVEL RL6.00
1 IN 100 YEAR TWL7.20

CATCHMENT 8
GROSS AREA = 1.87Ha
NET AREA = 1.50Ha
CATCHMENT 9
GROSS AREA = 0.80Ha
NET AREA = 0.64Ha
TOTAL NET AREA = 2.14Ha
PLUS UNKNOWN EXTERNAL CATCHMENT
STORAGE VOLUMES
1 IN 1 YEAR - 131m³
1 IN 5 YEAR - 338m³
1 IN 10 YEAR - 413m³
1 IN 100 YEAR - 806m³
STORAGE ALLOWANCE
(CALCULATIONS ALLOW FOR OVERFLOW FROM CATCHMENTS 4 AND 7)
UNDERGROUND 1 IN 1 YEAR - 1031m³
ABOVEGROUND - 3162m³

SWALE BASE AREA = 2405m²
SWALE TWL AREA = 4443m²
BASE LEVEL RL7.80
1 IN 100 YEAR TWL9.00

CATCHMENT 10
GROSS AREA = 0.66Ha
NET AREA = 0.53Ha
EXTERNAL NET AREA = 8.85Ha
TOTAL NET AREA = 9.38Ha
STORAGE VOLUMES
1 IN 1 YEAR - 1512m³
1 IN 5 YEAR - 2773m³
1 IN 10 YEAR - 3202m³
1 IN 100 YEAR - 5556m³
STORAGE ALLOWANCE
UNDERGROUND 1 IN 1 YEAR - 1512m³
ABOVEGROUND - 4044m³

WELLARD ROAD

LEGEND

PROPOSED DRAINAGE LINE

CATCHMENT BOUNDARY

NOTE:
ALL DRAINAGE SWALES ARE TO BE 1 IN 6 SIDE SLOPES AND 1.2m U.N.O

1:1000 0m 20 40 60m

Filename: 590300403

WAPC No.

No.	DATE	DRAWN	CHECKED	AMENDMENT
E	21.02.14	DP	PC	SWALE TWL LEVELS ADDED. ISSUED FOR COMMENT
D	13.02.14	DP	PC	SWALE DETAILS ADDED. ISSUED FOR COMMENT
C	10.12.13	DP	PC	STORAGE VOLUMES ADDED. ISSUED FOR COMMENT
B	23.11.13	DP	PC	ISSUED FOR COMMENT
A	20.11.13	DP	PC	ISSUED FOR COMMENT

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CLIENT
DEPARTMENT OF HOUSING and SATTERLEY PROPERTY GROUP

DESIGNED	CHECKED	APPROVED
DP	PC	
DRAWN	CHECKED	
DP	PC	

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E admin@cosweb.com.au

PROJECT
LOTS E26, 303 & 9014 GILMORE AVENUE, KWINANA

TITLE
PRELIMINARY DRAINAGE CATCHMENT PLAN

SCALE	DRAWING NUMBER	ISSUE
1:1000	5903-00-403	E

SWALE BASE AREA = 126m²
SWALE TWL AREA = 682m²
BASE LEVEL RL7.60
1 IN 100 YEAR TWL8.80

SWALE BASE AREA = 4063m²
SWALE TWL AREA = 6141m²
BASE LEVEL RL6.60
1 IN 100 YEAR TWL7.80

CHALLENGER AVENUE

404
MIXED USE SITE
GRADED LOT MINIMUM LEVEL RL10.60

394
G.H.S.
GRADED LOT MINIMUM LEVEL RL9.80

8009

G.H.S.
395
GRADED LOT MINIMUM LEVEL RL9.50

8001

9001
FUTURE STAGE

8002
PUBLIC OPEN SPACE

PUBLIC OPEN SPACE

398
G.H.S.
GRADED LOT MINIMUM LEVEL RL9.20

MEARES AVENUE

8010
POS

GILMORE AVENUE

GRADED LOT MINIMUM LEVEL RL10.70
396 G.H.S.
397 G.H.S.

V-DRAIN
DEPTH 0.3m (NOM)
TWL AREA = 288m²
BASE LEVEL VARIES RL9.00 (NOM)
MAX TWL9.50

8008

399
G.H.S.

EAST-WEST ROAD

POS
8011

8003
PUBLIC OPEN SPACE

SWALE BASE AREA = 1410m²
SWALE TWL AREA = 2851m²
BASE LEVEL RL7.00
1 IN 100 YEAR TWL8.20

POS
8012

V-DRAIN
DEPTH 0.3m (NOM)
TWL AREA = 468m²
BASE LEVEL VARIES RL9.00 (NOM)
MAX TWL9.50

8007

400
G.H.S.

NORTH-SOUTH ROAD

8004
PUBLIC OPEN SPACE

401
G.H.S.

402
G.H.S.

SWALE BASE AREA = 1809m²
SWALE TWL AREA = 3324m²
BASE LEVEL RL6.00
1 IN 100 YEAR TWL7.20

8005
PUBLIC OPEN SPACE

406
G.H.S.

G.H.S.
403
GRADED LOT MINIMUM LEVEL RL10.37

GRADED LOT MINIMUM LEVEL RL9.63
405
G.H.S.

PUBLIC OPEN SPACE

8006

SWALE BASE AREA = 2405m²
SWALE TWL AREA = 4443m²
BASE LEVEL RL7.80
1 IN 100 YEAR TWL9.00

WELLARD ROAD

NOTE

1:1000 0m 20 40 60m

Filename: 590300SK12

WAPC No.

No.	DATE	DRAWN	CHECKED	AMENDMENT
A	21.02.14	DP	PC	ISSUED FOR INFORMATION

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This plan is not to be used for construction unless issued as rev 0 or higher and signed as "Approved"

CLIENT: DEPARTMENT OF HOUSING and SATTERLEY PROPERTY GROUP

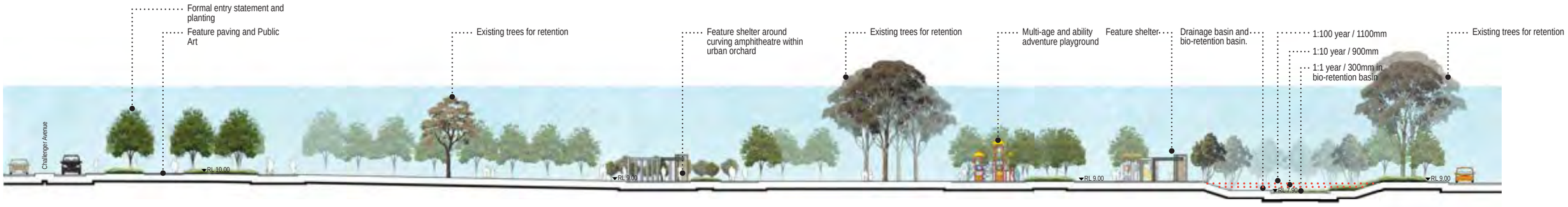
DESIGNED	CHECKED	APPROVED
DP	PC	
DRAWN	CHECKED	
DP	PC	

Cossill & Webley CONSULTING ENGINEERS
Level 2
431 Roberts Road
Subiaco WA 6008
T (08) 9422 5800
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E admin@cosweb.com.au

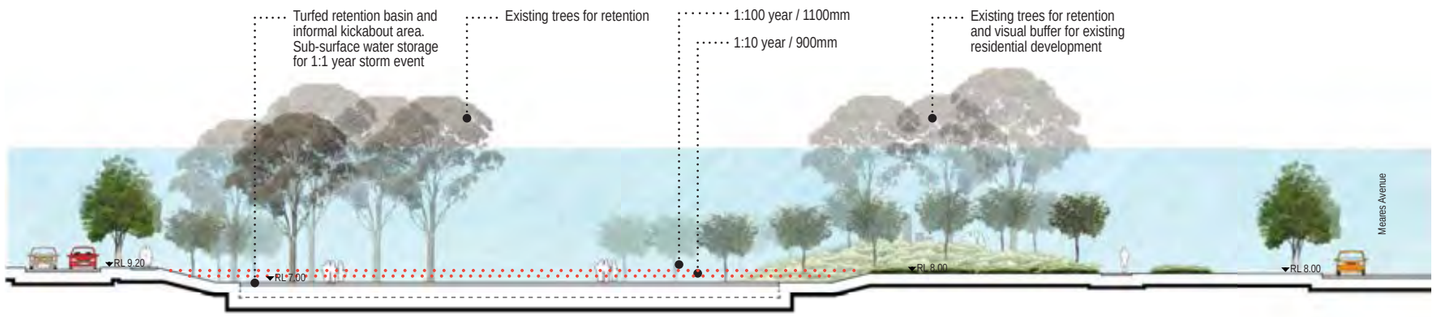
PROJECT: LOTS E26, 303 & 9014 GILMORE AVENUE, KWINANA

TITLE: PROPOSED PAD LEVELS AND BASIN TOP WATER LEVELS

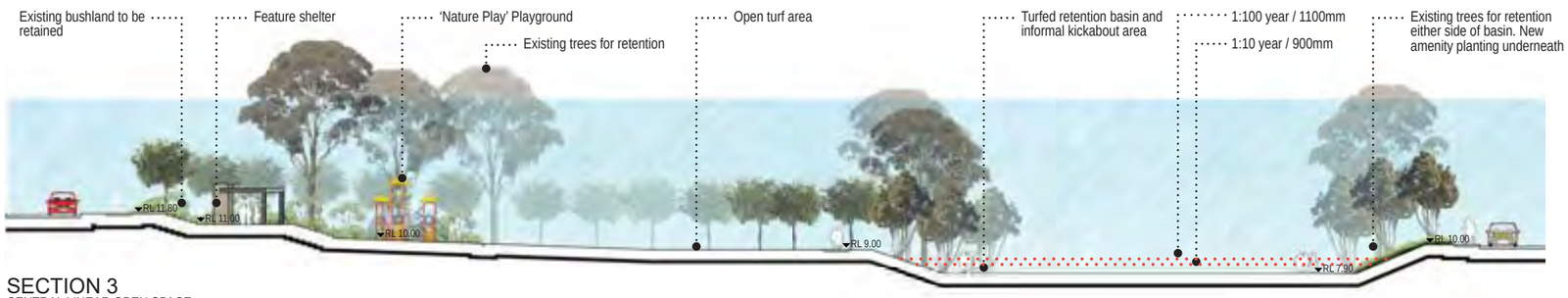
SCALE	DRAWING NUMBER	ISSUE
1:1000	5903-00-SK12	A



SECTION 1
FORMAL TOWN CENTRE OPEN SPACE



SECTION 2
MULTIPLE USE / DRAINAGE PUBLIC OPEN SPACE



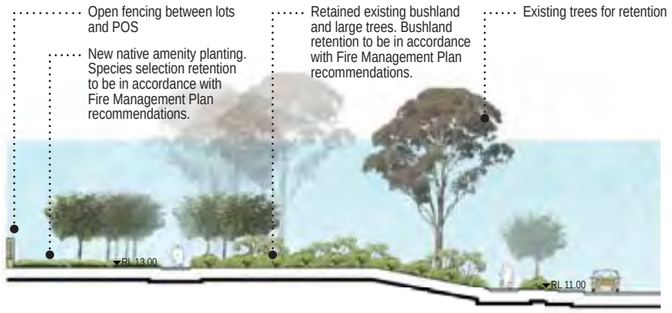
SECTION 3
CENTRAL LINEAR OPEN SPACE

LOTS E26, 303 & 9014, GILMORE AVENUE, KWINANA
landscape sections

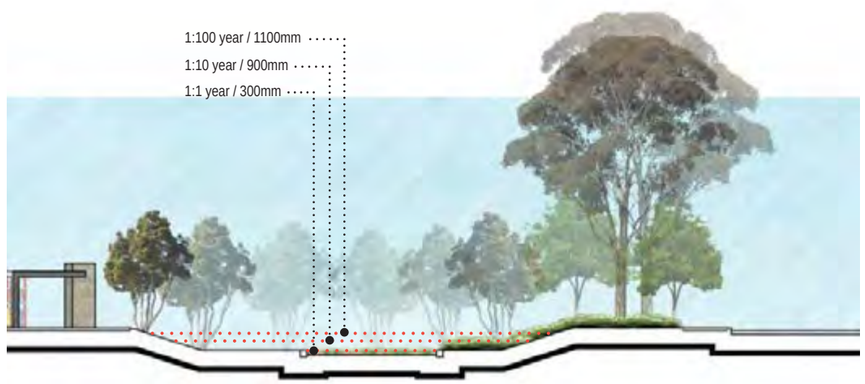
scale 1:250 @ A1
20.01.2014

Government of Western Australia
Department of Housing

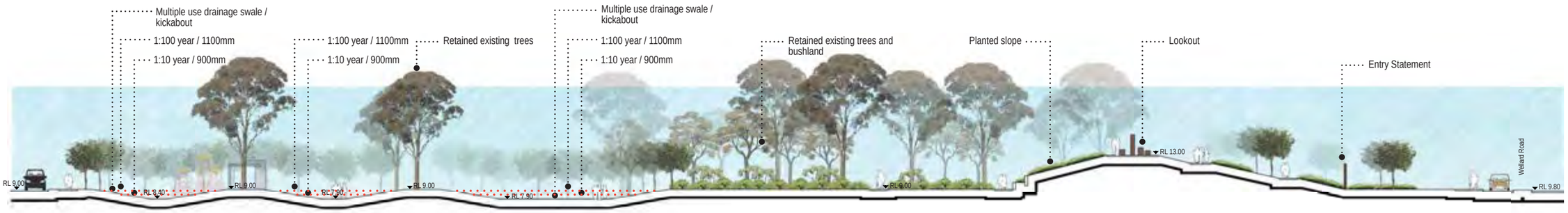
Satterley
Cossill & Webley
SKM
360
emerge ASSOCIATES
Integrated Science & Design



SECTION 4
CENTRAL LINEAR OPEN SPACE RETAINED BUSHLAND



SECTION DETAIL
TYPICAL BIO-RETENTION BASIN



SECTION 5
SOUTHERN MULTIPLE USE OPEN SPACE AND ENTRY STATEMENT



SECTION 6
MULTIPLE USE / DRAINAGE PUBLIC OPEN SPACE & RETAINED BUSHLAND

LOTS E26, 303 & 9014, GILMORE AVENUE, KWINANA
landscape sections

scale 1:250 @ A1
20.01.2014

Government of Western Australia
Department of Housing

Satterley
Cossill & Webley
SKM
360
emerge ASSOCIATES
Integrated Science & Design

APPENDIX C

Soil Borelogs from Groundwater Well Installation

Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW1
Sheet: 1 of 3
Date: 2-07-09
Logged By: JT

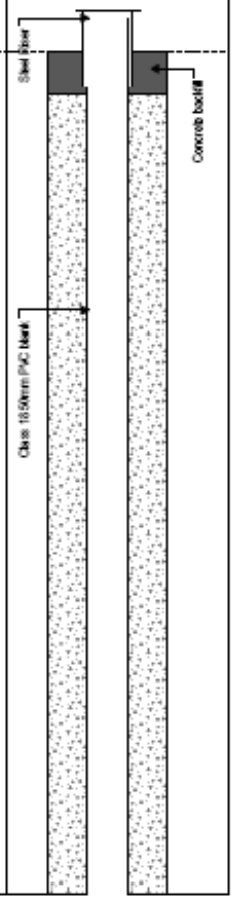
Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388427
Northing: 6430632

RL:

Drilling and Sampling Information | Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
									Ground Surface		
					GW1-A		0.0		SP SAND, fine to medium grained, some organics at surface, dark brown.		
					GW1-B		0.5		SP SAND, fine to medium grained, brown.		
					GW1-C		1.0		SP SAND, fine to medium grained, light brown.		
					GW1-D		1.5		SP SAND, fine to medium grained, orange.		
					GW1-E		2.0				
					GW1-F		2.5				
					GW1-G		3.0				
							3.5				
					GW1-H		4.0				
					GW1-I		4.5		SP SAND, fine to medium grained, dark brown.		
									SP SAND, fine to medium grained with limestone fragments, orange. Limestone becoming harder with depth.		



Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW1
Sheet: 2 of 3
Date: 2-07-09
Logged By: JT

Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388427
Northing: 6430632

RL:

Drilling and Sampling Information | Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
					GW1-J		5.0				
							5.5				
					GW1-K		6.0				
							6.5				
					GW1-L		7.0		SP SAND, fine to medium grained, some limestone fragments, yellow. Limestone layer @ approx 7.5m.		
							7.5				
					GW1-M		8.0				
							8.5				
					GW1-N		9.0		SP SAND, fine to course grained, light yellow. Ground up limestone.		
							9.5				

Sandbackfill

Bentonite granules

Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW1
Sheet: 3 of 3
Date: 2-07-09
Logged By: JT

Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

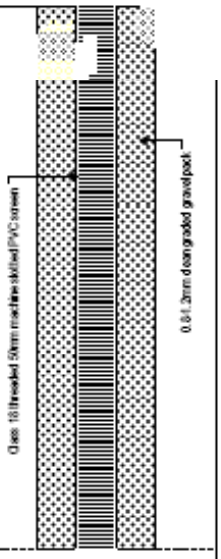
Easting: 0388427
Northing: 6430632

RL:

Drilling and Sampling Information

Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
				▼			10.0				
							10.5				
							11.0				
							11.5				
							12.0				
							12.5				
							13.0		End of Log		
							13.5				
							14.0				
							14.5				



Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW2
Sheet: 1 of 2
Date: 2-07-09
Logged By: JT

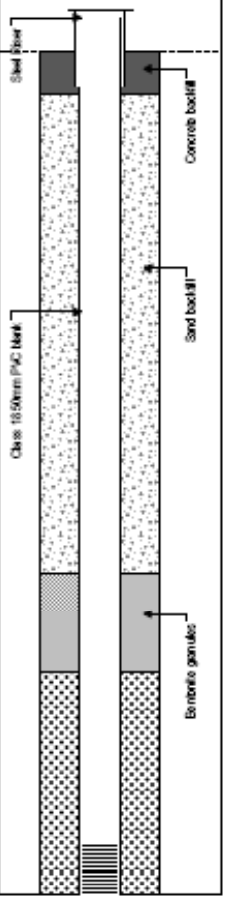
Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388555
Northing: 6431416

RL:

Drilling and Sampling Information | Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
									Ground Surface		
					GW2-A		0.0		SP SAND, fine to medium grained, some organics, dark brown.		
							0.5		SP SAND, fine to medium grained, brown.		
					GW2-B		1.0				
							1.5		SP SAND, fine to medium grained, orange, some limestone fragments present.		
					GW2-C		2.0				
							2.5			M	
					GW2-D		3.0				
							3.5				
					GW2-E		4.0				
							4.5				



Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW2
Sheet: 2 of 2
Date: 2-07-09
Logged By: JT

Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388555
Northing: 6431416

RL:

Drilling and Sampling Information | Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
				▼	GW2-F		5.0		SP SAND, fine to medium grained, dark yellow.		
							5.5				
					GW2-G		6.0				
							6.5			W	
					GW2-H		7.0				
							7.5				
							8.0				
							8.5		End of Log		
							9.0				
							9.5				

Class 18 threaded 50mm machine slotted PVC screen

0.6-1.2mm clean graded gravel pack

Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW3
Sheet: 1 of 2
Date: 2-07-09
Logged By: JT

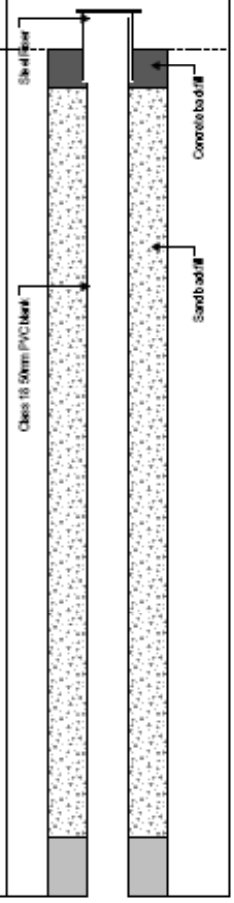
Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388270
Northing: 6431467

RL:

Drilling and Sampling Information | Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
									Ground Surface		
					GW3-A		0.0		SP SAND, fine to medium grained, some organics, dark brown.		
							0.5		SP SAND, fine to medium grained, brown.		
					GW3-B		1.0		SP SAND, fine to medium grained, orange, trace of coarse grained sand.		
					GW3-C		1.5				
							2.0				
					GW3-D		2.5				
							3.0				
							3.5			M	
							4.0				
							4.5				
							5.0				



Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW3
Sheet: 2 of 2
Date: 2-07-09
Logged By: JT

Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388270
Northing: 6431467

RL:

Drilling and Sampling Information | Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
				▼			5.5				Bentonite granules
							6.0				
							6.5				
							7.0				
							7.5				Class 18 threaded 50mm machine slotted PVC screen
							8.0				
							8.5			W	
							9.0				0.6-1.2mm clean graded gravel pack
							9.5				
							10.0		End of Log		
							10.5				

Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

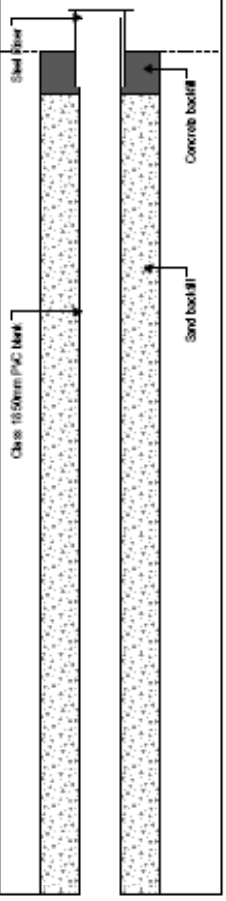
Borehole Number: GW4
Sheet: 1 of 3
Date: 2-07-09
Logged By: JT

Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388103
Northing: 6430818

RL:

Drilling and Sampling Information							Material and Substance				
Penetration				Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
1	2	3	4								
									Ground Surface		
					GW4-A		0.0		SP SAND, fine to medium grained, some organics, brown.		
					GW4-B		0.5 1.0 1.5				
					GW4-C		2.0		SP SAND, fine to medium grained, orange.		
					GW4-D		2.5 3.0 3.5				
					GW4-E		4.0 4.5				



Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW4
Sheet: 2 of 3
Date: 2-07-09
Logged By: JT

Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388103
Northing: 6430816

RL:

Drilling and Sampling Information | Material and Substance

Penetration 1	2	3	4	Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
					GW4-F		5.0				
					GW4-G		6.0				
					GW4-H		7.0				
							7.3		LIMESTONE		
							7.5		SP SAND, fine to medium grained, orange.		
					GW4-I		8.0		SP SAND, fine to medium grained, yellow.		
							8.5				
							9.0				
							9.5				

Groundwater Bore Installation: Class 18 threaded 50mm machine-slotted PVC screen; 0.6-1.2mm clean graded gravel pack; Bentonite granules

Client: Department of Housing
Project: KTC LWMS
360 Job Number: 665-3
Borehole Location: Lot E26 Gilmore Avenue

Borehole Number: GW4
Sheet: 3 of 3
Date: 2-07-09
Logged By: JT

Drill Model: Hollow Flight Auger
Hole Diameter: 100mm

Easting: 0388103
Northing: 6430816

RL:

Drilling and Sampling Information							Material and Substance				
Penetration				Water	Analytical Soil Samples	PID Reading (ppm)	Depth (m)	Graphical Log	Lithologic Description	Moisture Condition	Groundwater Bore Installation
1	2	3	4								
							10.0 10.5 11.0 11.5				
							12.0 12.5 13.0 13.5 14.0 14.5		End of Log		

APPENDIX D

Groundwater Monitoring Results

CERTIFICATE OF ANALYSIS

Work Order	: **EP0904555**	Page	: 1 of 3
Client	: **360 ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: MR JOSEPH TOON	Contact	: Michael Sharp
Address	: PO BOX 14 WEST PERTH WA, AUSTRALIA 6872	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: josephtoon@360environmental.com.au	E-mail	: michael.sharp@alsenviro.com
Telephone	: +61 9321 0420	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 9226 0739	Facsimile	: +61-8-9209 7600
Project	: 665-3	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: 665-3 13092009-1	Date Samples Received	: 13-AUG-2009
Sampler	: ----	Issue Date	: 21-AUG-2009
Site	: KTC UWMS		
		No. of samples received	: 5
Quote number	: EP-120-09 BQ	No. of samples analysed	: 5

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ankit Joshi	Inorganic Chemist	Perth Inorganics

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insuffient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

- **LOR raised for TP due to sample matrix**

Analytical Results

Sub-Matrix: **WATER**

Compound	CAS Number	LOR	Unit	Client sample ID: GW1	GW2	GW3	GW4	DUP1
				Client sampling date / time: 13-AUG-2009 14:10	13-AUG-2009 14:10	13-AUG-2009 14:10	13-AUG-2009 14:10	13-AUG-2009 14:10
				EP0904555-001	EP0904555-002	EP0904555-003	EP0904555-004	EP0904555-005
EK055G: Ammonia as N by Discrete Analyser								
Ammonia as N	7664-41-7	0.01	mg/L	**0.16**	**0.04**	**0.05**	**0.05**	**0.04**
EK057G: Nitrite as N by Discrete Analyser								
Nitrite as N	----	0.01	mg/L	**0.02**	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser								
^ Nitrate as N	14797-55-8	0.01	mg/L	**0.69**	**2.99**	**1.61**	**1.07**	**2.86**
EK059G: NOX as N by Discrete Analyser								
Nitrite + Nitrate as N	----	0.01	mg/L	**0.72**	**2.99**	**1.61**	**1.07**	**2.86**
EK061: Total Kjeldahl Nitrogen (TKN)								
Total Kjeldahl Nitrogen as N	----	0.1	mg/L	**2.9**	**0.7**	**0.4**	**0.2**	**0.7**
EK062: Total Nitrogen as N								
^ Total Nitrogen as N	----	0.1	mg/L	**3.6**	**3.7**	**2.0**	**1.3**	**3.6**
EK067G: Total Phosphorus as P by Discrete Analyser								
Total Phosphorus as P	----	0.01	mg/L	**6.28**	**0.48**	**0.18**	<0.02	**0.35**

CERTIFICATE OF ANALYSIS

Work Order	: **EP0906412**	Page	: 1 of 4
Client	: **360 ENVIRONMENTAL PTY LTD**	Laboratory	: Environmental Division Perth
Contact	: SIMON BRETT	Contact	: Michael Sharp
Address	: PO BOX 5829 ALBANY WA, AUSTRALIA 6332	Address	: 10 Hod Way Malaga WA Australia 6090
E-mail	: SimonBrett@360environmental.com.au	E-mail	: michael.sharp@alsenviro.com
Telephone	: +61 08 98415236	Telephone	: +61-8-9209 7655
Facsimile	: +61 08 98429320	Facsimile	: +61-8-9209 7600
Project	: 665-3	QC Level	: NEPM 1999 Schedule B(3) and ALS QCS3 requirement
Order number	: ----		
C-O-C number	: 665-3 061109 - 1	Date Samples Received	: 06-NOV-2009
Sampler	: Adam Harris	Issue Date	: 13-NOV-2009
Site	: KTC UWMP		
		No. of samples received	: 6
Quote number	: EP-120-09 BQ	No. of samples analysed	: 6

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. All pages of this report have been checked and approved for release.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

NATA Accredited Laboratory 825

This document is issued in accordance with NATA accreditation requirements.

Accredited for compliance with ISO/IEC 17025.

Signatories

This document has been electronically signed by the authorized signatories indicated below. Electronic signing has been carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Todd Lee	Senior Organic Chemist	Perth Inorganics

General Comments

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Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When date(s) and/or time(s) are shown bracketed, these have been assumed by the laboratory for processing purposes. If the sampling time is displayed as 0:00 the information was not provided by client.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting

Analytical Results

Sub-Matrix: WATER				Client sample ID	GW1	GW2	GW3	GW4	DUP1
				Client sampling date / time	[06-NOV-2009]	[06-NOV-2009]	[06-NOV-2009]	[06-NOV-2009]	[06-NOV-2009]
Compound	CAS Number	LOR	Unit		EP0906412-001	EP0906412-002	EP0906412-003	EP0906412-004	EP0906412-005
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		0.11	0.02	0.04	0.06	0.02
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		0.04	<0.01	<0.01	<0.01	<0.01
EK058G: Nitrate as N by Discrete Analyser									
^ Nitrate as N	14797-55-8	0.01	mg/L		3.29	2.67	1.38	0.90	2.58
EK059G: NOX as N by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		3.33	2.67	1.38	0.90	2.58
EK061: Total Kjeldahl Nitrogen (TKN)									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		0.7	2.6	1.0	1.8	2.2
EK062: Total Nitrogen as N									
^ Total Nitrogen as N	----	0.1	mg/L		4.0	5.3	2.4	2.7	4.8
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		1.07	3.50	4.42	1.82	4.08

Analytical Results

Sub-Matrix: WATER				Client sample ID	RS1	----	----	----	----
				Client sampling date / time	[06-NOV-2009]	----	----	----	----
Compound	CAS Number	LOR	Unit		EP0906412-006	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.01**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	----	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
^ Nitrate as N	14797-55-8	0.01	mg/L		**0.02**	----	----	----	----
EK059G: NOX as N by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.02**	----	----	----	----
EK061: Total Kjeldahl Nitrogen (TKN)									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		<0.1	----	----	----	----
EK062: Total Nitrogen as N									
^ Total Nitrogen as N	----	0.1	mg/L		<0.1	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		<0.01	----	----	----	----

LABORATORY REPORT

ARL Lab No: 10-2725
Date: 31 May 2010

CLIENT: 360 Environmental
22 Altona Street
WEST PERTH WA 6005

ATTENTION: Melissa Hobson

SAMPLE DESCRIPTION: Four water samples as received for analysis of ammonia-N, nitrate-N, nitrite-N, total nitrogen and total phosphorus.

DATE RECEIVED: 20 May 2010

LOCATION / JOB NO: Kwinana Town Centre

PURCHASE ORDER: 665-3

METHOD REFERENCES:

Nitrate	ARL No. 313
Nitrite	ARL No. 311
Total Nitrogen	ARL No. 330
Ammonia	ARL No. 303
Total Phosphorus	ARL No. 308

NATA
WORLD RECOGNISED
ACCREDITATION
This document is issued in accordance with NATA's accreditation requirements
Accreditation No. 2377

Kim Rodgers
Laboratory Manager

Analytical Reference Laboratory (WA) Pty. Ltd.
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsimile: 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

360 Environmental
ARL Lab No: 10-2725
31 May 2010

Nutrients Quality Control Data

	Matrix Spike	Certified Reference Material
	% Recovery	
Ammonia-N	88%	102%
Nitrite-N	-	119%
Nitrate-N	102%	113%
Total Nitrogen	91%	81%
Total Phosphorus	110%	101%

Nutrients

Date Prepared **20/05/2010**
Date Analysed **21/05/2010, 26/05/2010, 31/05/2010**

ARL Lab No	Method Detection Limit	10-2725-1	10-2725-2	10-2725-3	10-2725-4
Sample Marks		GW1A	GW2A	GW3A	DUP1A
	mg/l	mg/l	mg/l	mg/l	mg/l
Ammonia-N	0.2	< 0.2	< 0.2	< 0.2	< 0.2
Nitrite-N	0.01	0.03	< 0.01	< 0.01	< 0.01
Nitrate-N	0.01	5.6	5.0	1.9	4.9
Total Nitrogen	0.2	7.2	7.0	3.6	7.1
Total Phosphorus	0.01	8.5	8.8	6.4	8.5

mpl Laboratories
Part of the Envirolab Group ENVIROLAB
16 - 18 Hayden Court, Myaree, Western Australia 6154
PO Box 4023 Myaree BC, Western Australia 6960
Tel: +61 8 9317 2505 / Fax: +61 8 9317 4163
email: laboratory@mpl.com.au
www.envirolabservices.com.au
Envirolab Services (WA) Pty Ltd ABN 53 140 099 207

CERTIFICATE OF ANALYSIS 105062

Client:
360 Environmental
PO Box 14
West Perth
WA 6872

Attention: S Brett

Sample log in details:

Your Reference:	**Kwinana Town Centre, LD008-2**
No. of samples:	5 x Water
Date samples received:	30.08.10
Date completed instructions received:	30.08.10
Location:	

Analysis Details:
Please refer to the following pages for results, methodology summary and quality control data.
Samples were analysed as received from the client. Results relate specifically to the samples as received.
Results are reported on a dry weight basis for solids and on an as received basis for other matrices.
Please refer to the last page of this report for any comments relating to the results.

Report Details:

Date results requested by:	6/09/10
Date of Preliminary Report:	Not issued
Issue Date:	6/09/10

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Accredited for compliance with ISO/IEC 17025.
Tests not covered by NATA are denoted with *.

Results Approved By:

Joshua Lim
Operations Supervisor

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Nutrients in Water Our Reference: Your Reference Date Sampled Type of sample	UNITS ---------- ----------	105062-1 GW1 30/08/2010 Water	105062-2 GW2 30/08/2010 Water	105062-3 GW3 30/08/2010 Water	105062-4 GW4 30/08/2010 Water	105062-5 DUP1 30/08/2010 Water
Total Nitrogen (Total N)	mg/L	7.2	5.8	2.8	2.0	7.2
Total Phosphorus (Total P)	mg/L	0.21	0.19	0.16	0.16	0.20
Nitrate as N	mg/L	5.5	4.8	2.0	0.050	5.9
Nitrite as N	mg/L	0.043	<0.005	<0.005	0.011	0.041
Ammonia as N	mg/L	0.023	0.027	0.015	0.026	0.038

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Method ID	Methodology Summary
WILAB 18	Total Nitrogen by colourimetric chemistry in accordance to APHA 4500-P B5, 4500-NO3 F
WILAB 18	Total Phosphorus by colourimetric chemistry in accordance to APHA 4500-P B5, E
WILAB 18	Nitrate by calculation
WILAB 18	Nitrite by colourimetric chemistry in accordance to APHA 4500-NO2 B
WILAB 18	Ammonia by colourimetric chemistry in accordance to APHA 4500-NH3 F

QUALITY CONTROL Nutrients in Water	UNITS	PQL	METHOD	Blank	Duplicate Sm#	Duplicate results Base ll Duplicate ll %RPD	Spike Sm#	Spike % Recovery
Total Nitrogen (Total N)	mg/L	0.05	WILAB 18	<0.05	[NT]	[NT]	LCS	107%
Total Phosphorus (Total P)	mg/L	0.01	WILAB 18	<0.01	[NT]	[NT]	LCS	99%
Ammonia as N	mg/L	0.005	WILAB 18	<0.005	[NT]	[NT]	LCS	89%

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ACCREDITED FOR TECHNICAL COMPETENCE

Report Comments:

Australian Drinking Water Guidelines recommend that Thermotolerant Coliform & E.coli levels are less than 1cfu/100mL.
The recommended maximums are taken from "Australian Drinking Water Guidelines", published by NHMRC& ARMC 2004.

INS: Insufficient sample for this test; NT: Not tested; PQL: Practical Quantitation Limit; <: Less than; >: Greater than
RPD: Relative Percent Difference; NA: Test not required; LCS: Laboratory Control Sample; NR: Not requested
NS: Not specified; NEPM: National Environmental Protection Measure

Quality Control Definitions

Blank: This is the component of the analytical signal which is not derived from the sample but from reagents, glassware etc, can be determined by processing solvents and reagents in exactly the same manner as for samples.
Duplicate: This is the complete duplicate analysis of a sample from the process batch. If possible, the sample selected should be one where the analyte concentration is easily measurable.
Matrix Spike: A portion of the sample is spiked with a known concentration of target analyte. The purpose of the matrix spike is to monitor the performance of the analytical method used and to determine whether matrix interferences exist.
LCS (Laboratory Control Sample): This comprises either a standard reference material or a control matrix (such as a blank sand or water) fortified with analytes representative of the analyte class. It is simply a check sample.
Surrogate Spike: Surrogates are known additions to each sample, blank, matrix spike and LCS in a batch, of compounds which are similar to the analyte of interest, however are not expected to be found in real samples.

Laboratory Acceptance Criteria

Duplicate sample and matrix spike recoveries may not be reported on smaller jobs, however were analysed at a frequency to meet of exceed NEPM requirements. All samples are tested in batches of 20. The duplicate sample RPD a matrix spike recoveries for the sample batch were within laboratory acceptance criteria.

Duplicates: <5xPQL - any RPD is acceptable; >5xPQL - 0-50% RPD is acceptable.
Matrix Spike and LCS: Generally 70-130% for inorganics/metals; 60-140% for organics and 10-140% for SVOC and Speciated Phenols is acceptable.
Surrogates: 60-140% is acceptable for general organics and 10-140% for SVOC and Speciated Phenols.

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APPENDIX E

Flow Paths



Legend

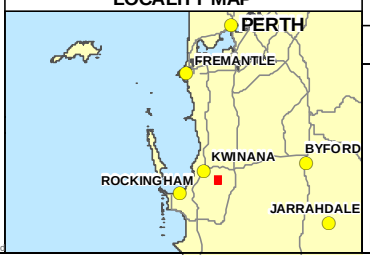
- Site Location
- Site Layout
- Catchment Divide
- Flow Direction

0 25 50 100 150 200

Metres
1:5,000 @ A4

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

LOCALITY MAP



a10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360
f (08) 9381 2360
www.360environmental.com.au

DRAWING ID	DATE
277_1year_event.mxd	25-Feb-2014

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
CS	RP	SB	0

Satterley Property Group/ Department of Housing

Local Water Management Strategy

Figure 1 - 1 Year Event Plan

- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2013
- LOCALITY MAP SOURCED FROM LANDGATE 2006
- COSSILL & WEBLEY DATA PROVIDED

SLIP ENABLER

K:\Admin\Templates\New_A4L.mxd

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Legend

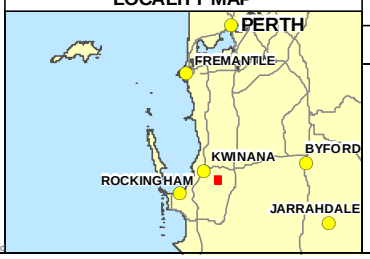
- Site Location
- Site Layout
- Flow Direction
- Catchment Divide
- Inundated Areas

0 25 50 100 150 200

Metres
1:5,000 @ A4

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

LOCALITY MAP



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f (08) 9381 2360
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DRAWING ID	DATE
277_5year_event.mxd	25-Feb-2014

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
CS	RP	SB	0

Satterley Property Group/ Department of Housing

Local Water Management Strategy

Figure 2 - 5 Year Event Plan

- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2013
- LOCALITY MAP SOURCED FROM LANDGATE 2006
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Legend

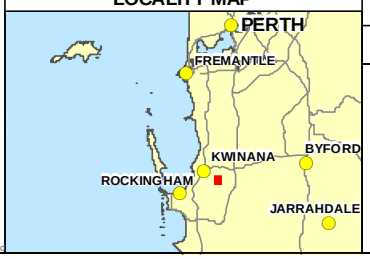
- Catchment Divide
- Site Location
- Flow Direction
- Site Layout
- Inundated Areas

0 25 50 100 150 200

Metres
1:5,000 @ A4

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

LOCALITY MAP



360 ENVIRONMENTAL
a10 Bermondsey St, West Leederville, 6007 WA
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www.360environmental.com.au

DRAWING ID	DATE
277_100year_event.mxd	26-Feb-2014

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
CS	RP	SB	0

Satterley Property Group/ Department of Housing

Local Water Management Strategy

Figure 3 - 100 Year Event Plan

- AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2013
- LOCALITY MAP SOURCED FROM LANDGATE 2006
- COSSILL & WEBLEY DATA PROVIDED

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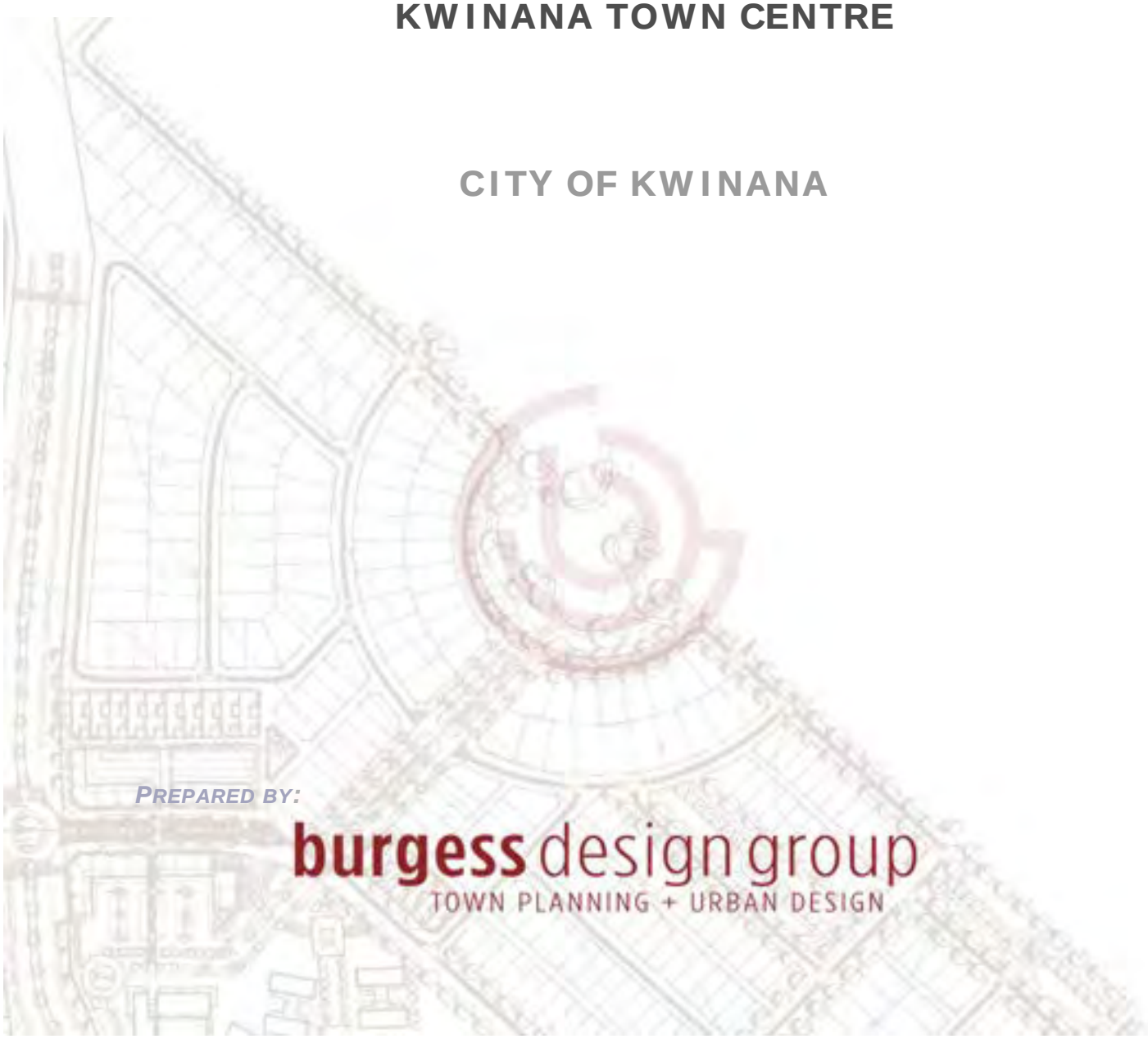
APPENDIX 7
Fire Management Plan

CHALLENGER PRECINCT FIRE MANAGEMENT PLAN

LOT E26 GILMORE AVENUE, LOT 303 & 9036 WELLARD ROAD AND PT. WELLARD ROAD – ROAD RESERVE,

KWINANA TOWN CENTRE

CITY OF KWINANA



PREPARED BY:

burgess design group

TOWN PLANNING + URBAN DESIGN

LOT E26 GILMORE AVENUE, LOT 303 & 9036 WELLARD ROAD AND PT. WELLARD ROAD - ROAD RESERVE, KWINANA TOWN CENTRE

CITY OF KWINANA

Challenger Precinct
Fire Hazard Assessment

ISSUE 4: March 2014

Prepared for: **SATTERLY PROPERTY GROUP**
DEPARTMENT OF HOUSING
CITY OF KWINANA

Prepared by: Burgess Design Group
101 Edward Street, Perth, 6000
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Email: reception@burgessdesigngroup.com.au

Project Planner: J.Drummond
Job code: SAT KWI
File reference: 140106RLGA_Fire Management Plan (V.3)
Revision No: 3

Quality Assurance

Issue/Version:	Date:	Author:	Reviewer:
1	08.04.2013	B.Foley	J.Drummond
2	01.06.2013	J.Drummond	City of Kwinana
3	20.12.2013		J.Drummond
4	24.03.2014		J.Drummond

DISCLAIMER

Any representations, statements, opinions and advice whether expressed or implied within this document are based on information contained within the Planning for Bush Fire Protection Guidelines ,Ed. 2, DFES & WAPC (2010), the Australian Standard for the construction of buildings in bushfire prone areas (AS3959-2009), and a desktop analysis of the land undertaken in 2012 & 2013.

Any statements, opinions, representations or advice expressed or implied in this document is made in good faith, and on that basis Burgess Design Group is not liable for any damage or loss whatsoever which may occur as a result of action taken or not taken as the case may be in respect to any statements, opinions, representations or advice referred to in this report.

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Appendix 1 DFES: PREPARE. ACT. SURVIVE (V4: Nov 2012)

Appendix 2 DFES Fire Incident Report

Appendix 3 FMP Checklist (28 October 2013)

1. INTRODUCTION

This Bushfire Management Plan has been prepared at the request of the City of Kwinana to support the implementation of a structure plan over, and guide future development of, land within the Kwinana Town Centre, referred to as the Challenger Precinct and bound by Challenger Avenue to the north, Meares Avenue to the east, Wellard Road to the south and Gilmore Avenue to the west ('subject land' or 'the site').

Generally, a Fire Management Plan takes into account the various physical attributes of the land including its topography, on-site vegetation, local climate, past and current land uses, fire history and land use management practices, road access, water supplies, adjacent property and tenure, and existing and future obligations by various stakeholders such as the local authority and future residents.

This strategic level Fire Management Plan (FMP) has been prepared by Burgess Design Group in accordance with the WAPC/DFES Planning for Bush Fire Protection Guidelines, Edition 2, 2010 (The Guidelines). In particular, this is a strategic level document and subject to review and refinement at the future subdivision stage as per Appendix 1 and model fire management plan, contained within the Guidelines.

This Fire Management Plan (text and Hazard Assessment plan) should be read in conjunction with the structure planning documents for the proposed subdivision/ development of the land prepared by Burgess Design Group, as well as The Guidelines and any current DFES publications.

It should be noted that development of the subject land is subject to an overall subdivision design process and therefore further Hazard Assessments relating to the internal site shall be carried out and implemented as a requirement of subdivision, under the relevant Challenger Precinct Structure Plan. The retention of specific trees and bushland within the subject land is subject to assessment of the preliminary earthwork design associated with the proposed plan of subdivision and it is therefore anticipated that changes to this Fire Management Plan will be required as a result of the subdivision process.

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

- "Planning for Bushfire Protection Edition 2" WAPC (2010);

Other documents that have been prepared for the subject land and relevant to the future subdivision proposal which should be consulted when reading this plan include:

- E26 Challenger Precinct 'Local Structure Plan' Report;
- E26 Challenger Precinct LSP 'Environmental Assessment' Report;
- E26 Challenger Precinct LSP 'Landscape Strategy and Master Plan';
- E26 Challenger Precinct LSP 'Transport and Access Report' ;
- E26 Challenger Precinct LSP 'Servicing and Engineering' Report.

2. AIM

The aim of this Bushfire Management Plan (FMP) is to determine the land capability of the site at the strategic level and to determine any additional considerations that may be required at the future subdivision stage of the subject land.

This Bushfire Management Plan (FMP) addresses potential fire threats on both public and private land external to the subject land and details the fire management methods and requirements that will likely be implemented at later planning stages. The FMP will provide guidance as to how to plan for and manage potential bushfire threat for the future urban development of primarily residential housing.

The FMP has been prepared to ensure measures are incorporated at the subdivision stage which will minimise the risk to future residents or property from bushfires within and near the development area.

This plan addresses issues associated with bushfires within an urban context only. It does not deal with the management of internal residential fires.

Following inspection of the on-site vegetation and landscaping strategy for the site, the site was assessed as having a “Moderate” bush fire hazard rating due to the presence of Woodland vegetation, with the following “Performance criteria” and “Acceptable solutions” which are requiring to be met:

- Location;
- Vehicular access;
- Water;
- Siting of development; and
- Design of development

3. OBJECTIVES

The following objectives are proposed for fire management:

1) identifying risks to life and property posed by bushfires;

2) identifying risks to core functions of public land management and biodiversity conservation posed by bushfires;

3) developing strategies to address the highest risks; and implementing works and activities within reasonable resource requirements to ensure:

- the protection of human life from the threat of fire followed by,
- the protection of critical infrastructure;
- protection of property and economic assets; an
- the protection of environmental and cultural values

These fire protection objectives will be achieved by implementing the fire protection strategies detailed in the following sections. Fire management strategies and activities have been planned and will be carried out in an environmentally sensitive manner given the high value placed on the landscape character of the Challenger Precinct and the desire to preserve the natural land form and significant vegetation.

4. DESCRIPTION OF THE AREA

4.1 General

This Fire Management Plan applies to the Kwinana Town Centre zone, Challenger Precinct site, located in the suburb of Kwinana Town Centre. The site is bound by Challenger Avenue to the north, Meares Avenue to the east, Wellard Road to the south and Gilmore Avenue to the west, approximately 35 Km south of the Perth CBD and directly south of the Kwinana Marketplace Shopping Centre. Refer to **Figure 1** for a Location Plan.

The subject land comprises all landholdings within 100 of the Challenger Precinct site.

4.2 Land Use

Development of the subject land is subject to the land uses prescribed within the Challenger Precinct Local Structure Plan. Under the LSP, development proposes primarily residential land uses allowing for the creation of approximately 650 dwellings, mixed commercial residential uses along Challenger Avenue and 6 relatively large Public Open Space (POS) areas spread throughout the site.

The LSP is based on a logical and permeable network of streets. Higher residential densities are envisaged in those areas with higher amenity such as opposite areas of POS and to the north of the site, where mixed use and medium-high density development is proposed to support the existing and future commercial uses, and to take advantage of access to the Kwinana bus station. Refer **Figure 2** for the Local Structure Plan.

Surrounding the site, to the east and west, adjoining development is low density residential, generally characterised by curvilinear streets. The Kwinana Market Place is located to the north and the Peter Carnley School to the south.

4.3 Climate

When, where, whether and how a bushfire burns is influenced by daily weather and the seasonality of rainfall at any location, being a reflection of climate (Handmer *et al*, 2008). Wind, temperature, humidity and rainfall are all climatic elements that affect the behaviour of bushfires (Bureau of Meteorology, retrieved September 2013).

Perth has a mixture of the Californian and Mediterranean climates, characterised by mild winters and hot dry summers. Throughout the Perth metropolitan area, the bushfire season typically starts in December and runs through to April, between late spring and early autumn when fuels have dried after the winter rains (Bureau of Meteorology, retrieved September 2013). The amount of rain in preceding months affects the amount of dry grasses; influencing fire seasonality, fuel loads and condition (Handmer *et al*, 2008). If good spring rains have resulted in abundant plant growth, sunshine and high temperatures rapidly dry timber and grass (fuel) which burn very quickly and can make late summer grass fires intense.



Illustration 1. Australia's bushfire seasons (Bureau of Meteorology, 2013)

4.3.1 *Temperature and Rainfall*

Rainfall statistics from the nearby Medina Research Centre (being the closest research station), indicates the Kwinana area experiences an average annual rainfall of 760mm across 114 days each year. Over the summer months (December to January), it rains on average between 2 to 4 days each month with maximum temperatures averaging around 30° but potentially reaching up to 45° (Monthly Climate Statistics, Medina Research Centre http://www.bom.gov.au/climate/averages).

By world standards, Australia has a low and very unreliable rainfall and dry spells create a high fire risk. Low relative humidity, high winds and lack of rain all contribute to increased fire danger in the region (http://www.bom.gov.au/weather-services/bushfire/about-bushfire-weather.shtml#weather).

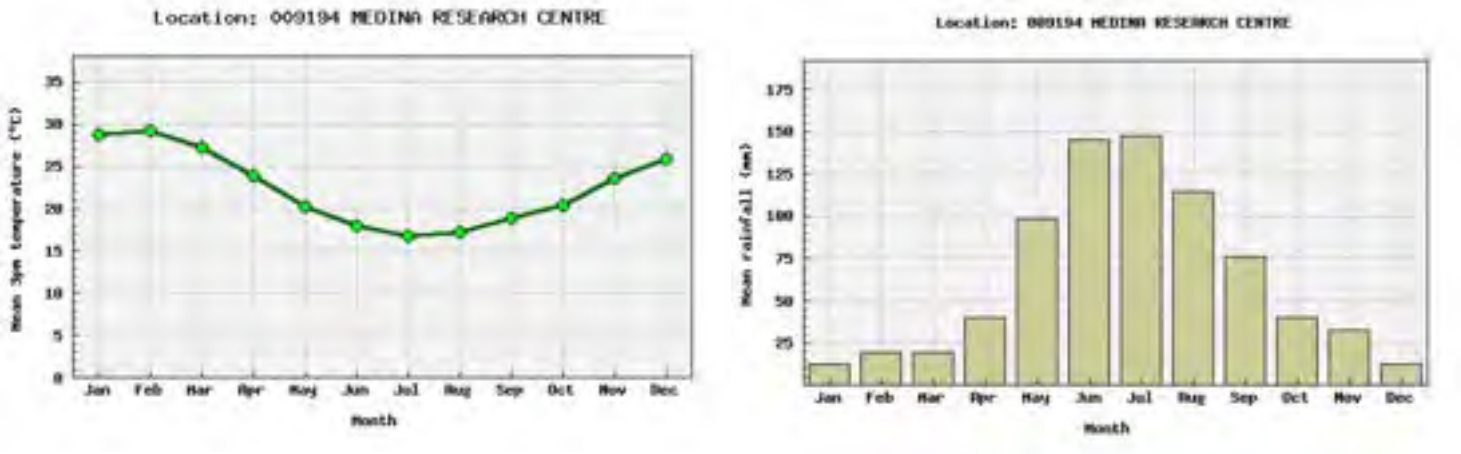


Illustration 2. Annual Temperature and Rainfall Statistics for Kwinana

4.3.2 Wind

Wind is also an important factor in bushfire behaviour as it influences the rate of spread of the fire front and spreads burning embers / sparks, providing ignition sources for spot fires ahead of the main fire front. As shown in the below illustration, likely wind patterns taken from the climatic statistics for the Kwinana area indicate that in the mid-summer months, wind patterns change from light (south) easterly winds in the morning to stronger south westerlies in the afternoon (Wind Rose, Medina Research Centre http://www.bom.gov.au/climate/averages).

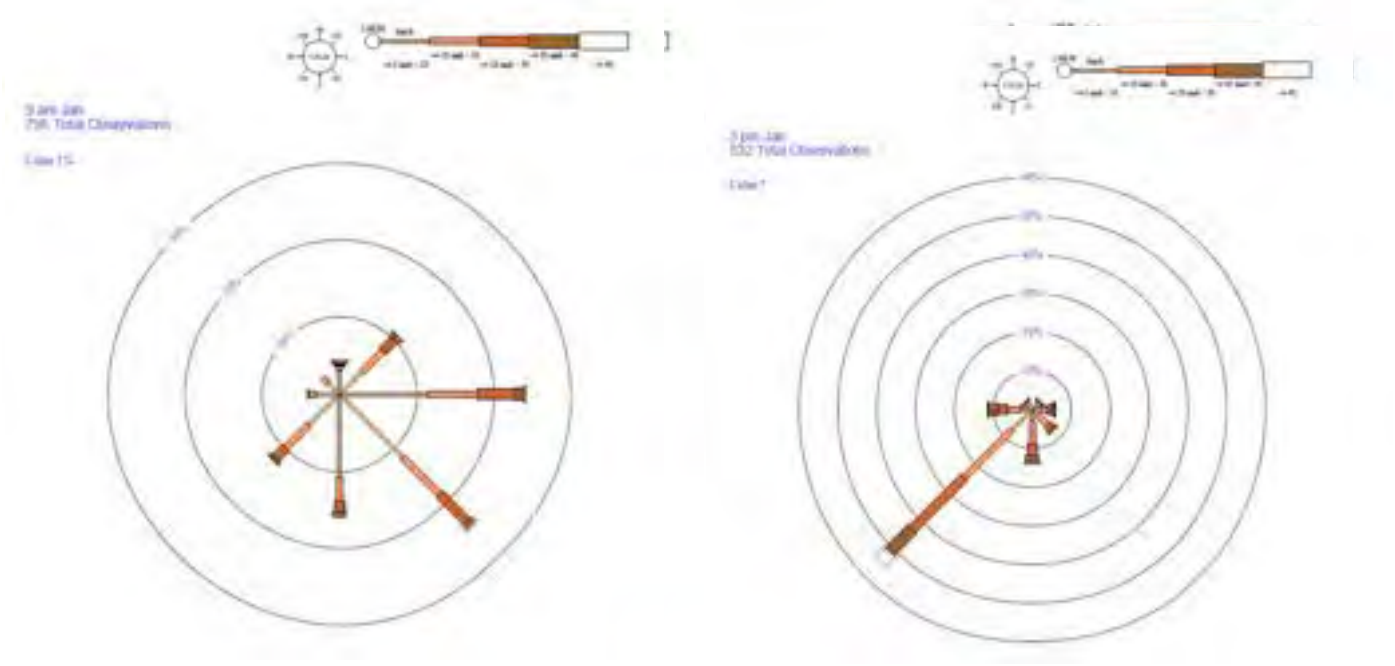


Illustration 3: Wind Rose, January 9am and January 3pm (Medina Research Centre, Bureau of Meteorology)

Fire intensity and vulnerability is not however influenced by climate and weather variables alone, but also vegetation types, soil moistures, fuels, topography and the interactions between all those factors.

4.4 Topography

Slope is a critically important factor when assessing fire risk and likely fire behaviour as the rate at which a fire can spread increases as the angle of the slope of the land increases. The rate of progress downslope tends to slow at a corresponding rate however wind direction can be unpredictable and can cause fires to change direction unpredictably.

A slope analysis plan and contour mapping has been prepared in accordance with the WAPC Guidelines for surrounding landholdings which contain potentially hazardous vegetation types to determine the rate and intensity of potential fires (refer **Figure 7**).

The development site's existing topography features an undulating surface with ground levels ranging between approximately seven metres (m) Australian Height datum (AHD) and 13.5mAHD. The existing contours vary across the site from a high point at the central western area of site to low points to the south and in the north-east. The site levels are consistently between approximately 10m and 11m around its perimeter, levels fall away from the adjacent road reserves into the site prior to rising near its centre. Preliminary earthworks designs

undertaken on the proposed subdivision layout will ultimately modify the natural topography of the site, to an extent.

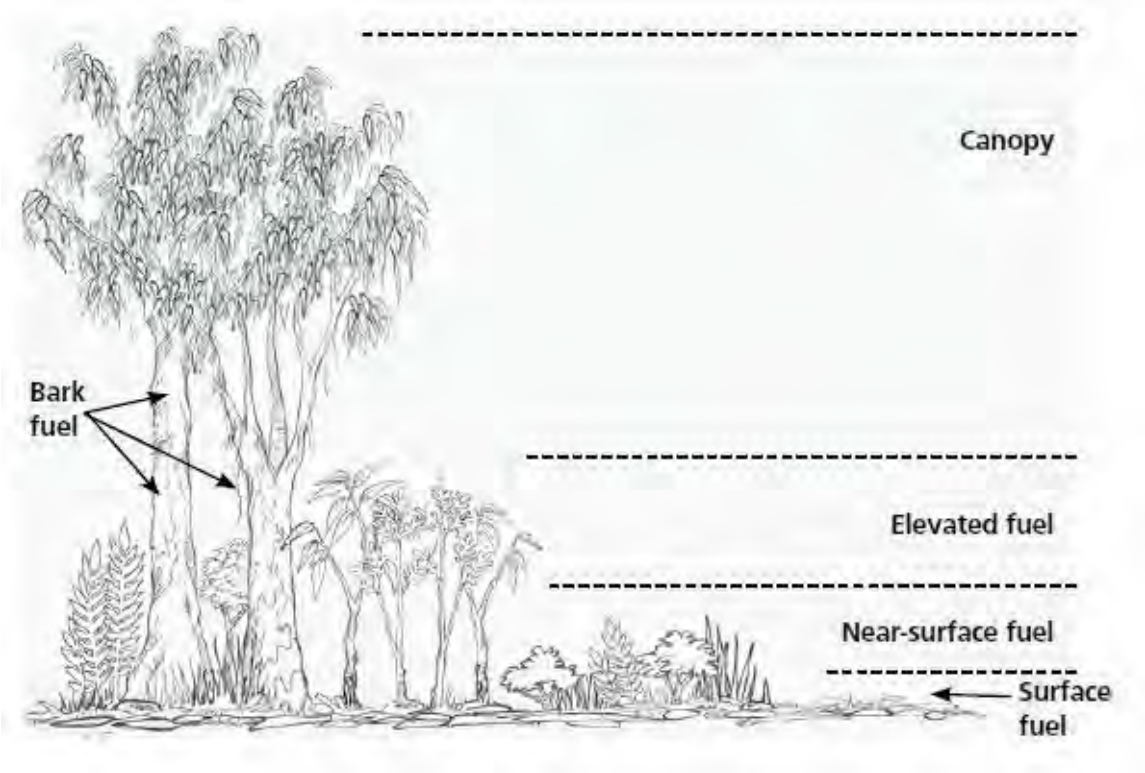
This Fire Management Plan therefore provides an assessment of bush fire hazard at the strategic level only, as per Appendix 1 of the WAPC Guidelines, and therefore does not deal with the internal development of the site.

An addendum to this FMP will need to be prepared at subdivision and will determine hazards based on earthworked levels of the site and will take into consideration detailed landscaping design and areas of bushland being retained within the development. A separate slope analysis will need to be prepared once final site levels have been determined, particularly within future areas of POS.

4.5 Bushfire Fuels

Bushfires are generally classified according to the dominant vegetation (called fuel) in which they are burning (CSIRO, retrieved September, 2013). In Australia, there are four broad fuel layers identified for measuring the intensity of fuel, these are:

- **Surface fuel**, or litter, consists of horizontally layered surface litter such as dead leaves, twigs and the loose bark from both overstorey and understorey plants ;
- **Near-surface fuel** consists of both horizontal and vertical fuel components made up of grasses, low shrubs and collapsed understorey, and can also support surface fuels above the ground;
- **Elevated fuel** comprises shrub and other understorey plants, generally vertical in orientation and includes both live and dead material; *and*
- **Bark** fuel is the bark on tree trunks and branches.



Illustraition 4. Fuel Layers (Victorian Government, 2010)

As per the methodology set out under the WAPC Planning for Bushfire Protection Guidelines, vegetation class must first be determined and characterised to identify fuel hazards, and to assess the overall bushfire hazard. Importantly, the Guidelines note (Table 1) that in Western Australia:

> *"Overstoreys of 'Open Woodland', 'Low Open Woodland', 'Tall Open Shrubland' and 'Low Open Shrubland' should be classified to the vegetation type on the basis of their understoreys. Vegetation height is the average height of overstorey vegetation*".

As such a vegetation class map has been prepared for surrounding landholdings for a minimum distance of 100m, which can be found at **Figure 6** and is described under Section 4.5.2 below.

This strategic FMP assessment has been carried out in accordance with Table 1 and Figure 1 (illustration 5 below) of the WAPC Guidelines, to identify which vegetation types predominate in the bushfire hazard assessment area and to determine the bushfire hazard rating for the subject land.

Combustible fuel is a critical element in bushfire risk management, as it is the one factor relating to fire behaviour that can be managed. An overall Fuel Hazard for vegetation on the land within and adjoining development site can be determined using the WAPC Planning for Bush Fire Protection Guidelines vegetation type and class guide (Table 1 and Figure 1).

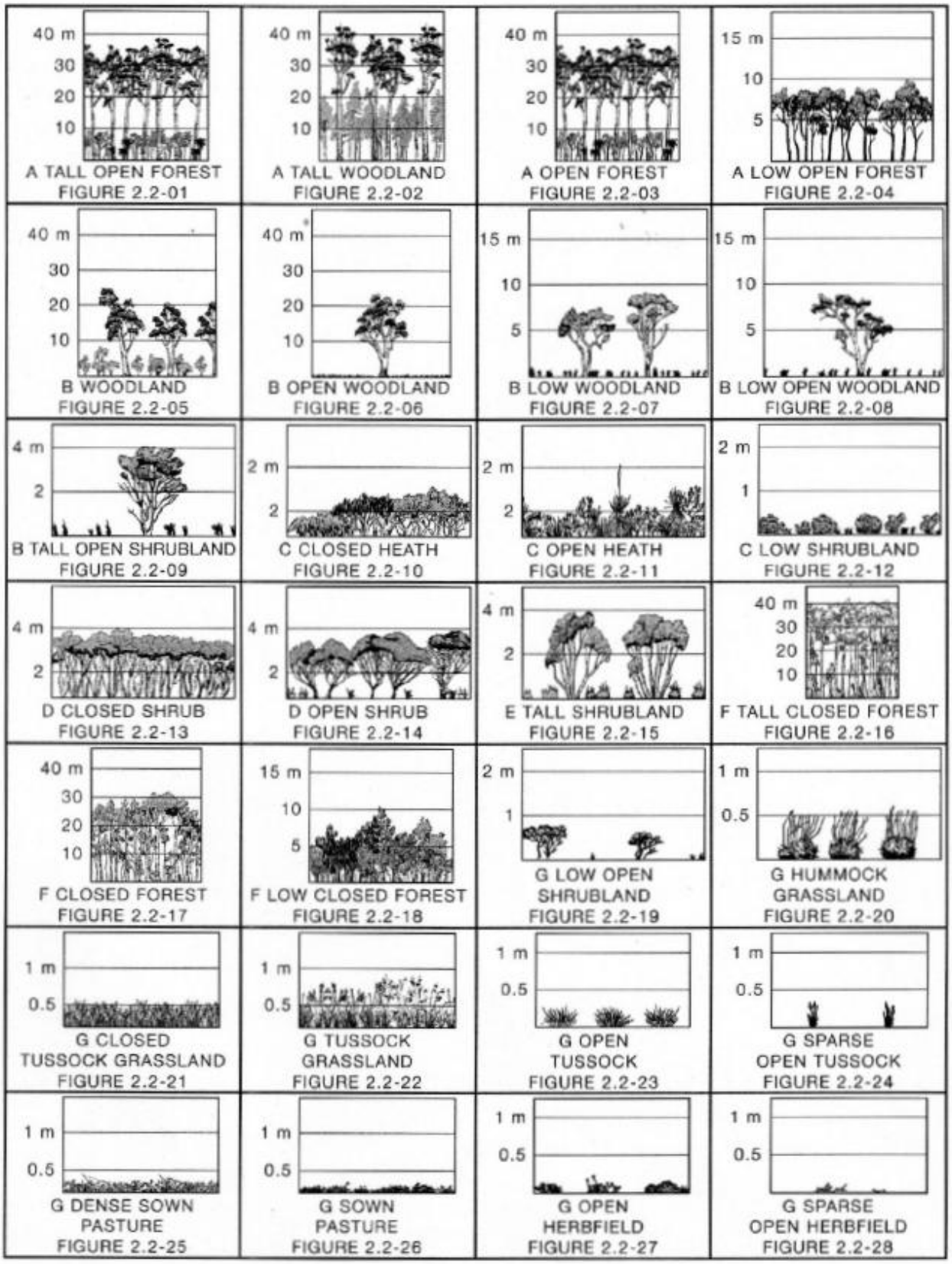


Illustration 5. Vegetation type and class description (WAPC Guidelines Ed2, 2010 Figure 1.)

4.5.1 On-site Vegetation Assessment

The Environmental Assessment carried out by 360Environmental provides an overview of the vegetation within the subject land and along its periphery. Four broad vegetation groups are identified at the site: Jarrah Banksia woodlands; Tuart open woodlands; Marri woodlands; and finally shallow limestone shrublands.

The majority of vegetation on site is proposed to be cleared to enable the built form of the subdivision. However, within the Structure Plan Area the Draft Landscape Master plan indicates that some areas of existing vegetation will remain, particularly within POS areas 2, 3, 5 and 6 (refer **Figures 2 & 3**). The vegetation within these areas is classified as Woodland – Vegetation Class B as prescribed in Figure 1 of the WAPC Guidelines.

While other areas of POS include open kick about and recreation areas, the periphery of these sites all depict street tree planting at intervals of about 10m apart. Given these areas would be managed and irrigated, and that these parklands best corresponds with the Low Woodland/ Open Woodland Vegetation Class, in accordance with Table 1 of the Guidelines, Grassland (Class G) should be classified for these parkland areas based on the understorey of the vegetation type.



Image 1. On-site Vegetation

Whilst the subject land has not been significantly cleared since 1953, the site will change significantly from its current form of undeveloped, uncleared bushland to a new residential development with pockets of bushland managed in areas of Public Open Space. Refer to Appendix # (Landscape Master Plan) to identify areas of bushland proposed to be retained. A separate Fire Management Plan will need to be prepared at subdivision stage to assess any on-site bush fire hazards and potential risks.

Further management of POS areas within the development will need to be addressed at the subdivision stage once detailed landscaping plans and engineering plans have been carried out and an accurate assessment of the vegetation types, fuel types and contours being retained are known.

4.5.2 Off-site Vegetation Assessment

Some vegetation that exists within 100m of and outside the subject site, which should be considered as part of the FMP (refer to **Figure 6**), is described below:

1. South of the site, across Wellard Road:

Conservation Category Wetland and remnant bushland vegetation exist within Reserve 50531 and within Lot 386. These areas are classified as Woodland, being Vegetation Class B under the WAPC Guidelines.



Image 2. Reserve 50531 Wellard Road and Revegetation Area



Image 3. Reserve 50531 view from Henley Boulevard



Image 4. Lot 386 (Peter Carnley School) Wellard Road

Vegetation south of Wellard Road consists of unmanaged surface fuels, near-surface fuels and elevated fuels which therefore poses a Moderate to Extreme bushfire hazard to the subject land.

2. East of the site, across Meares Avenue:

Two areas of Public Open Space areas are located to the east of and within 100m of the subject land. The first POS area being Reserve 40380, located towards the southern end of Meares Avenue. This parkland falls within an existing suburban area and is mostly devoid of standing native vegetation.

Reserve 40380 has little to no surface fuel or elevated fuel and therefore poses a Low bush fire hazard rating based on a predominant vegetation type of Grassland (Class G).



Image 5. Grassland vegetation at Reserve 40380 Meares Avenue.

The second POS area (reserve 36852) is located at the corner of Tristram Garden and Meares Avenue. While this land is parkland cleared and irrigated, significant stands of trees spaced less than 10m apart remain. This land is therefore classified as Low Woodland (Vegetation Class B as prescribed in Figure 1 of the Guidelines).



Image 6. Tristram Park, Reserve 36852 Meares Avenue

In accordance with Table 1 of the Guidelines, Low Woodland should be classified based on its understorey, in this case being managed grassland with no surface or elevated fuels and therefore poses a Low bushfire hazard rating.

3. North of the site, across Challenger Avenue.

Lot 6 Challenger Avenue, located next to the Gull Petrol Station, is an undeveloped area of land within the Kwinana Town Centre. This land is parkland cleared and whilst not irrigated, is managed by regular mowing and through the removal of fallen branches.



Image 7. Lot 6 Challenger Avenue.

Land within Lot 6 can be classified as Open Woodland (Vegetation Class B) although poses a Low risk as prescribed Grassland under Table 1 of the WAPC Guidelines. It is further understood that Lot 6 is subject to a separate development application currently being assessed by the City of Kwinana for a bulky goods commercial complex. Should this development go ahead, any risk will be removed completely with the clearing of this vegetation.

4. West of the site, across Gilmore Avenue

There are two areas of undeveloped landholdings and one area of Public Open Space within 100m of the western boundary of the subject land that need to be taken into consideration when looking at potential hazards.

Lot 257 Wellard Road, Calista is located towards the south west of the site, at the corner of Gilmore Avenue. This landholding remains undeveloped and is mostly devoid of standing native trees within the 100m setback to the subject site. Lot 257 therefore can be classified as Grassland (Type G) under Table 1 of the WAPC Guidelines and poses a Low bushfire hazard.



Image 8. Lot 257 Wellard Road

Rhodes Park, located directly west of the subject land along Gilmore Avenue is an area of Public Open Space with parkland cleared stands of native trees and a large kick-about area. The outer edges of the POS area can be classified as Open Woodland under the WAPC Guidelines and there is a dual use pathway that separates the park from Gilmore Avenue.



Image 9. Rhodes Park, Gilmore Avenue



Image 10. Gilmore Avenue and Rhodes Park interface

As Rhodes Park is irrigated and managed by the City of Kwinana and has little to no surface or elevated fuels, the vegetation type can be classified according to its Grassland understorey, as per Table 1 of the Guidelines; Grassland vegetation poses very little bushfire threat and Rhodes Park is therefore classified as having a Low bushfire hazard rating.

Towards the northern end of Gilmore Avenue is Lot 98 Isaac Way in Calista. This landholding remains undeveloped and consists of mainly managed grasslands with very limited native standing vegetation. This area can be classified as Low Open Woodland under the WAPC Guidelines and given its grassy understorey, is considered as being of a Grassland vegetation classification (Type G) under Table 1 of the Guidelines. This landholding therefore poses a Low bushfire hazard rating.



Image 11. Lot 98 Isaac Way, Calista

4.6 Assets

The City of Kwinana has identified the Challenger Neighbourhood as an area of natural bush land which has contributed for a long time to the special landscape character of Kwinana. Whilst it's development is inevitable, careful design of the patterns and forms of development means that the natural bush land quality of the area, including significant stands of natural vegetation and mature specimen trees, have been preserved wherever possible (http://www.kwinana.wa.gov.au/Images/Revised-Town-Centre-Strategy-Plan-Design-Guideline.aspx).

Whilst the site is currently used recreationally by local residents, a search of the Aboriginal Heritage and European Heritage databases shows nearby sites of Aboriginal heritage of significance however, there is no reported culturally significant heritage within the subject land.

The subject land is located opposite the existing Kwinana Marketplace Shopping Centre on the northern boundary of the site and abutting Challenger Avenue with predominantly established low single residential developments to the east, south and west of the site. Once developed, the values which will be potentially affected by fire include:

1. **Human lives:** It is likely that some 1000+ people could be resident at the newly created subdivision;
2. **Assets**: The development will contain dwellings and valuable public infrastructure such as playground equipment and parkland facilities, streetscape landscaping, roads and road signage, service provisions (refer to Challenger Precinct Landscape Strategy, Transport Assessment and Servicing Assessment reports); and
3. ***Environmental Conservation Values****:* retained bushland and native landscaping within Internal POS areas.

Figure 3 (Landscape Strategy) and **Figure 4** (Aerial) highlight key assets within the area.

4.7 Access

The existing principal infrastructure in the vicinity includes:

- Gilmore Avenue, which is a four lane divided road and categorised as a District Distributor (A) within Main Roads Western Australia's (MRWA) Functional Road Hierarchy. Gilmore Avenue borders the site to the west.
- Challenger Avenue, which is a two lane divided road bordering the site to the north is classified as a District Distributor (B) within the Functional Road Hierarchy and is classed a local road in the MRS. It provides access to the adjoining Market Place and intersects with Gilmore Avenue at a give-way controlled T-junction. Turning movements from Challenger Avenue are restricted to left turns.
- Wellard Road is a two lane divided road and classified a District Distributor (A) and abuts the site to the south.
- Meares Avenue is a two lane undivided road, classified a Local Distributor and abuts the site to the east.

There are numerous proposed points of ingress to/ egress from the site (refer **Figure 5**). In particular, there is anticipated to be a high degree of connectivity between the subject site and Challenger and Gilmore Avenue. In total there are nine access points into the site, with three off the accesses from Gilmore Avenue, one from Wellard Road, two from Challenger Avenue and four from Meares Avenue.

The planned internal street network is sufficiently permeable to allow good site access and traffic circulation. The network incorporates a north-south and east-west Neighbourhood Connector, and a permeable network of local access streets and laneways. Internal street layout and points of egress/ ingress are shown in **Figure 5**.

4.8 Water Supply

Water Corporation of WA has made provision for water supply to the subject site in its planning for servicing. The site has existing 300mm distribution mains and 150mm reticulation mains located within both Meares Avenue and Challenger Avenue adjacent to the site. Water supply to the Development area will be via the extension of water reticulation from these adjacent road reserves.

The Developer is to install fire hydrants in accordance with the specifications of the Water Corporation. All fire hydrants will be road marked and sign posted to a standard acceptable to the Department of Fire and Emergency Services and the City of Kwinana.

The Water Corporation's No.63 Water Reticulation Standard' is deemed to be the baseline criteria for development. Fire Hydrants are to be located to the satisfaction of DFES and the Water Corporation at time of subdivision.

Future subdivision of the subject land will have a Condition of Approval imposed by the WAPC to comply with State provisions for water supply, and installed as set out in the Guidelines.

5. FIRE PROBLEM

Bushfires can occur every summer; they can start suddenly and without warning. People have been killed or seriously injured, and many homes destroyed due to bushfires. The preparedness and behaviour of residents, and the local community as a whole, forms the most important part of bush fire management. Residents need to understand the risks to both family and property before a bushfire starts; this is so that they can make well informed decisions on how to make their property safer and how to safely manage both their family and property during a bushfire.

Residents who live in areas which may be exposed to bush fires must take responsibility to manage bushfire risk. Responsible bushfire management includes many aspects; which include but is not limited to: being well informed about bushfire risk and management; leaving well before an area is affected by a bushfire or actively protecting a property; being able to deal with small fires; adequately maintaining a property; and wearing appropriate protective clothing.

Land use planning, development controls and building standards have a central role in reducing the risk to people and property from bushfire. Modification of elements of the landscape is an important means of reducing risks to assets. Among the objectives of landscape modification are reducing the probability of a bushfire starting, slowing its spread, limiting its intensity so that it might be controlled, and maintaining ecological processes and biodiversity. Strategically planned and effectively implemented fuel reduction, is the primary means of risk reduction (http://coagbushfireenquiry.gov.au/report/summary.htm)

5.1 Bush Fire History

According to the Department of Fire and Emergency Services (DFES), due to the nature of the area and the Incident Reporting style of the time, it is difficult to identify Incidents for the precise location prior to around 2006.

However, the Fire Incident Report provided for Lot E26 indicates a long history of small scale landscape fires (<3 ha) both accidental and suspicious or deliberately lit fires, particularly ignition of illegally dumped rubbish and vehicles.

There have been a total of 24 reported incidents over the past 5 years (since 2009). The most recent fire on record was an accidental landscape fire affecting approximately 1ha of the site on 5th March, 2013.

A copy of the Fire Incident Report is attached at Appendix 2.

5.2 Bush Fire Risk

A fire can be determined as starting where bushland exists. Land use planning, development controls and building standards have a central role in reducing the risk to people and property from bushfire. Modification of elements of the landscape is an important means of reducing risks to assets. Among the objectives of landscape modification are reducing the probability of a bushfire starting, slowing its spread, limiting its intensity so that it might be controlled, and maintaining ecological processes and biodiversity. Strategically planned and effectively implemented fuel reduction, is the primary means of risk reduction (COAG, 2004).

Residents who live in areas which may be exposed to bush fires must also take responsibility to manage bushfire risk. Responsible bushfire management includes many aspects including, but is not limited to:

- being well informed about bushfire risk and management;
- leaving well before an area is affected by a bushfire or actively protecting a property; *and*
- adequately maintaining a property.

Given the subject site will change significantly from its current form of undeveloped, uncleared bushland to a new residential development with pockets of bushland managed in areas of Public Open Space, it is difficult to determine and assess the likelihood of a high intensity fire starting on site. However, there is enough fuel within the adjoining reserve south of Wellard Road to sustain fire on days of high, very high or extreme fire danger or under severe conditions, which may reach the site if there is a southerly wind behind it. Additionally, a bushfire could be caused by a summer electrical storm or by arson within retained areas of bushland in Public Open Space areas internal to the development.

The risk of a bushfire occurring from within the new development will decrease substantially following development and subdivision, as earthworks will modify levels across the site and existing bushland will largely be replaced by houses and gardens. Future development will remove the risk of bushfire attack substantially however, the site remains exposed to some level of risk from a fire occurrence spreading across the vegetation within the site's POS areas and from surrounding sites to the south across Wellard Road.

Fuel is a critical element in bushfire risk management, as it is the one factor relating to fire behaviour that can be managed. Dry fuel will burn quickly, but damp or wet fuel may not burn at all. As a consequence, the time since rainfall and the amount of rain received is an important consideration in understanding risk and assessing bushfire hazard.

5.3 Bush Fire Hazard

The main fuel for a bushfire comprises vegetation, litter and debris that accumulates on the ground. The type and extent of fuel on the ground depends on the type of vegetation that produces the fuel. The level of hazard also depends on fuel continuity (horizontal and vertical), height, amount (weight), proportion of dead material, thickness of the foliage and twigs, and flammability of the live foliage (McCarthy *et al*, 2010).

A strategic level Bushfire Hazard Assessment has been prepared for the subject land and is located atFigure 8. Depending on the predominant vegetation (type and class), fuel load (in tonnes per hectare) and the slope of the land, bush fire hazard levels designated as low, moderate or extreme are applied to different locations surrounding the subject site, in accordance with the WAPC Guidelines.

A separate Bushfire Hazard Assessment will be prepared at time of subdivision to determine any additional hazards within the development site; when areas and extent of natural bushland being retained is known.

The strategic hazard assessment (**Figure 9**) provides a measure of the fire intensity and likelihood of fire attack measures on future subdivision from external areas (Planning for Bushfire Protection, Edition 2, 2010). This measure can provide an assessment of the land for suitability for residential uses and takes into account:

1. Vegetation Assessment – type and class in each direction;

2. Distance - between the predominant vegetation class and proposed building;

3. Topography and slope – with reference to accessibility; and

4. Land use – surrounding and internal to the proposal.

5.4 Calculating Fire Risk:

5.4.1 Internal development

The Fire Hazard within the proposed subdivision will be assessed as being a suburban area with some areas of retained bushland and native tree cover with slopes generally less than 5°. The majority of the subdivision would be rated as "Low" as there is substantial areas of managed grassland and urban housing. The proposed POS areas internal to the subdivision site are to be landscaped however some sites will retain areas of natural bushland.

The overall rating of the internal fire risks for the site will be determined at subdivision stage.

At subdivision stage, the extent and type of vegetation within the subject site will be classified in accordance with the criteria as set out under the WAPC Guidelines 'Planning for Bushfire Protection'.

5.4.2 External to the development

Strategic level assessment - Any area of Open Space or Bushland within 100m of the subject site has been subject to Bushfire Hazard Assessment. Majority of surrounding land uses are considered to pose a low risk as they are generally inner suburban areas with limited native vegetation and maintained gardens as per Appendix 1 of the WAPC Guidelines. Some area of Public Open Space and undeveloped land surrounding the site have also been assessed as posing a low risk due the nature of vegetation on site (being grassland understorey) or being devoid of standing native vegetation.

Bushland within the properties across Wellard Road, south of the subject land, have been classified as Woodland (Type B) with areas of Open Woodland and Tall Open Shrubland. Woodland areas pose an extreme fire risk whereas the Open Woodlands and Tall Open Shrublands pose a moderate fire risk to properties at the southern end of the site.

Setback of development from the risk - The setback of development from the identified areas of risk varies within the structure plan area. The Bushfire Hazard Assessment atFigure 8 depicts the setback of development to areas of classified vegetation and identifies those lots within the 100m hazard separation zone.

Average uphill slope from the risk to development - The average uphill slope of the classified vegetation has been determined by carrying out a slope analysis (refer **Figure 7**) of the topography of the vegetation within 100m of the subject site. Cross-sections have also been prepared to determine whether development is upslope or downslope from vegetation (refer Figure 8). Based on preliminary earthwork designs, it is assumed that development will be uphill from classified vegetation surrounding the site.

5.4.3 *Calculating the Bushfire Attack Level (BAL)*

All dwellings within 100m of classified vegetation posing a moderate or extreme risk are subject to Bushfire Attack Level requirements and will require notifications to be placed on Titles. Indicative BAL ratings have been determined at the strategic level to identify those lots likely to be subject to BAL at development.

As setbacks vary across the Structure Plan area, no single BAL is likely to be applicable to the land. The exact location of development within future lots, and the extent of landscaping will also have an impact on the BAL of each single lot development.

However, given that the siting of development in the BAL-FZ and BAL-40 zone is not recommended by DFES and the WAPC, the Maximum BAL that will be permitted is BAL-29.

The bushfire hazard assessment contained at Figure 8 identifies indicative BAL levels as a result of classified vegetation within 100m of the subject land, as outlined under Section 4.5.2 above.

5.4.4 *Minimum construction standards*

In order to comply with the Guidelines, some lots will be required to reduce the threat of a bushfire by way of constructing dwellings to a higher standard. This standard is known as Australian Standard AS3959. AS3959 will ensure future dwellings meet an acceptable construction standard within a determined setback to classified vegetation. This will be based on the requirements to meet BAL-12.5, BAL-19 and BAL 29 levels for lots abutting or adjacent to classified vegetation (**Figure 6**) and as shown on the Bushfire Hazard Assessment at Figure 8.

It should be noted that these indicative locations will vary depending upon the location of development within the lot. A site assessment must therefore be undertaken at the time of subdivision and lodged with the City of Kwinana to confirm the BAL of the development and the minimum construction standards required.

A notification on the title to all lots subject to AS3959 will alert future owners to the higher development standard required on those lots, as a result of the increased bush fire risk. In addition to the notifications, specific dwelling requirements will need to be highlighted on a Detailed Area Plan.

6. FIRE MITIGATION STRATEGIES / RISK REDUCTION

The fire hazard management strategy is based on:

- the sources and location of fires, fire risk and the distribution of fire hazard;
- land use (current or intended statutory use and tenure) within, and adjacent to, the planning area boundary;
- fire origins and causes;
- topography;
- fuels/vegetation types/ecological vegetation classes;
- significant areas of housing, or other private or community improvements on, or adjacent to, public land;
- existing road and proposed road networks;
- fuel management.

6.1 Bush Fire Hazard Management

The majority of the subject land will be cleared to accommodate residential development, with the exception of some of bushland which is to be retained within public open space areas, and select trees which are to be retained within Public Open Space and Road Reserves.

The areas of public open space which are not to retain natural bushland will be landscaped to a standard established in consultation with the City of Kwinana. It is expected that the landscaped areas will be developed generally in accordance with the draft Landscape Master Plan (Figure 3).

The areas of public open space that retain bushland, both within and external to the subject land, classified as posing a moderate or extreme bushfire risk, will require construction to the current AS3959-2009 standard.

6.1.1 Location

As per the Bushfire Hazard Assessment, future development is located in an area (subject land) where the bush fire hazard level is manageable. The site is appropriately setback from classified vegetation, with Wellard Road acting as a barrier between development and the identified hazard south of Wellard Road. As such, the Structure Plan does not propose any development that requires a construction standard of BAL-40 or higher; as adequate setbacks can be achieved.

6.1.2 Vehicular Access

The site is bound by the public road network on all sides.

The internal layout, design and construction of vehicular access in the local structure plan allows emergency vehicles to move through it easily and safely. All public access streets will be constructed to at least minimum pavement standards of 6m in accordance with Liveable Neighbourhoods and will allow for two-way traffic and conventional two-wheel drive vehicles to travel safely on them.

Vehicle access standards shall apply to this development; these standards are the minimum requirements from Planning for Bushfire Protection Edition 2 (2010) and acceptable from DFES for implementation. These standards shall be included in the engineering design of the subdivision. Separate dedicated Fire Service and Emergency Access is not required as access will be along the established internal roads.

Other Access Considerations

- Only one cul-de-sacs is proposed as part of the Structure Plan design however, it does not exceed 200m in length;
- Battle Axes are not proposed under the Structure Plan design;
- Fire Service Access Ways are proposed along the public road network and therefore do not require further signage to define the access ways;
- Gates for POS will be determined at subdivision;
- Internal fire breaks are not required in an urban landscape.

6.1.3 Water

The subdivision will be provided with a permanent reticulated water supply as per the requirements of the Water Corporation and Department of Water for urban developments. This will ensure water is available to enable life and property to be defended in the event of a bushfire.

Fire Hydrants will be required to be installed by the developer at subdivision stage in consultation with DFES and Water Corporation. Location and spacing is dependant on the level of risk and must meet the following standards:

- Australian Standards approved underground fire hydrants are required; and
- Fire hydrants outlets must be installed to Water Corporation 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 by the Developer.

Refer Appendix 3 of Challenger Precinct Local Structure Plan – Servicing and Engineering Report.

6.1.4 Siting of Development

A Bushfire Hazard Assessment is located at Figure 8. This is a strategic level assessment to determine whether the land is capable of development by taking into consideration external impacts within 100m of the subject land.

The subject land is bound by the public road network on all sides and as such achieves adequate separation from classified vegetation surrounding the site:

- Gilmore Avenue borders the site to the west - a four lane divided road and categorised as a District Distributor (A) and approximately 30m wide;
- Wellard Road borders the site to the south - two lane divided road, classified a District Distributor (A) and approximately 25m wide;
- Meares Avenue borders the site to the east - a two lane undivided road and classified a Local Distributor, approximately 20m wide;

- Challenger Avenue bordering the site to the north - a two lane divided road and classified a District Distributor (B), approximately 20m wide.

Peter Carnley Anglican Community School and local reserve is immediately south of the site. To the east and west, adjoining development is low density residential, generally characterised by curvilinear streets and cul-de-sacs. The Kwinana Town Centre Market Place is located immediately north of the site.

Figure 6 indicates the setback of the development to all classified vegetation and reveals that a minimum setback distance of 20m between future development and classified vegetation can be achieved.

Stage 2 FMP Subdivision

A secondary hazard assessment will be required at subdivision stage and will be based on the subdivision layout of the site, earthwork plans and detailed landscaping design for Public Open Space areas. The subdivision design will need to ensure every residential building is sited a minimum distance from any vegetation classified as a moderate or extreme hazard, in accordance with Table. 2 and will determine Bushfire Attack Levels for each lot.

Hazard Separation Zone - Hazard Separation Zones (HSZ) are defined (as per Planning for Bushfire Protection Edition 2, 2010) as the area surrounding a building which is maintained in a fuel reduced state. The required HSZ for any site is 100m.

This can be achieved at subdivision stage during the construction of roads by clearing for formation of roads and slashing of understorey species. The internal road network will also assist housing to achieve HSZ.

All lots developed for residential use at the interface of remnant vegetation will be required to meet Hazard Separation Zones (HSZ) requirement. Majority of lots will be separated from potential hazards by a public road to assist in achieving minimum hazard separation distances. Where the minimum distance cannot be achieved, a Bushfire Attack Level (BAL) will be calculated and building constructions standards increased as per the current AS3959.

It is recommended by The Guidelines that the Fuel Loads within the Hazard Separation Zone be maintained below 5t/ha.

Building Protection Zone - A Building Protection Zone must also be maintained around all future dwellings and buildings abutting, or adjacent to classified vegetation. This Fire Management Plan requires the following minimum Building Protection Zone requirements to be achieved and maintained at the future subdivision and development stage:

- Minimum width measured from any external wall of a building which corresponds with the setback required under Table 2 of the Guidelines depending upon the Bushfire Attack Level the building is anticipated to be subject to.
- Grass must be maintained below 5 cm in height at all times
- Any tree crowns must be a minimum of 10m apart;
- No tree crowns may overhanging any building;
- No tall shrub or tree is to be located within 2m of a building
- Lower branches of all remaining trees must be trimmed annually.

- All fences and sheds must be constructed of non-combustible material (colour bond, iron, brick, limestone etc)

The exact width of Building Protection Zones will vary depending upon the final location and extent of development on each lot.

The Building Protection Zone for lots abutting Public Open Space will inevitably extend into the Public Open Space reserve in many instances. As landowners cannot control development within the adjacent public open space:

a) The developer must landscape these areas in such a way as to reduce the BAL to adjacent lots to at most the BAL-29 level; and

b) The City of Kwinana must ensure that Public Open Space, as it falls within a Building Protection Zone, is maintained in accordance with the construction standards approved for the adjacent development.

6.1.5 Design of Development

The proposed Structure Plan complies with the Acceptable Solutions criteria for the design of development and results in a low bush fire hazard level at the strategic level.

Vehicular Access is afforded to the subject land by way of the public road network on all sides.

The Local Structure Plan has identified the subject area as being subject, or likely to be subject, to bush fires.

Construction standard that shall apply to the dwellings adjacent to bushland and remnant vegetation will be determined at the subdivision stage however, is shown below in Table 1 – Minimum Setback Distances and Construction Standards. A minimum 20m BPZ must apply to all dwellings, an additional HSZ is required and dictates the BAL construction standard depending on the distance as shown in Table 1.

Some houses/dwellings located along the southern boundary of the Structure Plan will be setback from 'Woodland Vegetation' >100m and will therefore be required to meet current AS3959-2009 standards. Furthermore, some dwellings in more intensive residential areas may also be assessed as having the potential to be shielded from the threat of fire. Shielding can be achieved through careful design and placement of roads, infrastructure and other dwellings to give separation or barriers to fire.

Design of development will be assessed further at subdivision stage.

Distance of dwelling to Vegetation	Vegetation Type	BAL Rating	Construction
17 - <25m Vegetation slope is >0 to 5 degrees and downslope from development	Woodland Type B	BAL 29	AS3959-2009 to apply
25 - <35m Vegetation slope is >0 to 5 degrees and downslope from development	Woodland Type B	BAL 19	AS3959-2009 to apply
35 - <100m Vegetation slope is >0 to 5 degrees and downslope from development	Woodland Type B	BAL 12.5	AS3959-2009 to apply
>100 metres and any slope	All Vegetation	No BAL Rating Required	No construction standards required

Table 1 – Minimum Setback Distances and Construction Standards to achieve maximum BAL

6.2 Fire Fighting Facilities

The subject area is within the City of Kwinana. The closest permanently crewed fire station is the Hope Valley Fire and Rescue Service Station, located at 18 Armstrong Road, Hope Valley. The Kwinana Volunteer Fire and Rescue Service Station, which is under the command of the Hope Valley Service, is situated closer to the subject land at Lot 10 Chisham Avenue, Kwinana however, as the name suggests, this service is not permanently crewed.

Response times can vary depending on commitments of volunteers, fire events current at time and priority of the fire services in the south west of Western Australia during summer periods. DFES recommend 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."

In cases of emergency, always call 000.

7. RESPONSIBILITIES

7.1 Property Owners Responsibilities

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

- Comply with minimum construction standards as outlined by the applicable Fire Management Plan prepared at subdivision stage;
- Take measures to protect their own assets on their property;
- Owners must maintain individual building protection zones in accordance with the requirements of the applicable FMP and the City of Kwinana. This may include maintenance of the verge where it abuts a lot.
- Owners must ensure compliance with City of Kwinana Annual Fire Break notices.
- Owners must ensure compliance with the applicable Fire Management Plan and DFES "Prepare. Act. Survive" booklet;
- Take measures maintain in good order and condition individual Building Protection Zones, Hazard Separation Zones and driveway standards;
- Comply with City of Kwinana and DFES fire and emergency services personnel during emergencies or in maintaining their property.

7.2 Developers Responsibilities

Prior to development of the site commencing, the Developer shall be required to carry out works that include the following, in respect to individual stages of development. The Developer shall have no further responsibilities to the provision of fire fighting facilities and fire management on individual lots that pass from their management and/or ownership.

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

- The Developer is to prepare and addendum to this FMP to confirm the threat of a bushfire internal to the development at the subdivision stage, once further details relating to retention of bushland, landscaping and lot configuration is known.
- Prepare Detailed Area Plans for any lots that require building protection zones contained within the lot boundary as a result.
- Comply with standards as outlined by the City of Kwinana and WAPC conditions of subdivision with respect to construction of roads, identifying hyrdrant locations and sign-posting.
- Ensure any contractors who are engaged in works for future development are aware of requirements for fire hydrants.
- Ensure that potential property owners are aware of the applicable Fire Management Plan; The developer must lodge a section 70A notification on all certificates of titles within the area depicted on the Bushfire Hazard Assessment Plan as requiring a

notification on the title for the purpose of alerting purchasers to the possible threat of bushfire and the responsibilities contained within this fire management plan.

- The developer must supply a copy of this Fire Management Plan and a copy of the latest of DFES's Bushfire Survival Guide. (Currently called 'Prepare.Act.Survive' V4: November 2012 attached at Appendix 1) to prospective purchasers of the lots subject to the notification.

- The developer must provide a copy of this Fire Management Plan to the City of Kwinana for endorsement.

- The developer shall install and must mark all fire hydrants to Department of Fire and Emergency Services - standard road and pole specifications and Water Corporation No.63 Water Reticulation Standard.

- The developer must construct Public Open Space areas adjacent to, and/or abutting developable lots in accordance with the Landscape Strategy and Master Plan to ensure a standard which reduces bushfire attack level of those abutting or adjacent lots to at most a BAL-29 level.

- The developer shall install internal access roads in accordance with the approved Challenger Precinct Local Structure Plan.

- Establish a temporary 100m low fuel zone between the last stage of development and any undeveloped land where temporary interface is to occur, to prevent AS3959 requirements.

7.3 City of Kwinana Responsibilities

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

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

- Endorse the Section 70A notification on each CT of the proposed lots requiring notification under the Fire Management Plan.

- Endorse the Detailed Area Plan required to identify Building Protection Zones within individual lots.

- Develop and maintain district fire fighting facilities, apparatus and district water sources for the purposes of fire fighting.

- Enforce the annual Fire Control Notice to all surrounding lots.

- Endorse the relevant Australian Standards to all building approvals on the new lots subject to the Section 70A notification.

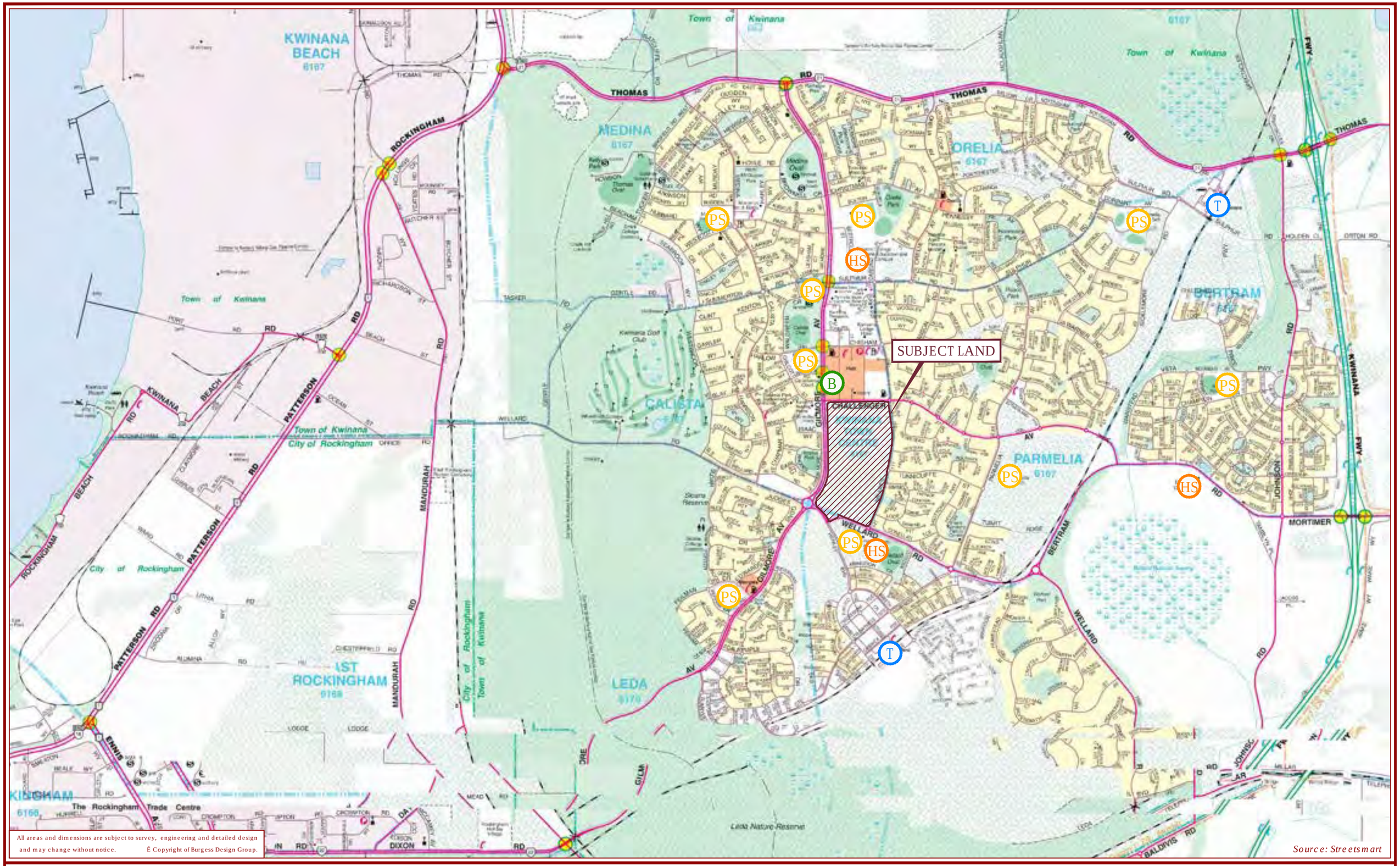
- Ongoing management of any public areas will be the responsibility of the City of Kwinana only after the Developer has relinquished construction and ongoing maintenance responsibilities.

- The City of Kwinana must maintain Public Open Space areas adjacent to, and or abutting developable lots to a standard which corresponds with the maximum BAL approved on the adjacent or abutting lots.

- Assess building designs in accordance with any current AS3959 performance criteria and BAL rating as enforced through the applicable FMP.

Figure 1

Location Plan



All areas and dimensions are subject to survey, engineering and detailed design and may change without notice. É Copyright of Burgess Design Group.

Source: Streetsmart

LEGEND

- PS Primary School
- HS High School
- B Bus Station
- T Train Stations

NORTH

LOCATION AND CONTEXT PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING

CITY OF KWINANA

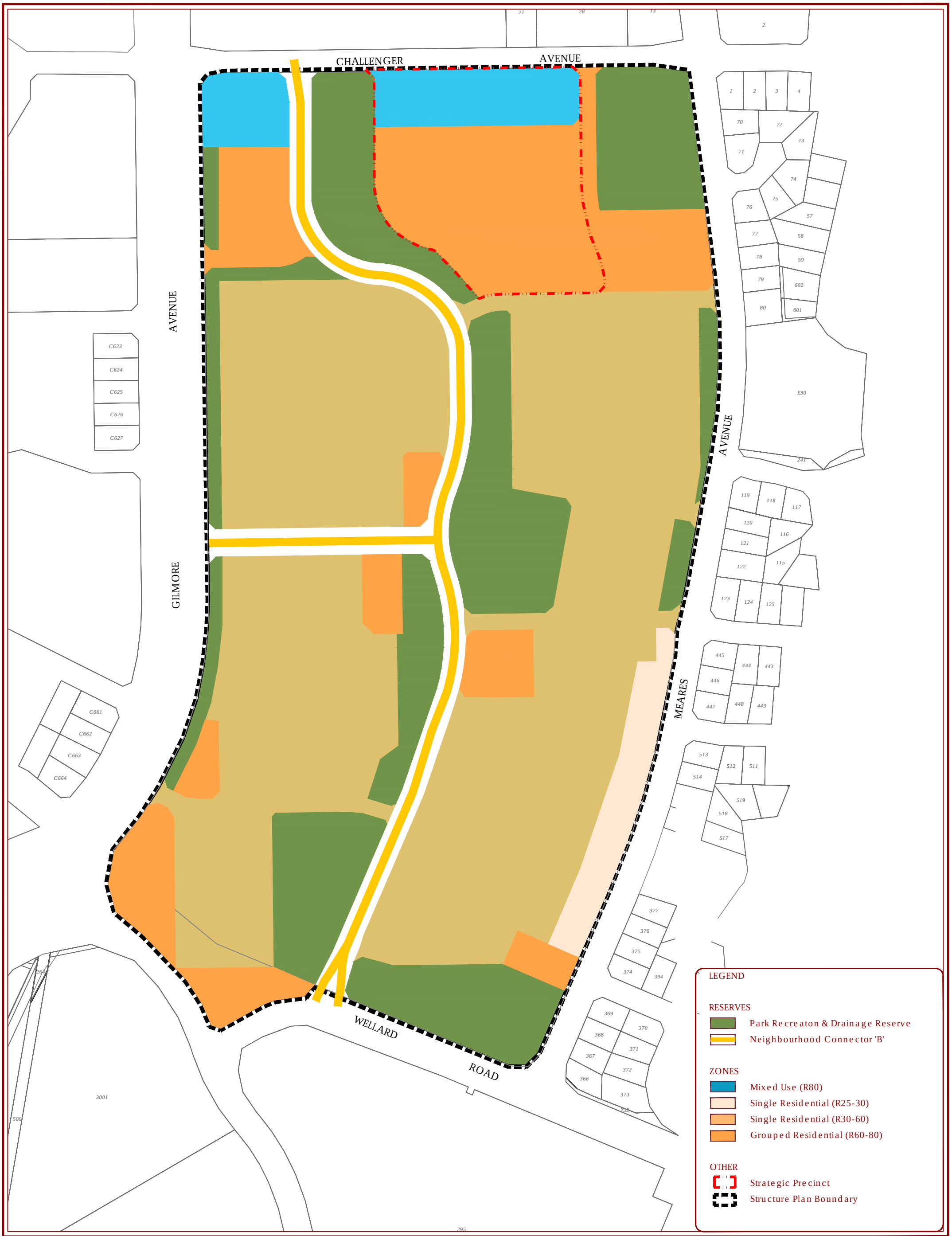
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Plan No: SAT KWI 9-04a_LC Client: SATTERLEY/DOH
Date: 26.02.13 Planner: JD

0 0.25 0.5 0.75 1km
SCALE 1:25,000 (A3)

Figure 2

Proposed Local Structure Plan



STATUTORY STRUCTURE PLAN MAP

PT CLOSED WELLARD RD, PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

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Plan No: SAT KWI-1-14h Date: 26.02.13
Planner: JD Client: SATTERLEY/DOH

CITY OF KWINANA

Figure 3

Landscape Masterplan



LOTS E26, 303 & 9014, GILMORE AVENUE, KWINANA
landscape masterplan

scale 1:1000 @ A0
18.11.2013
0 10 20 30 40 50

Satterley
Cossill & Webley
SKM
360
emerge ASSOCIATES

Figure 4

Aerial Image



LEGEND

Subject Land

NORTH

0 20 40 60 80 100m

SCALE 1:3,000 (A3)

AERIAL PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

SATTERLEY PROPERTY GROUP / DEPARTMENT OF HOUSING

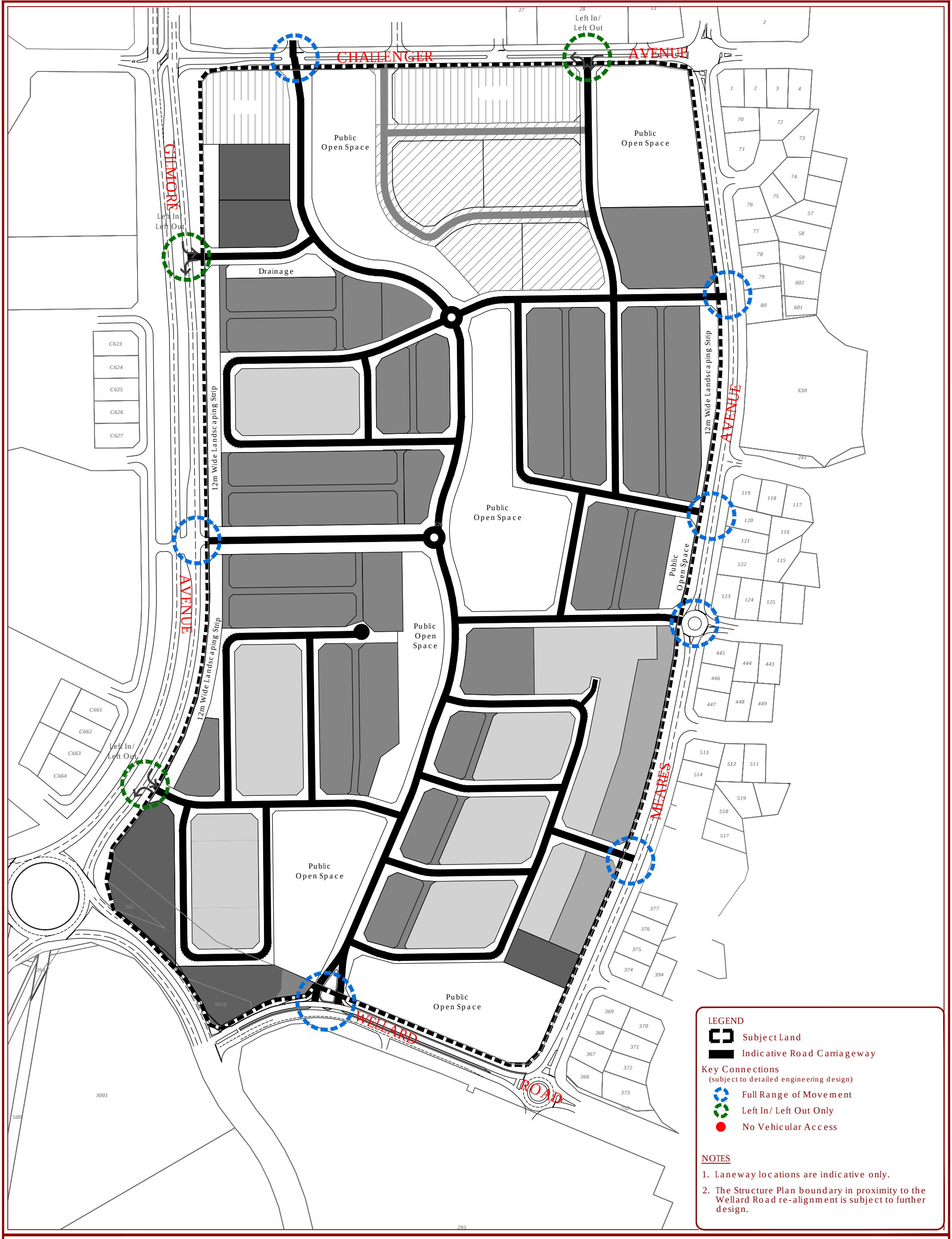
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Planner: JD
Date: 26.02.13
Client: SATTERLEY/DOH

CITY OF KWINANA

Figure 5

Access and Egress Plan



ACCESS & EGRESS PLAN

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

SATTERLEY/ PROPERTY GROUP / DEPARTMENT OF HOUSING

Planner: JD

Date: 20.06.13

Client: SATTERLEY/DOH

Figure 6

Vegetation Assessment



LEGEND

- Subject Land
- Investigation Area

Note

*Vegetation classified on the basis of their understorey, as per WAPC Planning for Bushfire Protection Guidelines

VEGETATION CLASSES

Low Risk

- Grassland (L)
- Low Open Woodland (L)*
- Open Woodland (L)*

Moderate to Extreme Risk

- Tall Open Shrubland (M)*
- Open Woodland (M)*
- Woodlands (E)
- Low Open Woodland (M) -Revegetation Area

NORTH

0 20 40 60 80 100m

SCALE 1:3,000 (A3)

VEGATATION ASSESSMENT

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

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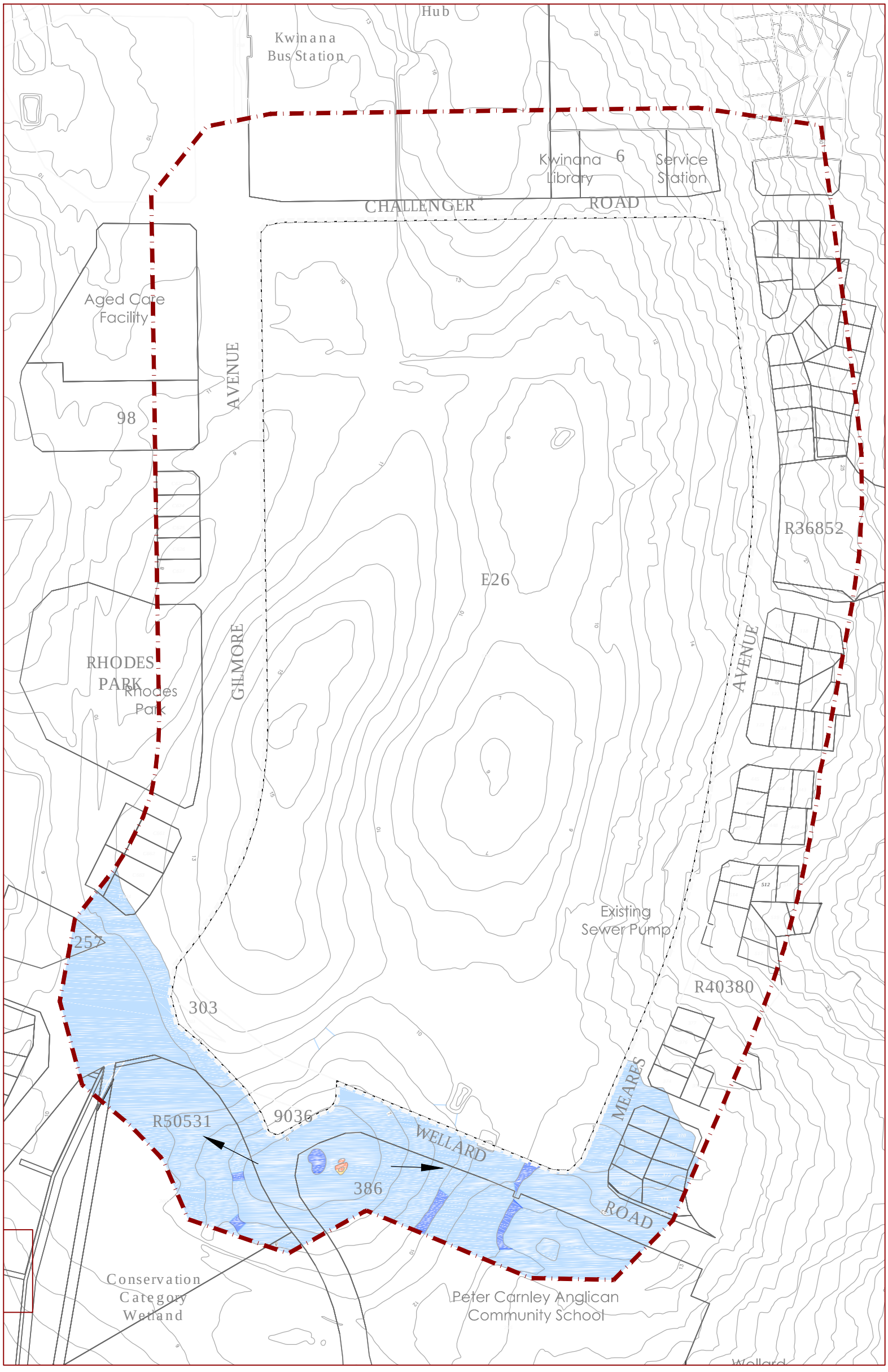
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Planner: JD
Date: 24.03.14
Client: SATTERLEY/DOH

CITY OF KWINANA

Figure 7

Slope Analysis



LEGEND

- Subject Land
- Investigation Area
- Direction of Slope

Slope Ranges

- 0Á to 5Á
- 5Á to 10Á
- 10Á to 15Á
- 15Á to 20Á

NORTH

0 20 40 60 80 100m

SCALE 1:3,000 (A3)

SLOPE ANALYSIS

PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE

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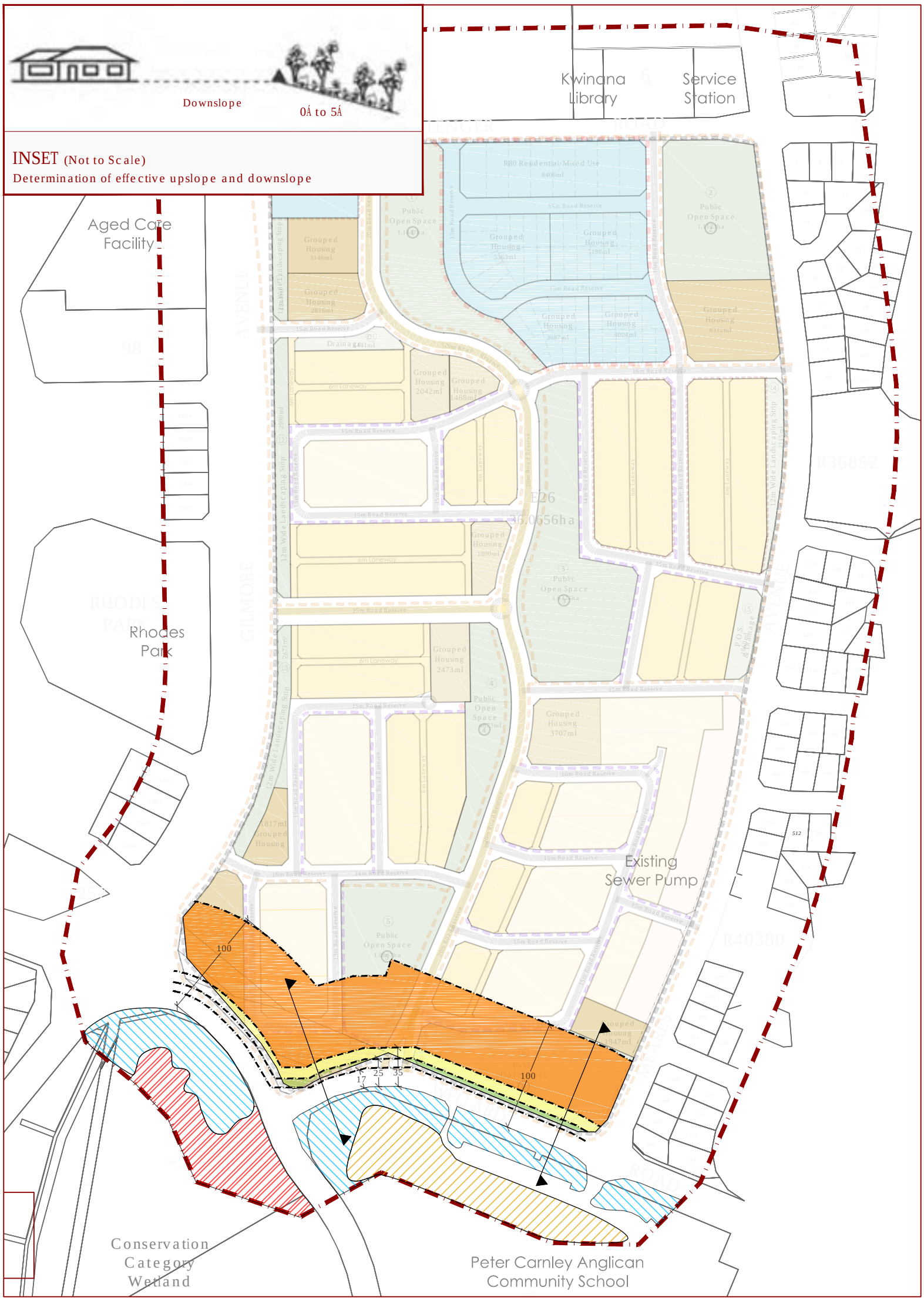
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CITY OF KWINANA

Figure 8

Strategic Bush Fire Hazard Assessment

INSET (Not to Scale)
Determination of effective upslope and downslope



LEGEND

- Subject Land
- Investigation Area
- Hazard Separation Line
- Cross-section Line - refer to Inset (Determination of Effective Upslope & Downslope) & Slope Analysis

Hazard Classification

- Low Risk Vegetation
- Moderate Risk Vegetation
- Extreme Risk Vegetation

BUSH FIRE HAZARD ASSESSMENT

	Construction Requirements	Heat Flux Exposure	Description of Risk		Construction Requirements	Heat Flux Exposure	Description of Risk
	BAL 12.5	≦12.5 KW/mİ	Ember attack		BAL 29	<19KW/mİ ≦29 KW/mİ	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux.
	BAL 19	≦19 KW/mİ	Increasing levels of ember attack and burning debris ignited by wind-borne embers together with increased heat flux		BAL 40	<29KW/mİ ≦40 KW/mİ	Increasing levels of ember attack and burning debris ignited by windborne embers together with increasing heat flux with the increased likelihood of exposure to flames.

NORTH
0 20 40 60 80 100m
SCALE 1:3,000 (A3)

OFF-SITE BUSHFIRE HAZARD ASSESSMENT
PT CLOSED WELLARD AVE, LOTS E26, 303 & 9036 GILMORE AVE
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Planner: JD
Date: 24.03.14
Client: SATTERLEY/DOH

CITY OF KWINANA

Appendix 1

DFES: Prepare. Act. Survive
(V4: Nov 2012)

PREPARE. ACT. SURVIVE.

IT COULD SAVE YOU AND YOUR FAMILY'S LIVES THIS BUSHFIRE SEASON









How can I increase the chance my house will survive a bushfire?
What should I do when a bushfire is coming?
Is it possible to defend my house from a bushfire?

Read this book to find out

GOVERNMENT OF WESTERN AUSTRALIA

DFES
Department of Fire & Emergency Services

Version 4
November 2012

IMPORTANT CONTACTS

EMERGENCY CONTACT NUMBERS

Police, Fire, Ambulance (for life threatening emergencies):	**000**
Local GP/Doctors surgery:	
Hospital:	
Out of area family contact:	
Work numbers:	
Local shire / council:	
Neighbour:	
School:	
Insurance company:	
Other:	

WHERE TO FIND INFORMATION

Department of Fire and Emergency Services (DFES) alerts and warnings

- Emergency Information Line **1300 657 209**
- Website ..... **www.dfes.wa.gov.au**
- Twitter feed ..... **www.twitter.com/dfes_wa**
- During major emergencies, tune in to local ABC radio and other media

Bushfires in national parks or information on prescribed burns

- Department of Environment and Conservation (DEC) ..... **www.dec.wa.gov.au**

Fire Danger Ratings and weather

- Bureau of Meteorology (BOM) ..... **www.bom.gov.au/weather/wa**

Road conditions and closures

- Main Roads ..... **www.mainroads.wa.gov.au or 138 138**

Crimestoppers

- If you notice any suspicious activities, call Crimestoppers **1800 333 000**

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Version 4 Published November 2012

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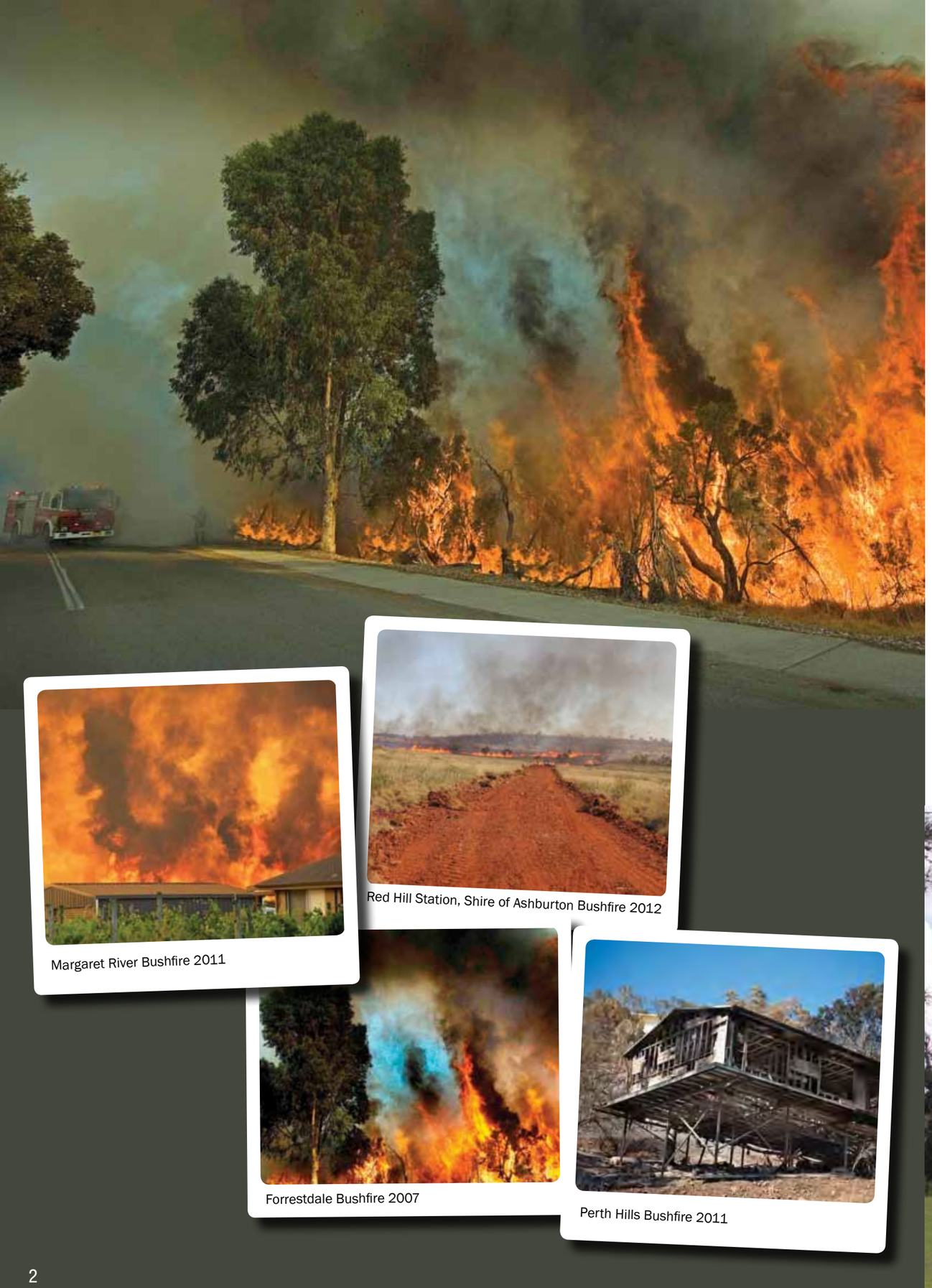
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Margaret River Bushfire 2011

Red Hill Station, Shire of Ashburton Bushfire 2012

Forrestdale Bushfire 2007

Perth Hills Bushfire 2011

PREPARE. ACT. SURVIVE.

Bushfires happen every summer, they can start suddenly and without warning. People have been killed or seriously injured, and homes destroyed during bushfires. If you live in or near bush, fire is a real risk to you and your family.

Preparing yourself, your family and your home is your responsibility. Serious bushfires can occur in rural and suburban communities. You need to understand the bushfire risk to your family and home so you can make decisions now on what you will do if a bushfire starts.

Firefighters are preparing for the bushfire season and will do everything they can to keep your community safe, however you cannot rely on firefighters to protect you and your property. Many firefighters are volunteers and take time away from their families during bushfires. You need to help them by having a bushfire survival plan and preparing your home to make it as safe as possible.

Whether you choose to leave for a safer place, or to actively defend your home, preparation is the key to your survival.

Information in this guide will help you to prepare and develop a bushfire survival plan. Refer to the Checklists at the back of this guide.

REMEMBER:

Bushland does not just mean trees and forest, it also means areas of scrub and grassland. Bush is found in both suburban and regional areas.

Before summer starts you need to decide what you will do if a bushfire threatens. If you live or work near bushland you need to:

PREPARE your family, home or business – know your risk from bushfire and have a bushfire survival plan. Having a plan may be the difference in saving your life.

ACT on the Fire Danger Ratings – put your preparations into action, do not wait and see. The Fire Danger Rating is your trigger to ACT.

SURVIVE by monitoring conditions if a fire starts – know the bushfire warning alert levels and what you will do if you are caught in a fire.



Prepare yourself, your family and your home



PREPARE. ACT. SURVIVE.

Preparing yourself, your family and your home is your responsibility. The more you prepare your home the better the chance it will survive a fire, even if you are not there.

The majority of houses can survive most bushfires with planning and effort. A well prepared home will give you more protection if a fire threatens suddenly and you cannot leave.

During a major bushfire, firefighters will be working to stop the fire. A fire truck and water bombing by aircraft cannot be guaranteed to defend your home during a bushfire.

Bushfires can start suddenly and without time for firefighters to issue a warning.

Make a plan for what you will do if a bushfire occurs and practise it regularly with your family. Having a plan could be the difference in saving you and your loved ones lives.

It is your responsibility to reduce the risks and take actions to protect your home and your family to survive the bushfire.

What will you and your family do to be safe?

You need to make a commitment to develop a bushfire survival plan that details preparations and actions you will take if a bushfire threatens, and keep it updated.

Are you and your family at risk?

You need to think about the bushfire risk to your family and home:

- Do you live in or near bush?
- Does your local area have a bushfire history?
- Do you have trees and shrubs within 20 metres of your house?
- Is your house built on a slope?
- Is your bushfire survival plan more than one year old?

If you answered yes to one or more of these questions then bushfire is a real risk to you and your family.



Aerial view of Perth suburban bushland



PREPARE YOUR PLAN
IT COULD SAVE YOUR LIFE

If you live in or near bush, developing and using a bushfire survival plan is critical. This plan will help you take action and avoid making last minute decisions that could prove deadly during a bushfire. When developing your plan decide if you will leave for a safer place, which may be to relocate to family or friends, or stay to actively defend your home.

Your plan must be prepared and practiced with all members of your family or household before the start of the bushfire season. If you live alone you may like to form a plan with a neighbour. Make sure you write it down, give everybody their own tasks and have a list of actions to take if there is a bushfire.

Your plan needs to take into account what you will do based on the Fire Danger Rating (see page 16). On days of catastrophic or extreme fire weather it is safest to leave early, that is the night before or early in the day. You must decide in what conditions you will stay, if any, and when it would be best to leave. Do not forget to think about what you will do with your pets and livestock if there is a bushfire.

Practice your plan regularly and review it every year, keep it in an easy to find place and make sure everyone knows where it is. Everyone's bushfire survival plan will be different depending on individual situations and circumstances.

CHECKLISTS ARE AT THE BACK OF THIS GUIDE TO HELP YOU DEVELOP YOUR OWN BUSHFIRE SURVIVAL PLAN



When developing your bushfire survival plan, you and your family need to think about:

- What are your triggers to leave?
- 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 or 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, people with disabilities or illness? When, where and how will they be relocated? Who will care for them?
- Do you need to consider anyone else in your plan? Think about house mates, neighbours or friends that you will need to help or that you may need to help you.
- 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?
- Will your home provide shelter if you have to or decide to stay?
- Are you capable of defending your home without the support of firefighters?
- Do you have the skills, knowledge, resources and capacity to check for and put out spot fires for up to 10 hours after the fire front has passed?
- Do you have the right equipment and resources to actively defend? (eg. sufficient independent water supply of at least 20,000 litres and a petrol, diesel or a 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.

PREPARE. ACT. SURVIVE.

HAVE A BACKUP PLAN

Conditions can change very quickly in a bushfire, often without warning. Make sure your plan is flexible and covers a range of situations you may face before, during or after the fire. Bushfires can be very unpredictable. You must take into account what you will do if things go wrong. Ask yourself 'What if?', What if?', What if?'.

CATASTROPHIC CONDITIONS

When the Fire Danger Rating is catastrophic in your area, homes are not designed or constructed to survive fires in these conditions. If this weather is expected you should leave the night before or early in the day, this is the best option for your survival. Staying could be deadly.

SEE THE **FIRE DANGER RATINGS: WHAT IT MEANS TO YOU** ON PAGE 16

Think about what could go wrong:

- If you have no time to leave and a fire threatens you – where will you shelter and how will you survive?
- What will you do if the building you are sheltering in catches on fire?
- What will you do if you lose electricity and water supply?
- If you are going to leave – where will you go, how will you get there, what will you take and when will you go?
- What if your escape route is blocked or your ability to leave your home safely is reduced?
- What if you or your family are at work or school?
- What if the weather changes suddenly and the fire reaches you much sooner than you thought?
- What if you are having a party or friends are staying? Their survival may depend on you.
- What if your children or elderly parents are home alone?
- What if you have let your holiday house to friends or visitors? Have you prepared the property? Will they know what to do? What is your plan for them?

It is important that you and your family know what to do if things do not go to plan.



Develop a bushfire survival plan



Practice your bushfire survival plan

PREPARE YOUR HOME AND PROPERTY

You should prepare your home to survive a fire, even if your plan is to leave. A well prepared and constructed house is more likely to survive a bushfire than an unprepared one. Firefighters cannot defend every property and are unlikely to defend a poorly prepared property, remember their lives are at risk too.

WHAT IS EMBER ATTACK?

- Embers are burning twigs, leaves and pieces of bark and debris that are carried by the wind.
- Ember attack is the most common way houses catch fire during a bushfire.
- Ember attack occurs when embers are carried by the wind and land on or around a house, sparking spot fires.
- Ember attack can spark fires up to 20 kilometres from the fire front.

Walk around your property and imagine a bushfire is coming. Look for items likely to burn or where embers could start a fire. (eg. embers can enter through gaps in roofs, walls, evaporative air conditioners and gutters.) Remember to install a stainless steel open weave mesh cover over your evaporative air conditioner and metal fly screens on your windows and vents to keep sparks and embers out.

Many homes destroyed during bushfires are lost due to ember attack. These burning embers get into gaps within the building, such as into the roof cavity, and ignite the material within the cavity. It can take a number of hours before the burning can be seen and by that time the building may not be able to be saved.

It is recommended that all homes that may be affected by embers be made ember proof. If a bushfire occurs in the general area then the roof cavity and other crevices should be inspected to ensure that no embers have caused a fire. Be aware that there are electricity cables in the roof area and the use of water will be a safety issue.



This home caught fire from an ember attack – Perth Hills Bushfire 2011

REDUCING FUEL AROUND YOUR HOME

Reducing vegetation, rubbish and anything that can burn from around your home will increase its chances of surviving a bushfire.

A building protection zone (BPZ) is an area extending for at least 20 metres around a building on all sides where there is little or nothing to burn.

In suburban areas this may mean that your whole block will be part of your BPZ.

Embers may still enter the home from the air, but taking steps to reduce fuel from around your home will increase its chances of survival.

For at least 20 metres around your home and other buildings:

- Cut long grass and dense scrub. Remove dead material.
- Remove all rubbish and rake up leaf litter, twigs, bark and material that may catch fire.
- Maintain a minimum two metre gap between your house and tree branches. Make sure that no trees overhang the house.
- Prune lower branches (up to two metres off the ground) to stop a fire on the ground spreading to the canopy of the trees.
- Do not clump shrubs, ensure that there is a gap. Shrubs should be planted at a distance of at least three times their height at maturity from buildings.

Other actions you will need to take to reduce fuel loads are:

- Keep your gutters free of leaves and other combustible material.
- Create a mineral earth firebreak, with no vegetation along your boundary.
- Build your paths adjacent to the building and have your driveway placed so that it maximises the protection to the house.
- If possible, plan your garden so that your vegetable garden, lawn, pool or patio is on the side of the house likely to face a fire (where the bush is).
- Store firewood away from the building.
- Ensure that your gas bottles are secured and positioned so that it will vent away from the building if it is subject to flame contact or radiant heat.
- Ensure fences are non-combustible so they can help to shield your home from a bushfire and radiant heat.

USE THE **PREPARING YOUR PROPERTY CHECKLIST** ON PAGES 30 – 32 TO HELP YOU GET READY FOR A BUSHFIRE.





This home survived a bushfire because it had a properly prepared building protection zone.



Correctly secured gas bottles

DID YOU KNOW

During the February 2011 bushfires in the Perth Hills, 81 homes that were damaged did not have a properly prepared building protection zone[1].

1 Final Report on the Investigation of House Losses in the Roleystone Kelmscott Bushfire 6 February 2011, Ralph Smith.

WATER SUPPLY AND PUMPS

During a bushfire, it is likely you will lose power and water. Mains water pressure may drop or fail and as a result, if you are planning to actively defend, you will need to have an independent water supply. This should be a concrete or steel tank with a 20,000 litre capacity to ensure adequate defence of your home.

Exposed PVC pipes and fittings will melt in the heat of a fire so metal pipe fittings should be used for above ground applications. PVC and polyethylene pipes can be used for below ground applications and should be buried at least 30 centimetres.

If you lose power you will need a generator to pump your water supply for actively defending your home. Your generator will need to have more than 1.5 kVA capacity to drive a home pressure pump, or a petrol or diesel firefighting pump. Pumps and generators should be able to pump 400 litres per minute (lpm) and must be shielded from high temperatures caused by a bushfire.

It is important that everyone likely to stay and defend your property knows how to start and operate the pump and generator, and have practised it.

Hoses from the pump should be long enough to reach all corners of the home and should be fitted with a nozzle able to deliver 30 to 100 lpm. Fire hoses should be durable, flexible, able to withstand high temperatures and have UV protection. Hoses should be kept on a reel for ease of use and storage.



PREPARE YOUR PETS AND LIVESTOCK

Make sure you plan for all your family this summer, including your pets to keep them safe. During a bushfire your pets will need water, shade and a safe place to stay. If you have livestock that can be moved out of the area, allow yourself plenty of time to relocate them.

If possible, move larger animals to paddocks with little vegetation. At the start of the bushfire season consider slashing a paddock to create a safer area.

Never turn animals out on to the road to run free. This is dangerous for fire trucks and vehicles, and you may be legally responsible if they cause a crash. Animals will panic during a bushfire which may result in injuries if they are not secured.

Pets and livestock are not allowed at public relocation centres, so you need to consider what you will do with them in your bushfire survival plan.

Once you have left your property it is likely to be several days before emergency services give the all clear and you will be allowed to return home. This can be very upsetting, however it is vitally important that you obey road closures and wait for the all clear. Ignoring these instructions could put your life and the lives of emergency services personnel at risk as there may be hazards in the area such as falling trees and branches, downed power lines and damaged or blocked roads.

During a major bushfire, emergency services will establish communication and recovery processes to help community members. This includes access to properties, if it is safe, to attend to livestock and other important matters.

FOR TIPS ON DEVELOPING A BUSHFIRE PLAN FOR YOUR HORSE REFER TO **HORSES AND BUSHFIRES FACT SHEET** AT **www.dfes.wa.gov.au**



Lake Clifton Bushfire 2011

PREPARE. ACT. SURVIVE.

PREPARE TO ACTIVELY DEFEND – PHYSICALLY, MENTALLY AND EMOTIONALLY

If you choose to stay and defend your house, be prepared for a frightening experience. You must have a plan for how you will actively defend your house and where you will shelter when the fire front passes. Make sure you have all the equipment you need.

If you live through a bushfire you may have physical, mental and emotional pain from the experience. You need to think about how you and the rest of your family or household will cope.

> "The fire was roaring like a jet engine. There was so much smoke, it was getting thicker, and there was so much noise from people yelling and screaming. There were explosions all around me."

> "I started fighting the fire on Saturday lunchtime ... I was still putting out fires on the Monday morning with only a few hours sleep, with little contact or support from anyone."

> "So, I tried for a total of about nine hours and I was exhausted after about four hours. I just couldn't do any more. I was ready to drop on my feet, but to their credit my family stayed on and they carried on hosing out both major and minor fires that were occurring."
>
> *Stephen Noblett, Kelmscott*



Coconut Wells, Broome Bushfire 2011

Picture yourself in the middle of a bushfire:

Fires happen in the hottest weather. Think about how hard it is to be outside doing physical activity in summer, now think about the additional heat of a bushfire.

Imagine if the weather has been hot for days leading up to the fire. You may be exhausted before the fire even starts.

Before the main fire reaches you, your home may be surrounded by showers of sparks and embers. This can happen for several hours. Embers will collect in corners of your house or enter your home through gaps and you will need to put them out.

It is likely there will be strong winds and as the fire gets closer, burning leaves and bark will begin to land around your home.

Thick, heavy smoke will make it dark and you may not be able to see. Breathing may become difficult. Your eyes will water, and may become red and sore.

It will be extremely hot and you will need to wear protective clothing, such as long pants and a long sleeved shirt, and strong leather boots. Clothes should be loose fitting and made from natural fibres. Do not wear synthetics.

You must have supplies of necessary items such as food, drinking water and petrol. If you leave your property during a fire to restock it is likely that you will not be allowed to return home.

The fire will make a very loud roaring noise that you may find scary. The burning, crackling and roaring of the fire will be in addition to howling strong winds and sirens from fire trucks.

It is likely you will lose power, telephone and water services. Do you have the right equipment and resources to actively defend? (eg. sufficient independent water supply of at least 20,000 litres and a petrol, diesel or a generator powered pump capable of pumping 400 litres per minute). Remember, if you lose power during a bushfire, you will not be able to use cordless phones or remote controlled garage doors to access vehicles.

The fire front will normally take five to fifteen minutes to pass your house. This is when radiant heat given off by the fire will be at its highest. At this time you will need to shelter while checking inside your house for spot fires.

Now, ask yourself:

- Will I be able to cope during a bushfire?
- Will my family or household cope during a bushfire?
- What if family or friends are visiting, how will they cope?

Defending your home during a bushfire will take several hours. This includes the time needed to do all the hard preparation tasks before the fire front reaches your home and continually watching for spot fires.

You will need to be in good physical health, with the ability to maintain a constant watch on your home and surrounding area before, during and after the fire.

Think about any medical conditions that may be an issue because of stress and smoke (eg. heart conditions, asthma and other respiratory conditions). These may affect your ability to defend your home.

If you are planning to actively defend your property you need to make sure you are self sufficient. If you are unprepared, not able to or not sure you can defend your home without the assistance of firefighters, you need to leave early well before the fire reaches you. Firefighting resources, including water bombing aircraft, will be busy trying to put the fire out and will not be there to help you defend your home.

Fires can be very frightening, and may make it hard to think clearly or make good decisions. It is important everyone agrees to your plan to actively defend. This will stop people making different decisions in the heat of the moment.

Make sure you prepare and practice your plan to actively defend before the bushfire season starts. This will give you a clear set of actions to follow before, during and after a bushfire.

USE THE **PREPARE TO ACTIVELY DEFEND CHECKLIST** ON PAGE 36 TO HELP YOU GET READY FOR A BUSHFIRE.

JOIN A BUSHFIRE READY GROUP

Bushfire Ready is a community action program that encourages local residents to work together to prepare and protect their families and properties against bushfires.

You and your neighbours can learn how to prepare your family and home so you can act if a bushfire threatens. Contact your local brigade for a Bushfire Ready group near you.



Radiant heat – the killer in a bushfire

Bushfires produce enormous amounts of radiant heat. Radiant heat is the same warmth you feel from a campfire or the flame from a stovetop gas cooker, but could be up to 50,000 times more intense in a major bushfire.

Without protection, intense radiant heat can kill you very quickly – the human body cannot absorb large amounts of radiant heat.

The best protection from radiant heat is distance.

Radiant heat can be blocked by a solid object, such as a concrete wall or building, which creates a barrier between you and the bushfire.

Wearing protective clothing to cover exposed skin will only protect you from very low levels of radiant heat.

Protective clothing includes a long sleeved shirt and pants made from cotton or other natural fibre, sturdy boots, wide brimmed hat, leather gloves and face mask.

PREPARE. ACT. SURVIVE.

Bushfires can start suddenly so you need to be prepared to act even if you do not get a warning. Most people wait to be told what to do and expect a firefighter to knock on their door to tell them to leave, this is highly unlikely to happen. Do not wait for a warning before acting. The decision to wait and see can be deadly.

Not hearing a warning does not mean there is no threat. You should watch for signs of a bushfire, especially smoke and flames. Bushfires can move very quickly and there may not be time for a warning to be issued, you need to put your preparations into action immediately, do not wait and see.

During hot weather you should know the fire danger for your area so you can act to make sure you survive.

The Fire Danger Rating tells you what type of fire weather is forecast and the risk from a fire if one starts. It tells you what the fire conditions will be like and what you should do.

SEE THE **FIRE DANGER RATINGS: WHAT IT MEANS TO YOU** ON PAGE 16

"We had a bushfire survival plan prepared before the summer, once the smoke became thicker we knew it was time to put our plan into action."

KNOW YOUR TRIGGER

It is important that you use triggers that cause you to act before a fire even starts.

Finding out tomorrow's Fire Danger Rating is the best trigger and should be the first step in activating your bushfire survival plan.

You will also need to consider other triggers to put your bushfire survival plan into action, such as:

- If you can see or smell smoke
- If you can see a fire
- If you can hear sirens or water bombers
- If you are told by a neighbour or friend there might be a fire near you
- If you hear or receive a warning.

Do not wait and see, leaving at the last minute is deadly.

- Know the Fire Danger Rating at your location
- The Fire Danger Rating is your 'trigger' to act
- The higher the rating, the more dangerous the situation if a fire starts



Margaret River Bushfire 2011

THE DAY BEFORE

Act decisively once bad fire weather is forecast. You should put your preparations into action the night before or early on the day when the rating is very high or above.

Your plan should consider if your actions will change at different Fire Danger Rating categories and be based on a series of triggers. Your trigger may be different to your neighbour as it needs to work for you and your family's situation.

If you are planning to stay and actively defend it is a good idea to check water pumps and generators to make sure they work when bad fire weather is forecast, and prepare your protective clothing in case you need it quickly.

You need to be ready to act once a fire starts, and should have your bushfire survival plan and kit ready. Keep up to date with information via radio, television, the internet, information lines, by staying alert to your surroundings and by speaking to your neighbours so you can take action immediately if a fire starts.

KNOW WHAT THE FIRE DANGER RATING MEANS



Only a house prepared to the highest level and actively defended may offer any safety up to the Fire Danger Rating category of extreme.

This means your home needs to have been constructed to bushfire protection levels, for a start it must have enclosed eaves, an independent water supply, covers over external air conditioners and metal flyscreens.

The higher the rating the less chance your home can protect you. If you are not prepared to the highest level, leaving bushfire risk areas the night before or early in the day is your safest option.

If a Fire Danger Rating of catastrophic has been forecast your home is not designed or constructed to survive fires in these conditions. This is why your best chance for survival is to leave.

THE FIRE DANGER RATING IS PUBLICISED BY THE BUREAU OF METEOROLOGY AT **www.bom.gov.au/wa/forecasts,** ON THE DEPARTMENT OF FIRE AND EMERGENCY SERVICES WEBSITE AT **www.dfes.wa.gov.au** AND THROUGH THE MEDIA.

Brian's story



Carabooda resident, Brian Baily has had firsthand experience of how quickly fires can spread and the importance of having a detailed bushfire survival plan.

Brian experienced a bushfire that came within metres of his property. He said the experience had given him a taste of just how important it is to act quickly in a fire and know what you would do.

"The fire was a really difficult experience for me," Brian said. "I received a call at work from a neighbour telling me there was a bushfire near my home. We hadn't really thought about what we would do if a bushfire threatened and I went into complete panic because my daughter was home. Thankfully, my daughter got out just in time but the experience made me realise my family was at risk and we needed a plan."

Brian said he wanted others to learn from his experience and develop a detailed plan well before a fire starts.

"That way your judgement won't be clouded and you will be able to think clearly and make better decisions. There's a lot to consider when making a plan, but taking the time to do it, could save your life."

Brian said it was important to have a trigger so you know what you will do, and when.

On days when catastrophic fire weather is forecast, Brian and his daughter Leah plan to leave their home and stay with relatives.

"To us, it isn't worth the risk of staying at home in these sorts of conditions because if a fire starts, we will be putting ourselves in great danger. Homes can always be rebuilt but life is a lot more precious."

Brian's list of things to do on a catastrophic fire day includes taking the family dog and cat, photos, items of value and clothing with him to a relative's house.

"Even though we live in a beautiful area, it only takes one spark to turn it into a frightening unstoppable inferno that can threaten your property, your family and your life. I have learnt my lesson from the Carramar fire and I now tell people how critical it is to be prepared for what might happen if they are threatened by a bushfire."

WHAT IS YOUR TRIGGER WHEN **PLANNING TO LEAVE?**

KNOW YOUR FIRE DANGER RATINGS

VERY HIGH 32–49	SEVERE 50–74	EXTREME 75–99	CATASTROPHIC -100+
■ Well prepared homes that are actively defended can provide safety. This means you have the right equipment and resources to put out fires around your home eg. enough water supply, petrol/diesel portable pump, generator, protective clothing etc.	■ Only stay with your property if you are prepared to the highest level. This means your home needs to have been constructed to bushfire protection levels eg. enclosed eaves, covers over external air conditioners, metal fly screens etc. ■ You must be well prepared and able to actively defend your home if a fire starts. This means you have the right equipment and resources to put out fires around your home eg. enough water supply, petrol/diesel portable pump, generator, protective clothing etc. ■ If you are not prepared to the highest level, leaving bushfire risk areas early in the day is your safest option.		■ Homes are not designed or constructed to withstand fires in these conditions. ■ Leave as early as possible to a safer place, regardless of your plan.

PLANNING TO LEAVE EARLY

When to go?
Trigger

Where to go?

How to get there?
Route Options

Who will I tell?

What to take?

Our pets

Where will my kit be?

What is my trigger to return?

BACKUP PLAN

What if:
- I am at work?
- My partner is at work?
- Children are at home?
- Children are at school?
- We have visitors?

What if I am trapped by fire?

Where can I shelter safely?
Places of last resort examples:
- A well prepared home or neighbours
- Town centre
- Dam, pool, beach

USE THE **LEAVING FOR A SAFER PLACE CHECKLIST** AT THE BACK OF THIS GUIDE TO HELP YOU GET READY FOR A BUSHFIRE.

WHAT IS YOUR TRIGGER WHEN **PLANNING TO STAY AND ACTIVELY DEFEND?**

KNOW YOUR FIRE DANGER RATINGS

VERY HIGH 32–49	SEVERE 50–74	EXTREME 75–99	CATASTROPHIC -100+
■ Well prepared homes that are actively defended can provide safety. This means you have the right equipment and resources to put out fires around your home eg. enough water supply, petrol/diesel portable pump, generator, protective clothing etc.	■ Only stay with your property if you are prepared to the highest level. This means your home needs to have been constructed to bushfire protection levels eg. enclosed eaves, covers over external air conditioners, metal fly screens etc. ■ You must be well prepared and able to actively defend your home if a fire starts. This means you have the right equipment and resources to put out fires around your home eg. enough water supply, petrol/diesel portable pump, generator, protective clothing etc. ■ If you are not prepared to the highest level, leaving bushfire risk areas early in the day is your safest option.		■ Homes are not designed or constructed to withstand fires in these conditions. ■ Leave as early as possible to a safer place, regardless of your plan.

PLANNING TO STAY AND ACTIVELY DEFEND

Be well prepared:
- Adequate water supply
- Generator (inc fuel)
- Pump (inc fuel)
- Protective clothing
- Current bushfire survival plan

I have all the items above.
Am I able (physically and mentally) to defend for hours, if not days, at a time?

Put your bushfire survival plan in to action

Where are my places of last resort?
Places of last resort examples:
- A well prepared home or neighbours
- Town centre
- Dam, pool, beach

What if:
- I have no power or water?

I answered no or maybe to the last questions.

What if:
- I am home alone?
- I am not home when the fire starts?
- I have children at home?
- We have visitors?

LEAVE EARLY

USE THE **PREPARE TO ACTIVELY DEFEND CHECKLIST** AT THE BACK OF THIS GUIDE TO HELP YOU GET READY FOR A BUSHFIRE.

FIRE DANGER RATINGS: WHAT IT MEANS TO YOU.

FIRE DANGER RATING	WHAT DOES IT MEAN?	WHAT SHOULD I DO?
CATASTROPHIC 100+	■ These are the worst conditions for a bush or grass fire ■ If a fire starts and takes hold, it will be extremely difficult to control and will take significant firefighting resources and cooler conditions to bring it under control ■ Spot fires will start well ahead of the main fire and cause rapid spread of the fire ■ Embers will come from many directions ■ Homes are not designed or constructed to withstand fires in these conditions ■ The only safe place to be is away from bushfire risk areas	**YOU NEED TO ACT NOW** ✓ Put your survival first and leave bushfire risk areas the night before or early in the day – this is your best option ✓ Act immediately – do not wait and see: ▪ leave now ▪ avoid forested areas, thick bush or long, dry grass ▪ take shelter if you cannot leave
EXTREME 75-99	■ These are very hot, dry and windy conditions for a bush or grass fire ■ If a fire starts and takes hold, it will be unpredictable, move very fast and difficult for firefighters to bring under control ■ Spot fires will start and move quickly ■ Embers may come from many directions ■ Homes that are prepared to the highest level, have been constructed to bushfire protection levels and are actively defended may provide safety ■ You must be physically and mentally prepared to defend in these conditions ■ The only safe place to be is away from bushfire risk areas	**YOU NEED TO GET READY TO ACT** ✓ Only stay with your property if you are prepared to the highest level. This means your home needs to have been constructed to bushfire protection levels eg. enclosed eaves, covers over external air conditioners, metal flyscreens etc ✓ You must be well prepared and able to actively defend your home if a fire starts. This means you have the right equipment and resources to put out fires around your home eg. enough water supply, petrol/diesel portable pump, generator, protective clothing etc ✓ If you are not prepared to the highest level, leaving bushfire risk areas early in the day is your safest option
SEVERE 50-74		
VERY HIGH 32-49	■ These are hot, dry and possibly windy conditions for a bush or grass fire ■ If a fire starts and takes hold, it may be hard for firefighters to control ■ Well prepared homes that are actively defended can provide safety ■ You must be physically and mentally prepared to defend in these conditions	**YOU NEED TO BE AWARE** ✓ Well prepared homes that are actively defended can provide safety. This means you have the right equipment and resources to put out fires around your home eg. enough water supply, petrol/diesel portable pump, generator, protective clothing etc
HIGH 12-31	■ If a fire starts, it is likely to be controlled in these conditions and homes can provide safety ■ Be aware of how fires can start and reduce the risk ■ Controlled burning may occur in these conditions if it is safe – check to see if permits apply	✓ Check your bushfire survival plan ✓ Monitor conditions ✓ Action may be needed ✓ Leave if necessary
LOW-MODERATE 0-11		



⚠ Fires can threaten suddenly and without warning.

Watch for signs of fire, especially smoke and flames.

Know your Fire Danger Rating and be aware of local conditions.

Have your bushfire survival plan and kit ready.

ⓘ To seek information in the event of a major bushfire:

- Listen to local radio
- Visit **www.dfes.wa.gov.au**
- Call the Department of Fire and Emergency Services information line on **1300 657 209**

Call 000 to report a fire

STAY ALERT WHEN A FIRE STARTS

On hot dry days when bushfires are possible it is likely you will be inside with the curtains and blinds closed, and the air conditioner on.

A fire could be coming towards your home very quickly and you will not even know.

You need to stay alert on these days and look for information, regularly going outside to check for signs of bushfire.

If you see a bushfire, act immediately. Be ready to act without an official warning.

Do not wait and see – this can be deadly.



Red Hill Bushfire 2011

Coconut Wells, Broome Bushfire 2011

Hesitation can be deadly

If you wait and see 'what happens' you could be putting your life at risk.

On Black Saturday in 2009, at least 26% of the people that died were going to 'wait and see' before deciding what to do.

During hot weather

- Know the Fire Danger Rating for your area.
- Put your preparations into action the night before or early in the day if bad fire weather is forecast, do not wait and see.
- Have your bushfire survival plan and kit ready.
- Stay alert and monitor your surroundings by watching for signs of a bushfire, especially smoke and flames.
- Look and listen for information on television, radio, the internet, information lines and speak with your neighbours.
- Know what the levels of alert in the bushfire warning system mean.
- If you see signs of a bushfire, act immediately for your own safety.



Margaret River Bushfire 2011

"As soon as I see smoke or fire on the ridge through our window, we're loading up the car and taking the kids elsewhere."

Stephen's story



Kelmscott resident, Stephen Noblett said he had experienced bushfires before and thought he was prepared to fight a fire, but when a fire started near him unexpectedly it took him by surprise.

"Well the event for us started at around quarter to twelve and I was in the shower. Gail shouted from the bedroom there was a lot of smoke outside and even before I'd finished in the shower she said there is just so much smoke and she looked around the house," Stephen said.

"I hear this almighty scream that there's fire ... and she said get out, get out, you know and ... the fire was here, right on our doorstep."

Stephen said the reality of dealing with the fire was beyond his wildest imagination and has made him rethink his plan.

"The events were beyond anything I could ever possibly imagine," Stephen said.

"The scenes of white and yellow heat burning intensely and ... grass trees flaring and you ... put them out and they'd flare again and walls of flames rushing up slopes to the sound of ... what sounded like a jet engine to me and you know I'm only human and I have my fears and the fear is that I don't want to die."

"I had great intentions of defending our home but to say that I would die in such a situation ... in reflection might sway me if it ever happened again."

"To see a huge gum tree disappear in three seconds ... I've never seen anything like that before. The wall of flames. Your humanity takes over and fear clicks in, and yeah my knees were shaking. I felt fear alright."

TOTAL FIRE BANS AND FIRE RESTRICTIONS



A Total Fire Ban (TFB) is declared because of extreme weather conditions or when widespread fires are seriously stretching firefighting resources.

They are declared on days where fires are most likely to threaten lives and property, and take into consideration local conditions, such as how moist the soil is and the amount of vegetation in the area that could burn during a fire.

When a TFB is declared, it is illegal to do anything that could or is likely to start a fire. The ban includes all open fires for the purpose of cooking or camping.

It also includes incinerators, welding, grinding, soldering or gas cutting.

WHAT OTHER FIRE RESTRICTIONS ARE THERE?

Depending on the time of the year, there may be restrictions on lighting fires or other fire risk activities in your area.

Check with your local government for details on current restrictions in your area.

FOR MORE DETAILED INFORMATION ON TOTAL FIRE BANS, REFER TO THE **TFB FACT SHEET** ON PAGE 41

How will I know if a Total Fire Ban has been declared?

When a TFB has been declared it will be:

- Featured on the DFES website at **www.dfes.wa.gov.au**
- On the DFES information line on **1300 657 209**
- Broadcast on ABC local radio and other media outlets
- Displayed on local government roadside Fire Danger Rating (FDR) signs and variable message signs on major highways
- For more information visit **www.dfes.wa.gov.au** or call the Total Fire Ban information line on **1800 709 355**

PREPARE. ACT. **SURVIVE.**

DURING THE FIRE

Most people living in areas where bushfires happen know they are at risk but think it will happen to someone else. Many think about preparing but never get around to it. Bushfires impact people every year and there is a good chance it could be you. Be prepared and have a plan, your survival depends on it.

During a bushfire the safest place to be is away from the fire. Being involved in a fire may be one of the most traumatic experiences of your life. You and your family's survival and safety depend on the decisions you make now and how you act. Put your safety first – do not wait and see.

Any decision you make should be based on survival, homes can be rebuilt.

If a fire starts, leaving hours before a fire can reach you will always be the safest option for you, your family or household.

Only stay and defend your home if it is well prepared and constructed, and you are capable of actively defending it. Prepare for the emotional, mental and physical impact of defending your property. If you have any doubts about defending your home, you should leave.

Act decisively the moment you know there is danger. Whether you choose to leave for a safer place or shelter in a well prepared and defendable home, preparation is the key for survival.

CHECKLISTS TO HELP YOU PREPARE YOUR BUSHFIRE SURVIVAL PLAN ARE AT THE BACK OF THIS GUIDE.

STILL WITHOUT A PLAN?

Don't have a plan? Think it won't happen to you? You are not alone. Advice and support are available.

You can:

- Join a Bushfire Ready Group
- Talk to your local brigade about how to plan for bushfire
- Contact your local government for bushfire information
- Visit **www.dfes.wa.gov.au**

SHELTERING IN A BUSHFIRE

When the fire front passes the heat will be extreme and you must shelter at this time whether you planned to or not.

This information will increase your chances of survival:

- Stay in the house when the fire front is passing, this usually takes five to fifteen minutes. You need to actively defend (put out spot fires near you) while sheltering.
- Take shelter inside furthest from the fire front. Make sure you can easily escape from the building. It is best to shelter in a room with two exits and a water supply (eg. a laundry with a door that goes outside or a kitchen with two exits). People have died sheltering in bathrooms and other rooms without a door going outside.
- If your house catches on fire and the conditions inside become unbearable, you need to get out and go to an area that has already been burnt. Close all internal doors and leave through the door as far from the approaching fire as possible. Many people have died from toxic smoke and fumes when their house has caught fire.
- You should protect yourself from radiant heat with long sleeves, long trousers and strong leather boots. The majority of people die in a bushfire from radiant heat.

USE THE **PREPARE TO ACTIVELY DEFEND CHECKLIST** ON PAGE 36

After the fire front has passed:

- Go outside once it is safe.
- Check for, and put out small spot fires and burning embers:
  - inside the roof space
  - under floor boards
  - under the house
  - on verandas and decks
  - on window ledges and door sills
  - in roof gutters and valleys
  - in garden beds and mulch
  - in wood heaps
  - in outdoor furniture
  - in sheds and carports
- Keep drinking lots of water.
- Stay at your property until the surrounding area is clear of fire.
- Look and listen for information on radio, television, the internet and information lines.

"Everyone was driving erratically and one young guy was coming up the hill as I was going down. You could just see blind panic on his face as he was hurtling along on the wrong side of the road. I thought my God, you know, please see me."

Stephen Noblett, Kelmscott

LEAVING FOR A SAFER PLACE

Many people plan to leave for a safer place but leave it too late. You and your family need to identify and agree to a trigger that will prompt you to leave early, and have a backup plan in case you cannot leave in time. It is too late and extremely dangerous to leave when roads are closed and full of smoke. Bushfires move quickly, make sure you and your family know where your safer place is, how you will get there and when you will go. Families who have children, members who are sick, elderly or with a disability, need to leave especially early. You need to act the moment you know there is danger, do not wait and see.

Driving is very dangerous and stressful during a bushfire with smoke making it hard to see, fallen trees over the road and power lines down. The speed of the fire could also trap you and burn your vehicle, cars do not protect you from radiant heat. You should know the travel time and distance to your safer place, and include this information in your bushfire survival plan.

If you are not able to leave early, staying and actively sheltering may be your safest option. You will need to actively defend your property regardless of what you planned to do. Preparing your property will give you and your home more chance of survival.

USE THE **YOU AND YOUR FAMILY PLANNED TO LEAVE BUT IT IS TOO LATE CHECKLIST** ON PAGE 35 TO SEE THE ACTIONS YOU NEED TO TAKE TO PREPARE YOUR HOME.





Perth Hills Bushfire 2011

WHERE TO GO AS A LAST RESORT

As a last resort, a safer place is a local open space or building where people may go to seek shelter from a bushfire.

Use of a safer place may be your backup plan when:

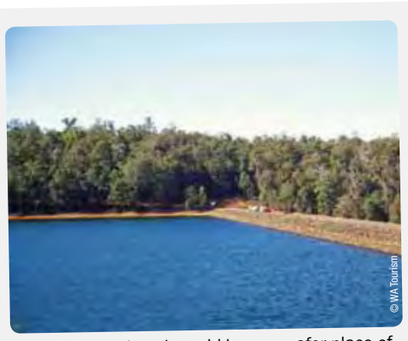
- Your bushfire survival plan has failed.
- Your plan was to stay and actively defend but the scale of the fire means your home cannot withstand the impact of the fire and your home is no longer a safe place to shelter.
- The fire threat has got worse and is now catastrophic or extreme, and leaving is your safest option.
- A safer place of last resort provides you and your family some level of protection from the effects of a bushfire.

If you plan to use a safer place as a last resort you need to think about their limits:

- They do not guarantee safety in all circumstances.
- Firefighters may not be there, they may be fighting the main fire front elsewhere.
- They do not cater for animals or pets.
- They do not provide meals or amenities.
- They may not provide shelter from the elements, particularly flying embers and hot weather.
- If you or a family member have special needs you should think about what assistance may be needed at a safer place.

Once you have arrived at your safer place, you need to:

- Look and listen for fire information by whatever means of communication you have – on radio, your mobile phone, internet etc.
- If you are sheltering in a building as the fire approaches, make sure all doors and windows are sealed as best as possible. When the fire has passed and if safe, check for spot fires and embers outside, and put them out if possible.
- If you are sheltering in an open space, as the fire approaches seek protection from radiant heat and embers as best you can. Attempt to cover any exposed skin with blankets or clothing. You should lie flat on the ground during the passage of the fire front.
- Remain vigilant for possible new fire fronts from other directions.





A local dam or beach could be your safer place of last resort



Red Hill Station, Shire of Ashburton Bushfire 2012

ACTIVELY DEFENDING YOUR HOME

Do not underestimate what is required to maintain your house as a place of safety during a bushfire. Actively defending your property will take huge physical and mental effort for many hours before, during and after the fire, as conditions will be unbearably hot. You need the right equipment, protective clothing for all your family or household members, and a property prepared to the highest level.

A defendable space around your home can provide protection from radiant heat but will not keep you safe from ember attack or spot fires. You will need to put out any spot fires that start long after the fire has passed, remain vigilant and keep checking for them. There may be many spot fires at once and you will need to prioritise these. Anyone who cannot help you to defend your home should relocate to a safer place well before the bushfire threatens.

When the Fire Danger Rating is catastrophic, extreme or severe it may not be possible to actively defend your home. On these days fires can be so bad that even homes prepared to the highest level and constructed to bushfire protection levels that are actively defended will not survive.

Being involved in a bushfire can have a serious and long lasting psychological and emotional impact. Think about your long term wellbeing.

IF YOUR PLAN FAILS

Bushfires can be extremely frightening and may make it difficult to think clearly and make sensible decisions. Fires are very unpredictable and you need to be prepared to change your plans.

You need to act decisively the moment you know there is danger. Having a plan to follow will help you avoid last minute decisions that could cost you, your family or household their life. There are many reasons your plan may no longer work when the fire happens. It is okay to rethink your plan for your survival.

If your plan fails or your situation changes you must act quickly and go to a safer place. You need to identify a number of places you can go to at the last minute. This may be a shed, your home, a swimming pool, a dam or another place. If your safer place of last resort is a swimming pool or dam you must protect yourself with a woollen blanket while the fire front passes.

How to handle the emotional impact

In highly stressful situations, the body often shows signs of anxiety, such as a racing heart, shortness of breath, dizziness and sweating. These reactions to stress usually trigger distressing thoughts such as ‘I cannot cope’ or ‘I am so afraid’.

Tips on how to feel more in control:

- Slow down your breathing to help calm your body’s reaction.
- To slow your breathing down, take smaller breaths and pause between breaths to space them out. When you have breathed out slowly, hold your breath for a count of three before inhaling your next breath.
- While concentrating on breathing out slowly, say to yourself ‘relax’ or ‘stay calm’, or ‘it is ok, I am managing ok’. These are good words to use because they are linked with feeling relaxed and in control.
- Replace frightening thoughts with more helpful ones.
- Try not to dwell on the bad things that might happen, instead tell yourself that the calmer you are, the better you will be at managing exactly what needs to be done.

Source: ‘Don’t panic: be prepared.’ The Australian Psychological Society Ltd

UNDERSTAND BUSHFIRE WARNINGS

During a bushfire, emergency services will provide as much information to you as possible through a number of different channels.

There are three levels of warning. These change to reflect the increasing risk to your life and the decreasing amount of time you have until the fire arrives.

ADVICE: a fire has started but there is no immediate danger, this is general information to keep you informed and up to date with developments.

WATCH AND ACT: a fire is approaching and conditions are changing, you need to start taking action now to protect you and your family.

EMERGENCY WARNING: you are in danger and you need to take immediate action to survive as you will be impacted by fire. This message may start with a siren sound called the Standard Emergency Warning Signal (SEWS).

SEWS is a distinctive sound effect that is broadcast immediately prior to major emergency announcements on radio, television and other communication channels. The signal sounds like 'whoop, whoop, whoop' and is broadcast for up to 15 seconds before the emergency information. SEWS tells you that you need to listen, there is an emergency in your area and you need to take action now. It is used like a siren and is strictly controlled by an authorised hazard management agency.

ALL CLEAR: the danger has passed and the fire is under control, but you need to remain vigilant in case the situation changes. It may still not be safe to return home.

SEE THE **BUSHFIRE WARNINGS: WHAT SHOULD YOU DO?** ON PAGE 26

Where to get information:

- DFES website at **www.dfes.wa.gov.au**. You can also subscribe to receive alerts and warnings as RSS feeds
- DFES emergency information line on **1300 657 209**
- DFES twitter feed at **www.twitter.com/dfes_wa**
- Radio, television, newspapers and news websites. Each media outlet determines how often they will broadcast information
- ABC local radio broadcasts updates at quarter to and quarter past the hour in addition to news bulletins during a 'Watch and Act' or 'Emergency Warning'
- You may get an Emergency Alert (see page 27)
- Your surroundings could be your best information source. Stay alert to what is happening around you. If you believe you may be in danger, act immediately to keep yourself safe



RELOCATION AND ROAD CLOSURES

The priority of firefighters during a bushfire is the protection of lives, and a decision may be made to relocate residents who are in immediate danger.

Once you have been asked to leave your property and relocate to a safer place, it may be several days before emergency services give the all clear to allow you to return home.

During a bushfire, roads will be closed for your safety and for safe access to the fire by emergency services. These road blocks are managed by police who will not allow you to return home under any circumstance. It is important that you take everything you need when you leave, such as your bushfire survival kit, which should include important papers, medications and personal supplies.

If you are not at home when the fire starts you may not be able to get to your home as road closures may have been put in place. During the bushfire season take note of the fire danger rating for the following day to be prepared as possible in the event of a fire.

Emergency services will provide you with information on which roads are closed and where possible, what route to take to get to a relocation centre. The Main Roads Traffic Operations Centre is in regular contact with emergency services about road closures during incidents to ensure up to date information is available, however this information can change quickly.

In regional areas roads may be closed for days. It will be extremely hot and unpleasant waiting in a car with little or no shade, and no toilet facilities. If you live or are travelling in a rural area check at roadhouses and police stations if any roads have been closed in the area. You should always take water and food with you to last a number of hours.

Where to find information about road closures:

Main Roads
- **www.mainroads.wa.gov.au**
- **138 138**

Department of Fire and Emergency Services
- **www.dfes.wa.gov.au**
- **1300 657 209**

RELOCATION AND WELFARE CENTRES

After some bushfires, relocation and welfare centres may be established and coordinated by the Department for Child Protection. They are established so that appropriate support services such as shelter, emergency accommodation, food, clothing, financial assistance, registration, personal support and other welfare services can be provided.



Lake Clifton Bushfire 2011

RETURNING HOME

Look and listen for information on radio, television, the internet and information lines to find out when an all clear advice has been issued and if it is safe to return home. Firefighters will have been working to cut down dangerous trees and make the area safe, but there may still be some hazards in the area so be alert when you return home.

When going home watch out for downed power lines, fallen trees, low branches and burning debris. Be careful of damaged infrastructure including walls, bridges, roads and footpaths. When driving in the fire area you should take extreme caution as emergency services personnel may be continuing their work.

A fire can be very destructive and selective, often leaving some homes untouched while others can be completely devastated. If your home has been badly damaged and you need a place to stay, seek help from welfare agencies.

You need to be mentally and emotionally prepared when returning to your property. If you live alone, you may want to bring someone with you when you first return. To minimise emotional hardship, it is best that you prepare mentally, have support and offer support to others during this time. Encourage your family to talk about their experiences with friends and neighbours, and become involved in community activities as soon as you can.

Access to your home should be limited to adults initially for safety reasons. When you arrive home you should:

- Use a face mask and wear protective clothing.
- Walk around the outside of your house to check for the following hazards:
  - live electricity
  - leaking gas (odour or hissing)
  - septic or sewage leaking
  - hot embers
  - trees and overhanging branches
  - major structural damage.

FOR MORE DETAILED INFORMATION ON HOW TO RECOVER FROM THE IMPACT OF A BUSHFIRE REFER TO THE DFES **AFTER THE FIRE** PUBLICATION AVAILABLE AT **www.dfes.wa.gov.au**

BUSHFIRE WARNINGS: WHAT SHOULD YOU DO?

ALERT LEVEL	WHEN WILL IT BE ISSUED?	WHAT SHOULD YOU DO?
ADVICE **Be aware and keep up to date** Issued at **11am** and **4pm** unless the situation changes	■ When a fire has started but there is no immediate danger ■ There is no threat to lives and homes ■ The fire is likely to be small and may be causing smoke near homes ■ Firefighters will be able to control the fire	**You need to be aware** ■ Stay alert and monitor your surroundings by watching for signs of a bushfire, especially smoke and flames ■ Check the Fire Danger Rating for your area ■ Close all doors and windows
WATCH AND ACT **Put your preparations into action – do not wait and see** Issued **every two hours** unless the situation changes	■ When a fire is approaching and conditions are changing ■ There is a possible threat to lives and homes ■ The fire will be out of control. There may be smoke and embers around your home and roads ■ Firefighters will be working with machines to put in containment lines to stop the fire spreading	**You need to leave or get ready to defend** ■ Put your bushfire survival plan into action ■ If you have decided to leave for a safer place, leave now and take your survival kit with you ■ Leave well before roads are closed and full of smoke
EMERGENCY WARNING **Take immediate action to survive – you will be impacted by fire** Issued **every hour** unless the situation changes	■ When there is immediate danger and the fire will impact your home ■ There is a threat to lives and homes ■ The fire will be out of control and moving very fast. This is the highest level of warning ■ Firefighters will find it difficult to control the fire and it will take significant firefighting resources and a change in conditions to bring it under control ■ A siren sound called the Standard Emergency Warning Signal (SEWS) may be used to get your attention on radio and television	**You need to act immediately to survive** ■ If you have not left yet and the way is clear leave immediately for your safer place and take your survival kit with you ■ If you have not prepared your home, it is too late to do it now. Your safest option is to leave for a safer place, if the way is clear ■ Do not relocate at the last minute in a vehicle or on foot as this is deadly, leave immediately if the way is clear
ALL CLEAR **Take care to avoid any dangers and keep up to date** Issued when the threat has passed	■ When the danger has passed and the fire is under control ■ Firefighters will be working to put the last bits of the fire out and make the area safe ■ It may still not be safe to return home. Emergency services will advise when you can go home	**You need to be careful** ■ Remain vigilant in case the situation changes ■ When driving in the fire area you should take extreme caution and drive slowly ■ Dangers like smoke, fallen trees and downed power lines may be on roads and emergency services will still be working in the area

EMERGENCY ALERT.
BE WARNED. BE INFORMED.

You may get an Emergency Alert

Emergency Alert is one tool used to warn communities of an emergency and should not be relied on as your only source of information. It is an additional tool used to alert people in a specific location where there is immediate danger. Radio, television, government websites and information lines are all good sources of information during emergencies.

All home phones, including silent numbers, are automatically registered to receive Emergency Alerts. Mobile phones are automatically registered to the customer address which may be different to where you live.

Emergency Alert works by delivering emergency warnings direct to you when lives may be in danger in your neighbourhood. It is a system that uses web technology to send warnings to home phones or mobiles. It will only be activated when authorities have credible information that there is an emergency that could or will threaten lives and properties. It does not replace the need to look after your own safety by monitoring local conditions, keeping up to date by radio, television, internet and information lines, and taking preventative action where possible. Emergency Alert cannot be guaranteed and there may be no warning for some incidents, for example if a bushfire is moving very quickly and starts close to homes.

How will I know if I have received an Emergency Alert?

0444 444 444 is the number assigned to Emergency Alert. This number will always be displayed in the message header or caller identification.



CHECKLIST PREPARING YOUR SURVIVAL KIT PAGE 1 OF 1

Prepare a bushfire survival kit before the bushfire season starts. This will help you get through the first few days after a fire. Make sure you have transport and a bushfire survival kit ready regardless of whether you are going to leave or actively defend your house.

GENERAL ITEMS

- [ ] Portable battery operated AM/FM radio
- [ ] Waterproof torch
- [ ] New spare batteries
- [ ] First aid kit with manual
- [ ] Woollen blankets

FOOD AND WATER

- [ ] Drinking water [at least three (3) litres per person per day for four (4) days]
- [ ] Canned food (dried food is also a good alternative) to last four (4) days
- [ ] Can opener, cooking gear and eating utensils
- [ ] A portable gas stove or barbecue
- [ ] Water container (for washing and cooking water)

ON THE DAY ADD

- [ ] Cash, key cards and credit cards
- [ ] Medications, toiletries and sanitary supplies
- [ ] Special requirements for infants, elderly, injured, those with disabilities and pets
- [ ] Mobile phone and charger, or phone card
- [ ] Emergency contact numbers
- [ ] Extra car and house keys
- [ ] Combination pocket knife
- [ ] Important documents, valuables and photos
- [ ] Change of clothes for everyone



A bushfire survival kit

CHECKLIST PREPARING YOUR PROPERTY PAGE 1 OF 3

Prepare your home and property for the bushfire season. It is everyone's responsibility. If you live in or near bush take the time to complete and action this checklist.

STARVE THE FIRE

Reduce the fuel loads around your home so that embers will have less chance to start a fire when they hit the ground. This will also help reduce the damage caused by the fire.

For at least 20 metres around your home and other buildings:

- [ ] Cut long grass and dense scrub. Remove dead material.
- [ ] Remove all rubbish and rake up leaf litter, twigs, bark and material that may catch fire.
- [ ] Maintain a minimum two metre gap between your house and tree branches. Make sure that no trees overhang the house.
- [ ] Prune lower branches (up to two metres off the ground) to stop a fire on the ground spreading to the canopy of the trees.
- [ ] Do not clump shrubs, ensure that there is a gap. Shrubs should be planted at a distance of at least three times their height at maturity from buildings.

Other actions you will need to take:

- [ ] Keep your gutters free of leaves and other combustible material.
- [ ] Create a mineral earth firebreak, with no vegetation along your boundary.
- [ ] Build your paths adjacent to the building and have your driveway placed so that it maximises the protection to the house.
- [ ] If possible, plan your garden so that your vegetable garden, lawn, pool or patio is on the side of the house likely to face a fire (where the bush is).
- [ ] Store firewood away from the building.
- [ ] Ensure that your gas bottles are secured and positioned so that it will vent away from the building if it is subject to flame contact or radiant heat.
- [ ] Ensure fences are non-combustible so they can help to shield your home from a bushfire and radiant heat.

FILL THE GAPS

Houses usually catch fire when embers get into the roof space, a wall cavity, on to ledges or under the house. Prevent sparks from entering your house by blocking all the gaps.

- [ ] Block any gaps under floor spaces, in the roof space, under eaves, external vents, skylights, chimneys and wall cladding.
- [ ] Place metal fly wire mesh on all windows, vents and install an ember protection screen on evaporative air conditioners to keep sparks and embers out.

FIX THE FIRE TRAPS

- [ ] Do not pile wood against or near the house.
- [ ] Remove any timber, rubbish and old junk lying around.
- [ ] Move all fuel containers into a shed away from your house and have a firebreak around it.
- [ ] Keep gas cylinders on the side of the house furthest away from the likely direction of a fire (where the bush is). Ensure the pressure relief valve is directed away from the house. Store gas cylinders upright and secure them with a metal chain to a secure, non-combustible post to prevent cylinders from falling over.

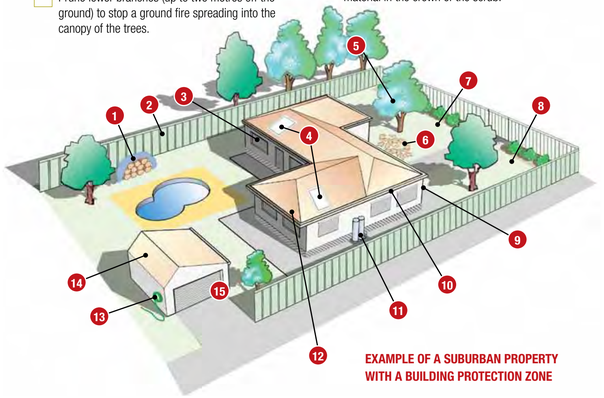
PROTECT YOUR ASSET

- [ ] Have a sufficient independent water supply of at least 20,000 litres and a petrol, diesel or a generator powered pump capable of pumping 400 litres per minute.
- [ ] Check that your home and contents insurance cover is adequate. Take into consideration renovations, fixtures and additions such as swimming pools, sheds, gazebos, luxury fittings or new appliances.

CHECKLIST PREPARING YOUR PROPERTY PAGE 2 OF 3

BUILDING PROTECTION ZONE (CIRCLE OF SAFETY)

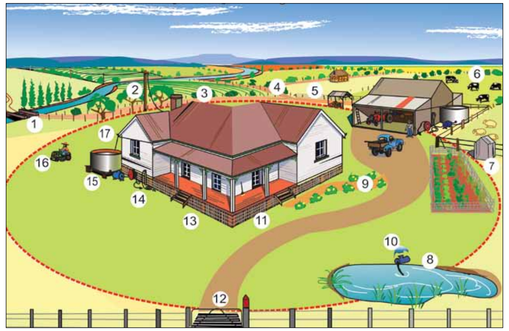
- ☐ Create a minimum 20 metre building protection zone around your home and other buildings. Reduce the fuel load in this area by removing all rubbish, keeping grass cut short, and raking up leaf litter, twigs, bark and material that may catch fire.
- ☐ Prune lower branches (up to two metres off the ground) to stop a ground fire spreading into the canopy of the trees.
- ☐ Create a mineral earth firebreak along the boundary of your property. Make sure you meet your local government's firebreak requirements.
- ☐ Cut long grass and prune the scrub so that it is not dense, and does not have fine, dead aerated material in the crown of the scrub.



EXAMPLE OF A SUBURBAN PROPERTY WITH A BUILDING PROTECTION ZONE

1. Do not pile wood against or near the house
2. Install a fire or heat radiation shield such as a solid fence
3. Place metal fly wire mesh on all windows, vents and install an ember protection screen on evaporative air conditioners to keep sparks and embers out
4. Block any gaps under floor spaces, in the roof space, under eaves, external vents, skylights, chimneys and wall cladding
5. Create and maintain a minimum two metre gap between your house and tree branches
6. Rake up leaf litter and twigs under trees
7. Remove shrubs and small trees under and between larger trees
8. Ensure garden mulch is kept away from the house and grass is kept short
9. Ensure all gaps in external wall claddings are sealed
10. Keep roof gutters and valleys clear of leaves and bark
11. Keep gas cylinders on the side of the house furthest away from the likely direction of a fire (where the bush is). Ensure the pressure relief valve is directed away from the house. Store gas cylinders upright and secure them with a metal chain to a secure, non-combustible post to prevent cylinders from falling over
12. Block any gaps in the roof space
13. Hoses must be long enough to reach all parts of your house. Use metal hose fittings for taps as they are less likely to melt
14. Remove flammable materials and store them away from the house
15. Have a sufficient independent water supply of at least 20,000 litres and a petrol, diesel or a generator powered pump capable of pumping 400 litres per minute.
16. Refer to DFES' Homeowners Bush Fire Survival Manual available at: www.dfes.wa.gov.au

CHECKLIST PREPARING YOUR PROPERTY PAGE 3 OF 3



EXAMPLE OF A REGIONAL PROPERTY WITH A BUILDING PROTECTION ZONE

1. Check bridge loading for fire tanker access
2. Trim branches away from power lines
3. Replace or repair damaged roofing and weatherboards where embers can enter
4. Put in firebreaks along paddock boundaries
5. Store firewood away from the house
6. If fire threatens move livestock to a well grazed paddock
7. Store petrol and gas safely away in a shed
8. Draw water from dams and pools. Don't rely on mains water supply
9. Keep a well maintained area with fire retardant plants
10. Install pumps with a spray nozzle
11. Seal under floor spaces to prevent embers entering
12. Check cattle grid loading for fire tanker access
13. Place water pipes underground from the dam pump to the house
14. Have a hose fitting on an internal tap to douse spot fires in the roof cavity
15. Fill water tanks and connect them to pumps for firefighting
16. Keep grass cut
17. Install gutter guards and keep gutters clear of leaf litter

BUSHFIRE SURVIVAL PLAN LEAVING FOR A SAFER PLACE

Use this guide to develop a bushfire survival plan that is suitable for your family and personal situation. You may wish to sketch a plan of your house and property to help you identify hazards and plan actions to reduce these risks.

FAMILY CONSIDERATIONS

This bushfire survival plan is for (list all household members):

What will be your trigger to leave? (consider triggers such as seeing a fire, the smell of smoke, family members being home alone, the Fire Danger Rating, loss of water or power and the ability to leave your home safely)

What will you do with your pets and/or livestock?

What will you take with you? (eg. survival kit, personal documents, personal items, medications and mobile phones)

How will you get to your safer place?

Where will you and your family/household go?

Address:

What will you do if someone is at school or work?

Who have you told about your bushfire survival plan and your intention to leave?

List any actions that you need to take that are specific to your home: (that may not be outlined in the leaving for a safer place checklist)

Who will you call when you arrive at your safer place?

List the items of protective clothing you will need: (everyone should have protective clothing in case they are unable to leave)

Where will you store your protective clothing?

BUSHFIRE SURVIVAL PLAN LEAVING FOR A SAFER PLACE

WHAT IS YOUR BACKUP PLAN?

You and your family planned to leave but it is too late. What will you do?

What might go wrong with your plan to leave? (eg. you have no transport)

How safe is your home if leaving is no longer an option?

PREPARING YOUR PROPERTY

What will you do as the fire front approaches? (ie. closing all doors and windows, filling buckets with water, turning off your evaporative air conditioner)

Identify potential fire risks around your home: (gaps in roofing and structure, evaporative air conditioners, vents, chimneys etc.)

List equipment you will need: (hoses, rakes, shovels pumps, generators etc.)

Where is your independent water supply and how will you access it? Do you have at least 20,000 litres?

What will you do if your home catches on fire while the fire front is passing? Where will you go to be safer?

CHECKLIST LEAVING FOR A SAFER PLACE PAGE 1 OF 1

AT THE START OF THE BUSHFIRE SEASON

- [ ] Complete the checklists on page 29 and 30.
- [ ] Consider what you will do if you cannot leave for a safer place (have a backup plan).

ON THE DAY THE BUSHFIRE THREATENS

- [ ] Keep updated with bushfire information.
- [ ] Leave early – what is your trigger to go.
- [ ] Move livestock to a safe area and put your pets in a safe place.
- [ ] Put your survival kit including drinking water, food and medications to last four (4) days into your car.
- [ ] Pack personal items such as change of clothing for everyone, cash and credit cards, medications, mobile phone, and toys for children, and put them in the car.
- [ ] If your car is behind an electric garage door, take it out of the garage and position it in the driveway or on the side of the road.
- [ ] Remove any material that could burn easily from around your house, on decks, verandas and pergola areas. This includes mats, outdoor furniture and wood piles.
- [ ] Make sure everyone is wearing protective clothing – long pants, long sleeved shirt and sturdy shoes such as leather boots. Clothes should be loose fitting and made from natural fibres like pure wool, heavy cotton drill or denim. Do not wear synthetics.
- [ ] Close all doors, windows and shutters.
- [ ] Turn off the mains gas supply to the house and any gas cylinders.
- [ ] Do not forget to lock your home, shed and garage securely before you go.
- [ ] Let someone know where you are going, when you are going and how long you will be there.

RETURNING HOME

- [ ] Listen to the radio, check the DFES website or with local police for when it is safe for you to return home. Roads may be closed for some time while the area is made safe.

YOU AND YOUR FAMILY PLANNED TO LEAVE BUT IT IS TOO LATE:

- [ ] Bring your pets inside.
- [ ] Turn off your evaporative air conditioner but leave water running through the system if possible.
- [ ] Close all doors, windows and shutters.
- [ ] Fill basins, sinks, baths, troughs and buckets with water.
- [ ] Locate mops and other equipment.
- [ ] Soak towels and rugs in water, and lay along the inside of external doorways.
- [ ] Soak blankets and keep them handy for protection against radiant heat.
- [ ] Take down curtains and push furniture away from windows.
- [ ] Place a ladder and torch close to the manhole so you can regularly check the ceiling space for embers and spot fires.
- [ ] If people are expecting you to leave, let them know you were unable to and you are now staying.
- [ ] If you still have electricity, keep electricity on but be aware of electrical safety at all times.
- [ ] Take all hoses, hose fittings (including plastic tap attachments) and equipment inside.
- [ ] Move everyone into the house when you see flames or it is too hot and smoky to stay outside.
- [ ] Stay inside the house while the fire front passes. This normally takes between five and fifteen minutes. Check for any spot fires inside the house.
- [ ] Drink plenty of water to avoid becoming dehydrated.
- [ ] Tune into ABC radio for fire information. Make sure you have a battery operated radio and spare batteries.
- [ ] Read *Sheltering in a Bushfire* on page 20 of this publication.

CHECKLIST PREPARE TO ACTIVELY DEFEND PAGE 1 OF 1

You should have equipment to actively defend your home, protective clothing for all your family and a well prepared property.

WEAR PROTECTIVE CLOTHING

Everyone must wear protective clothing to avoid injury from sparks, embers and extreme heat. Cover as much of your skin as you can with two layers of loose fitting clothing. It will be very hot so avoid tight fitting clothes and synthetic clothing.

Wear

- ✓ Loose fitting clothes made from natural fibres like pure wool, heavy cotton drill or denim
- ✓ Long sleeved shirts
- ✓ Trousers, jeans or overalls
- ✓ Sturdy leather shoes or boots without elastic sides (not brand new, worn in)
- ✓ Wool or cotton socks
- ✓ A wide brimmed or hard hat
- ✓ Gloves
- ✓ Goggles or glasses to protect your eyes from ash and embers
- ✓ A moistened face mask to protect your face from ash and other particles

Do not wear

- ✗ Synthetic clothing
- ✗ Singlets
- ✗ T-shirts
- ✗ Short sleeved shirts
- ✗ Shorts
- ✗ Dresses or skirts
- ✗ Sandals or thongs
- ✗ Stockings or synthetic socks

HAVE FIREFIGHTING EQUIPMENT READY

Consider what equipment you will need to actively defend your home.

- Hoses must be long enough to reach all parts of your house. Use metal hose fittings for taps as they are less likely to melt.
- Ladders for inside and outside the house. These need to be long enough so you can check your roof cavity and eaves.
- Knapsack or garden backpack spray to help you put out spot fires. If you decide to use a garden backpack make sure it has been cleaned out before using it in a bushfire.
- Metal rakes and shovels can be used to break up piles of burning material and for covering embers with sand.
- Cotton mops can hold a lot of water and can be used to put out embers.
- Buckets allow you to move water quickly and easily.
- Wet towels and blankets can be used under doors and windows to seal gaps. This will stop embers and smoke from coming inside your house.

MAKE SURE THERE IS WATER

It is likely that you will lose water and power supplies during a bushfire. If you are planning to actively defend, you must have at least 20,000 litres available as an independent water supply.

This should be a concrete or steel tank. Other storage options around your property that you could fill with water include:

- Rubbish bins (wheelie bins) and storage bins
- Bath, laundry tub, sinks, basins and buckets
- Troughs or garden ponds
- Swimming pool and dams if available

To draw on your 20,000 litre water supply, you will need:

- A generator (>1.5 kVA) to drive a home pressure pump or a petrol or diesel firefighting pump.
- Pumps and generators should be able to pump 400 lpm and must be shielded from high temperature.
- Hoses from the pump should be long enough to reach all corners of the home and should be fitted with a nozzle able to deliver 30 to 100 lpm.
- Sufficient fuel or diesel to run your pumps and generators.

BUSHFIRE SURVIVAL PLAN PLANNING TO ACTIVELY DEFEND PAGE 1 OF 2

Use this guide to develop a bushfire survival plan that is suitable for your family and personal situation. You may wish to sketch a plan of your house and property to help you identify hazards and plan actions to reduce these risks.

FAMILY CONSIDERATIONS

This bushfire survival plan is for: (list all household members)

Who will leave for a safer place? (consider very young children, elderly, people with disabilities and ill family members).

Where will they go and how will they get there?

What will be the trigger for them to leave?

What will you do if someone is at school or work?

What additional items do you need to add to your survival kit and where will it be stored?

PREPARING YOUR PROPERTY

Identify potential fire risks around your home: (gaps in roofing and structure, evaporative air conditioners, vents, chimneys etc.)

List any modifications you need to make and when:

List equipment you will need and where you will store it: (hoses, rakes, shovels, pumps, generators etc.)

Where is your independent water supply and how will you access it? Do you have at least 20,000 litres to defend your property?

BUSHFIRE SURVIVAL PLAN PLANNING TO ACTIVELY DEFEND PAGE 2 OF 2

PERSONAL SAFETY

Issues to be considered:

How many people will you need to actively defend your home?

Who will be there to help you?

List the items of protective clothing you will need: (everyone should have protective clothing in case they cannot leave)

Where will you store your protective clothing?

What is your backup plan if:

One person is home alone?

You cannot to return to your home to actively defend your house (roads blocked)?

ON THE DAY OF A BUSHFIRE

List what you need to do before the fire front arrives that are specific to your property: (that may not be listed in the 'planning to actively defend' checklist)

What do you need to do to make your pets and livestock safe?

If you plan to relocate some family members, pets or livestock and then return to your house, when will this be done and how long will this take?

What will you do if your home catches on fire while the fire front is passing? Where will you go to shelter?

CHECKLIST PLANNING TO ACTIVELY DEFEND PAGE 1 OF 1

AT THE START OF THE BUSHFIRE SEASON:

- [ ] Complete the checklists on page 29 and 30.
- [ ] What you will do if you cannot actively defend your home (have a backup plan).

ON THE DAY THE BUSHFIRE THREATENS

- [ ] Find out what the Fire Danger Rating is for your area.
  - If it is CATASTROPHIC leaving for a safer place is your best option. This is because homes are not built to withstand such dangerous fires.
  - If it is EXTREME leaving is the best option for your survival.
  - If you have not maintained your property or are in doubt, leave.

BEFORE THE FIRE FRONT ARRIVES

OUTSIDE

- [ ] Use a moistened mask or cotton cloth to help protect against ash.
- [ ] Move large animals and livestock to a safe location (as identified in your bushfire survival plan).
- [ ] Check your water supplies around the house, fill any additional containers that might be available.
- [ ] Bring outdoor furniture, mats and any other loose items that may burn inside.
- [ ] Wet down the side of the house and surrounding garden area that is facing the fire. If you have power and water, leave reticulation running.
- [ ] Block downpipes and fill gutters with water.
- [ ] Regularly patrol for spot fires around your home and put them out with your rake or knapsack spray.
- [ ] Turn off the mains gas supply to the house and any gas cylinders.

INSIDE

- [ ] Put your bushfire survival plan into action.
- [ ] Safely relocate young children and elderly family members.
- [ ] Everyone remaining needs to put on protective clothing.
- [ ] Bring pets inside.
- [ ] Turn off your evaporative air conditioner but leave water running through the system if possible.
- [ ] Fill basins, sinks, bath, troughs and buckets with water.
- [ ] Locate mops and other equipment.
- [ ] Soak towels and rugs in water, and lay along the inside of external doorways.
- [ ] Soak blankets and keep them handy for protection against radiant heat.
- [ ] Take down curtains and push furniture away from windows.
- [ ] Place a ladder and torch close to the manhole so you can regularly check the ceiling space for embers.
- [ ] Keep electricity on but be aware of electrical safety at all times.

AS THE FIRE FRONT APPROACHES AND DURING THE FIRE

- [ ] Take all hoses, hose fittings (including plastic tap attachments) and equipment inside.
- [ ] Move everyone into the house when you see flames or it is too hot and smoky to stay outside.
- [ ] Frequently check the roof cavity (through the manhole inside the house) for any spot fires.
- [ ] Stay inside the house while the fire front passes. This normally takes between five and fifteen minutes. Check for any spot fires inside the house.
- [ ] Drink plenty of water to avoid becoming dehydrated.
- [ ] Tune into ABC radio for fire information.

AFTER THE FIRE FRONT HAS PASSED

- [ ] Ensure everyone continues to wear protective clothing.
- [ ] Check the house thoroughly for spot fires both inside and outside when it is safe.
- [ ] Check for embers or signs of smoke in places such as roof cavity, under house spaces and around verandas, wooden decking, stairs, window sills and doorways. Also check sheds, carports and fences.
- [ ] Patrol your home for several hours for small fires and burning embers.

IF YOUR HOUSE CATCHES FIRE

- [ ] If your house catches fire as the fire passes and you are unable to put it out, leave immediately after the fire front has passed.
- [ ] Move on to a fuel-free area such as a driveway, lawn or on to already burnt ground.
- [ ] Beware of any hazards such as burning logs or materials.
- [ ] Do not return inside the house for any reason.

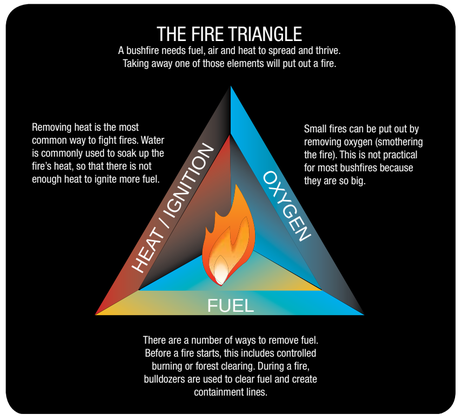
LEAVING AFTER THE FIRE FRONT HAS PASSED

- [ ] Leaving immediately after the fire front has passed can be dangerous, there may be hazards such as fallen power lines, trees and other risks.
- [ ] You need to listen to the radio or check with local police for when it is safe to leave.

FACT SHEET FIRE BEHAVIOUR

There are thousands of bushfires in Western Australia each year. Western Australia is one of the most bushfire prone parts of the world. No one knows where or when the next major bushfire will hit. You can increase the chance that your home and loved ones will survive a bushfire.

In 2010, career and volunteer firefighters responded to and put out more than 7000 bushfires across Western Australia.



HOW BUSHFIRES BEHAVE

It is important you understand how bushfires behave to help you protect your family and home against them. All fires need fuel, air and heat.

FUEL

Vegetation around your home like dry grass, leaves, twigs and bark provide fuel for a fire. This fuel plays a part in how hot a fire can be and how fast it can spread. If fuel is removed, the fire will starve.

HEAT

Bushfires generate unbelievable heat. Much of this heat goes up into the air but significant heat also radiates at ground level. This radiant heat spreads the fire by drying out vegetation so it will burn.

RADIANT HEAT

Radiant heat is the main cause of people dying in a bushfire. Radiant heat may not set fire to your home but it can crack and break windows that will allow embers in. The best protection from radiant heat is distance.

EMBERS

Even if the fire front does not reach your home it can still be damaged by burning embers carried by strong winds. Embers can get into your home through gaps in roofs, walls, evaporative air conditioners, windows and doors. They can land on materials that easily burn and this can start a fire. Research has shown that ember attack is the main reason that houses catch fire during a bushfire. Embers can continue to threaten your home even after the fire front has passed.

DIRECT FLAME CONTACT

When materials close to your home catch fire flames can touch the outside of your home. How long flames are in direct contact with your home depends on the amount of fuel to be burnt.

AIR

A bushfire needs air to keep going and the more there is the faster the fire burns. Strong winds not only force the fire along but also increase air circulation and provide more air.

Any change in wind direction or speed can rapidly increase the rate of spread and the direction of the fire. The prevailing afternoon breeze in summer presents the most common threat as it fans bushfires when fuel is at its driest during the day.

WIND

Strong winds usually come with bushfires and as the wind increases so does the fires temperature. The wind pushes flames closer to fuel making the fire travel faster. Embers and other burning materials are also carried by the wind which can damage homes kilometres from the fire front.

FACT SHEET TOTAL FIRE BANS

When a Total Fire Ban (TFB) is declared it will usually be in place from 12.01am to 11.59pm.

If conditions change through the day, a TFB can be declared or revoked.

When a TFB is declared, it is illegal to do anything that is likely to start a fire.

WHAT CAN'T I DO ON A TOTAL FIRE BAN DAY?

Some of the activities that are not allowed on TFB days include, but are not limited to:

- No barbecues that use solid fuel or have an open flame, this includes wood fired pizza ovens
- No grinding, welding or other forms of 'hot works' are allowed unless you have an exemption
- No burning of leaves, rubbish or an incinerator
- No camp fires, no cooking outdoors
- No fireworks or hot air ballooning.

WHAT ARE THE PENALTIES?

You could be fined up to $25,000 and/or jailed for 12 months, if you ignore a TFB.

WHAT OTHER FIRE RESTRICTIONS ARE THERE?

Depending on the time of the year, there may be other restrictions on lighting fires or other fire risk activities in your area. Check with your local government for details.

How will I know if a Total Fire Ban has been declared?

When a TFB has been declared it will be:

- Featured on the DFES website at www.dfes.wa.gov.au
- On the DFES information line on 1300 657 209
- Broadcast on ABC local radio and other media outlets
- Displayed on local government roadside Fire Danger Rating (FDR) signs and variable message signs on major highways.
- For more information visit www.dfes.wa.gov.au or call the Total Fire Ban information line on 1800 709 355

Call 000 to report a fire.

To report suspicious activity, call Crimestoppers on 1800 333 000

FACT SHEET BURNS TREATMENT



Burns can be life threatening. If you or someone near you is burnt, act immediately.

1. Check for danger and call for help

Watch out for hazards such as electrical wires and fire. If it is safe to do so, stop, disconnect or remove these hazards before you help the patient to avoid injury to rescuers, bystanders or the patient. If the scene is unsafe, call **000** or the relevant authorities for help.

2. Stop the burning

Stop, Drop, Cover, Roll. Remove the burning source or move the patient.

The source of heat or burning should be stopped and the patient should be removed from the burning source.

This includes removing burned clothing, unless it is stuck to the patient. Jewellery on burned limbs should also be removed as it may constrict when swelling occurs over the next few hours.

3. ABCs

Remember to monitor Airway, Breathing and Circulation as part of basic life support. Call **000** if the patient is unwell.

4. Cool the burn for 20 minutes

Never use ice, oils or creams. Cooling methods should be applied for at least 20 minutes and be administered as soon as possible.

Cooling the wound is very important, it can significantly reduce the size of injury as well as reduce pain and swelling. Cooling the burn has an effect up to three hours post injury.

Clean, cool running water between 5-25°C is the best choice. Wet towels, refreshed with cool water every 2-3 minutes or burn specific gel sheets are useful alternatives.

Lakes, oceans, rivers and swimming pools can also help cool the burn, but there is an infection risk in still water. As such, these cooling methods should only be used when other first aid options are unavailable. Ice or icy water can cause further injury.

Never use water below 4°C as it causes reduced skin blood flow which can increase skin damage.

5. Chemical burns are serious

Chemical burns require additional irrigation and urgent medical attention for treatment specific to the chemical injury. If you are unsure of the chemical involved, bring the chemical bottle or label to the hospital.

6. Cover the wound

Wet clothes or towels are good dressings

Dressings help reduce pain and infection. Wet, clean, cotton dressings are a good choice. Gel based burns specific dressings are an alternative.

7. Avoid Hypothermia

Cool the wound, but warm the patient

Hypothermia is a risk of over-vigorous patient cooling, especially in children and the elderly.

Attempt to keep unburned areas of the skin dry and warm, remove wet clothing and wrap the patient in a blanket.

8. Seek medical aid urgently

Present to your doctor, local emergency department or call an ambulance. You can also get advice from HealthDirect on **1800 022 222.**

PREPARE. ACT. SURVIVE.

SUMMARY

Being prepared for the bushfire season is a shared responsibility between the Government, fire agencies and the community. If you live, work or travel in an area where bushfires may occur then you need to prepare a bushfire survival plan ahead of time and practise it regularly. If you are well prepared and stay informed you will improve your safety and chances of survival.

PREPARE

weeks and months before the bushfire season

You must make the important decisions before the season starts.

Whether you choose to leave early to go to a safer place or to stay and defend your well prepared home, preparation is the key to survival.

- ☐ Know and understand your bushfire risk.
- ☐ Prepare yourself, your family, your house and business.
- ☐ If you decide to stay and actively defend be physically and mentally prepared to defend for several hours.
- ☐ Prepare a bushfire survival plan – a good plan is one that is practised and has backup plans to allow for different circumstances on the day.

ACT

on the daily Fire Danger Ratings

The higher the Fire Danger Rating, the more dangerous the conditions.

Be prepared to act without receiving an official warning.

You need to:

- ☐ Know the daily Fire Danger Rating for your area and what you need to do.
- ☐ Stay alert to your surroundings and stay informed.
- ☐ Act decisively the moment you know there is a fire in your area.
- ☐ Put your plan into action.

The Department of Fire and Emergency Services (DFES) can not guarantee a fire truck or water bomber will be there to protect your property.

SURVIVE

during a bushfire

Fires may threaten without warning – know what you will do to survive.

Your survival and safety depends on the decisions you make. The safest place to be is away from the fire. Being involved in a fire may be one of the most dangerous and traumatic experiences of your life.

- ☐ Monitor conditions and keep up to date.
- ☐ You need to know what to do if you are caught in or threatened by fire with little or no warning.
- ☐ Make decisions and take action to protect you and your family.
- ☐ Know where your places of last resort are in case your plan fails.

For information on current alerts and warnings:

1300 657 209

www.dfes.wa.gov.au

IMPORTANT CONTACT DETAILS: BUSHFIRE SURVIVAL PLAN

DATE OF THIS PLAN:

IMPORTANT PHONE NUMBERS

Fire, Police, Ambulance:	**000 (TTY 106)**
Insurance Company:	
Policy number:	
Local Council:	
Bank:	
Doctor:	
School:	
Vet:	
Water Supplier:	
Electricity Supplier:	
Gas Supplier:	
Family / Friends:	
Family / Friends:	
Family / Friends:	
Department of Fire and Emergency Services Information line:	**1300 657 209**
The frequency of our local ABC and /or other radio station broadcasting emergency warnings and information:	
Our Fire Ban District is:	
A safer place we can go to is:	
Our place of last resort to shelter in (for if all plans fail):	
Leave early – who is going to leave early?	
Name:	Phone Number:
Name:	Phone Number:
Name:	Phone Number:
Name:	Phone Number:
Stay and defend – who will stay and defend?	
Name:	Phone Number:
Name:	Phone Number:
Name:	Phone Number:
Name:	Phone Number:

Listen out for bushfire 'Watch and Act' and 'Emergency Warning' messages

Monitor your local ABC or other radio station broadcasting emergency information using a battery powered radio

FESAOCT12_246

Appendix 2

DFES: Fire Incident Report
Lot E26 Kwinana Town Centre
(May, 2013)

Fire Callouts - Vicinity of Lot E26 Gilmore Avenue, Kwinana Town Centre

Incidents identified are broadly within the following boundaries:

NE: Cross Streets Meares Avenue / Challenger Avenue Parmelia
SE: Cross Streets Mears Avenue / Wellard Road Wellard
SW: Cross Streets Gilmore Avenue / Wellard Road Calista
NW: Cross Streets Gilmore Avenue / Challenger Avenue Kwinana Town Centre

Timeframe: 1/1/2003 - 16/5/2013

Note: Incidents with insufficient location details have been excluded from this report. This includes incidents attended on Gilmore Avenue, Wellard Road, Challenger Avenue and Meares Avenue where a precise location was not recorded.

Incident No	Incident Date/Time	Description	
3106	27/08/2003 5:21:29PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
12900	2/01/2004 12:59:38PM	Landscape Fire	CHALLENGER RD
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
16420	12/02/2005 9:11:53AM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
29937	2/09/2005 5:15:50PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
31488	2/10/2005 2:59:48PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
32515	20/10/2005 11:54:23AM	Landscape Fire	CHALLENGER AV
Cause:	N/A		PARMELIA
Approx Size:	1 Hectare or Less		

Incident No	Incident Date/Time	Description	
35802	7/12/2005 1:19:02AM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
36719	18/12/2005 7:46:32PM	Landscape Fire	WELLARD RD
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
43517	17/03/2006 9:25:19PM	Landscape Fire	CHALLENGER AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
43579	18/03/2006 3:29:46PM	Landscape Fire	CHALLENGER AV
Cause:	N/A		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
47995	15/05/2006 12:07:08AM	Landscape Fire	CHALLENGER AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
48431	21/05/2006 8:42:43AM	Landscape Fire	CHALLENGER
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
61542	24/11/2006 1:48:16AM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
61544	24/11/2006 2:37:14AM	Landscape Fire	GILMORE
Cause:	Suspicious/Deliberate		CALISTA
Approx Size:	1 Hectare or Less		
62307	2/12/2006 2:25:02PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
65503	5/01/2007 12:34:42AM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
69838	22/02/2007 12:53:56PM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
69844	22/02/2007 2:13:08PM	Landscape Fire	CHALLENGER AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		

Incident No	Incident Date/Time	Description	
80043	11/07/2007 2:20:59PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
94571	19/01/2008 5:22:21PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
701	8/02/2008 3:55:36PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
1377	17/02/2008 11:17:06AM	Landscape Fire	MEARES AVE
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
1930	23/02/2008 6:49:37PM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
5086	29/03/2008 9:36:50AM	Landscape Fire	WELLARD RD
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
8068	4/05/2008 12:20:29PM	Landscape Fire	MEARES AV
Cause:	Accidental		PARMELIA
Approx Size:	1 Hectare or Less		
8147	5/05/2008 3:00:36PM	Landscape Fire	CHALLENGER AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
8286	7/05/2008 2:51:28PM	Landscape Fire	CHALLENGER AVENUE
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
121612	14/04/2009 2:47:14PM	Landscape Fire	CHALLENGER AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
123721	8/05/2009 9:48:21PM	Other Fires - Includes Rubbish & Vehicle	WELLARD RD
Cause:	Suspicious/Deliberate		CALISTA
Approx Size:	1 Hectare or Less		
128733	13/07/2009 12:04:41AM	Other Fires - Includes Rubbish & Vehicle	WELLARD RD
Cause:	Suspicious/Deliberate		CALISTA
Approx Size:	1 Hectare or Less		

Incident No	Incident Date/Time	Description	
137703	22/11/2009 10:07:49AM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
138689	2/12/2009 4:08:42PM	Landscape Fire	GILMORE AV
Cause:	Accidental		CALISTA
Approx Size:	1 Hectare or Less		
138742	3/12/2009 8:12:57AM	Landscape Fire	MEARES AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
140134	17/12/2009 3:02:59PM	Other Fires - Includes Rubbish & Vehicle	GILMORE AV
Cause:	Accidental		CALISTA
Approx Size:	1 Hectare or Less		
142945	17/01/2010 8:03:12AM	Landscape Fire	GILMORE AV
Cause:	N/A		CALISTA
Approx Size:	1 Hectare or Less		
146228	24/02/2010 1:33:02PM	Landscape Fire	MEARES AV
Cause:	N/A		PARMELIA
Approx Size:	2 to 3 Hectares		
147612	11/03/2010 9:43:40PM	Landscape Fire	GILMORE AV
Cause:	Accidental		CALISTA
Approx Size:	1 Hectare or Less		
158965	12/08/2010 7:22:03PM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		CALISTA
Approx Size:	1 Hectare or Less		
161210	18/09/2010 1:10:20AM	Landscape Fire	CHALLENGER AV
Cause:	Suspicious/Deliberate		PARMELIA
Approx Size:	1 Hectare or Less		
167579	1/12/2010 6:51:25PM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
176491	15/03/2011 2:41:00PM	Other Fires - Includes Rubbish & Vehicle	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
179718	24/04/2011 1:15:17AM	Other Fires - Includes Rubbish & Vehicle	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		

Incident No	Incident Date/Time	Description	
186698	24/07/2011 4:53:49PM	Landscape Fire	CHALLENGER AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
199582	8/01/2012 3:28:30AM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
202126	2/02/2012 1:11:14AM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
202646	8/02/2012 4:20:35AM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	2 to 3 Hectares		
203066	12/02/2012 5:33:42AM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
204163	25/02/2012 1:33:54AM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
224319	24/10/2012 11:25:35PM	Landscape Fire	GILMORE AV
Cause:	Suspicious/Deliberate		KWINANA TOWN CENTRE
Approx Size:	1 Hectare or Less		
230969	4/01/2013 10:01:02AM	Landscape Fire	WELLARD RD
Cause:	Suspicious/Deliberate		CALISTA
Approx Size:	1 Hectare or Less		
236500	5/03/2013 2:33:00AM	Landscape Fire	MEARES AV
Cause:	Accidental		PARMELIA
Approx Size:	1 Hectare or Less		

Total Number of incidents 51

EXTERNAL USE APPROVED

The information contained within this report will be published and available to individuals or organisations outside of DFES. The data contained in the report has been fully checked and Quality Assured by the Operational Information Systems Unit.

Appendix 3

FMP Checklist

Compliance checklist for performance criteria and acceptable solutions

Element 1: Location

Does the proposal comply with the performance criteria by applying acceptable solution A1.1?

Yes ☑ No ☐

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P1 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Refer 6.1.1. & Figure 6

Element 2: Vehicular access

Does the proposal comply with the performance criteria by applying acceptable solution A2.1?

Yes ☑ No ☐ Refer 6.1.2 & Figure 5

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.2?

Yes ☑ No ☐ Refer 6.1.2 & Associated Traffic Report

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.3?

Yes ☑ No ☐ Refer 6.1.2 & Figure 5

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.4?

Yes ☑ No ☐ Refer 6.1.2

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.5?

Yes ☑ No ☐ NB; No House is further than 50m from a Public Road

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.6?

Yes ☑ No ☐ NB: No Emergency Access ways Provided - All Public Roads

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.7?

Yes ☑ No ☐ NB: No Cul-de-Sacs & only Public Roads

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.8?

Yes ☑ No ☐ NB: No Gates Required - All Public Roads.

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.9?

Yes ☑ No ☐ NB: Firebreaks are not required.

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A2.10?

Yes ☑ No ☐ NB: No Emergency Access Ways Provided.

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P2 for this area of non-compliance, and attach this explanation to the rear of this checklist.

* Please Refer Clause 6.1.2

↳ FMP to be read in Conjunction with LSP.

Element 3: Water

Does the proposal comply with the performance criteria by applying acceptable solution A3.1?

Yes ☑ No ☐ Refer 6.1.3

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A3.2?

Yes ☐ No ☐ N/A

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A3.3?

Yes ☐ No ☐ N/A

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P3 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Element 4: Siting of development

Does the proposal comply with the performance criteria by applying acceptable solution A4.1?

Yes ☑ No ☐ Refer 6.1.4. → BAL's imposed

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A4.2?

Yes ☑ No ☐ Refer 6.1.4 & 6.1.5

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A4.3?

Yes ☑ No ☐ Refer 6.1.4 re: BAL & BPZ

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please indicate the extent of the building protection zone on the plans submitted.

Does the proposal comply with the performance criteria by applying acceptable solution A4.4?

Yes ☑ No ☐ Refer 6.1.4 MS2

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please indicate the extent of the hazard separation zone on the plans.

Does the proposal comply with the performance criteria by applying acceptable solution A4.5?

Yes ☑ No ☐ N/A @ Structure Plan level - subject to subdivision

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P4 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Note: Please provide details of the proposed shielding to be implemented as part of the development.

Element 5: Design of development

Does the proposal comply with the performance criteria by applying acceptable solution A5.1?

Yes ☑ No ☐

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P5 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Does the proposal comply with the performance criteria by applying acceptable solution A5.2?

Yes ☑ No ☐ Refer 6.1.5 & BAL Assessment

If no, please explain in writing how the proposal satisfactorily complies with performance criterion P5 for this area of non-compliance, and attach this explanation to the rear of this checklist.

Applicant Declaration

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

Full name: Jaclyn Drummond - Burgess Design Group

Applicant signature: [signature]

Date: 28/10/13

Application property details:

The Fire Management Plan has been prepared at the Strategic Level as set out under Appendix One of the WAPC Planning for Bushfire Protection Guidelines.

The FMP supports a Structure Plan over Lot E26 in the Kwinana Town Centre and should therefore be read in conjunction with the Structure Plan and all other technical reports.

The FMP has been prepared in response to the Model plan set out under Appendix 3 of the WAPC Guidelines.