Perth and Peel Green Growth Plan for 3.5 million

Strategic Assessment of the Perth and Peel Regions

Draft EPBC Act Strategic Impact Assessment Report

Part D: MNES Assessment  

December 2015
Acknowledgements
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16 Other threatened fauna

16.1 SUMMARY

Eleven threatened fauna species are assessed in this Chapter. They include the Australasian Bittern, Australian Painted Snipe, Baudin’s cockatoo, Chuditch, Forest Red-tailed Black Cockatoo, Native Bee, Quokka, Short-Tongued Bee, Western Ringtail Possum, Western Swamp Tortoise and the Woylie.

Impacts to these species are likely to be limited and effectively mitigated by the provisions in the Strategic Conservation Plan. Most of the species are largely avoided by proposed development, and most conservation commitments relate to the management of indirect impacts and maintenance of habitat connectivity.

The conservation objectives for all eleven species will be achieved through implementation of the Strategic Conservation Plan.

16.1.1 Habitat, anticipated impacts and avoidance

In general, the potential for direct impacts to the eleven species are limited. No more than 9% of known or potential habitat for any species within the Strategic Assessment Area intersects with a class of action and is not protected within conservation category wetlands. For most of these species, the areas of intersection are much smaller as shown in Figure 16-1.

![Habitat status within the Strategic Assessment Area](image)

**Figure 16-1: Habitat status within the Strategic Assessment Area**

- Habitat within SAA intersecting with a CoA and not protected in a conservation category wetland (percentage given at top of chart)
- Habitat within SAA intersecting with a CoA and in a conservation category wetland
- Habitat within SAA not intersecting with a CoA

* Potential habitat has been shown for the two cockatoo species as known habitat data is not available.
Six of the species are widely distributed outside the Strategic Assessment Area and largely avoided by the proposed classes of action. The Woylie, Australasian Bittern, Chuditch, Western Ringtail Possum, Australian Painted Snipe and Quokka all have less than 5% of their known habitat within the Strategic Assessment Area, of which less than 6% intersects with a class of action. The main concerns for these species are loss of habitat connectivity and potential indirect impacts.

The remaining five species are more dependent on the Strategic Assessment Area.

The Western Swamp Tortoise has only two surviving natural populations, both within the Strategic Assessment Area (a translocated population has been released outside it). All known habitat and 98% of potential habitat within the Strategic Assessment Area is avoided by the class of action footprints.

The Strategic Assessment Area contains all of the known habitat and 81% of the potential habitat for the two bee species (*L. douglasiellus* and *N. simplicior*). Of the known habitat, 10% intersects with a class of action, 97% of which is contained within conservation category wetlands which are protected under the Strategic Conservation Plan. 12% of potential habitat within the Strategic Assessment Area intersects with a class of action, of which only 29% is protected within conservation category wetlands.

The two cockatoo species (Forest Red-tailed Black Cockatoo and Baudin's cockatoo) both have 14% of their potential habitat within the Strategic Assessment Area. Of this, 4% and 2% intersect with a class of action. This is not expected to impact either species through a reduction of habitat connectivity.

### 16.1.2 Conservation commitments

Action Plan F sets out overarching commitments to manage direct and indirect impacts, especially for conservation category wetlands.

There are no specific conservation commitments for the Woylie or Quokka beyond the measures in Action Plan F. The Forest Red-tailed Black Cockatoo and Baudin's cockatoo are also not subject to specific conservation commitments, however the conservation commitments for Carnaby's cockatoo (presented in Chapter 15) are considered sufficient to protect these two species as their habitat and connectivity requirements are similar.

Additional commitments have been made to manage direct and indirect impacts to the Western Swamp Tortoise, Australasian Bittern and Australian Painted Snipe, and to manage indirect impacts and maintain habitat connectivity for the Chuditch and Western Ringtail Possum. Potential Western Swamp Tortoise habitat and the possible translocation site have also been protected in keeping with the relevant Environmental Protection Policy (EPA 2010, Government of WA 2012b).

Conservation commitments have been provided to protect known populations and increase the extent of protected areas that support known habitat for the two bee species.

The design of the classes of action, implementation of species specific and over-arching conservation commitments will ensure that:

- conservation objectives for each species will be achieved; and
- outcomes are not inconsistent with any approved Recovery Plans or Threat Abatement Plans.
16.2 INTRODUCTION

Fourteen category 1 and 2 threatened fauna species were identified in Chapter 12 for detailed impact assessment. Eleven of these are addressed in this chapter (see Table 16-1).

In addition:

- Carnaby's cockatoo is addressed separately in Chapter 15.
- The Curlew Sandpiper and Eastern Curlew are addressed in conjunction with migratory shorebirds in Chapter 20.

Table 16-1: Category 1 and 2 threatened fauna species addressed in this chapter

<table>
<thead>
<tr>
<th>Scientific name (common name)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bettongia penicillata ogilbyi</td>
</tr>
<tr>
<td>(Woylie)</td>
</tr>
<tr>
<td>Dasyurus geoffroii</td>
</tr>
<tr>
<td>(Chuditch)</td>
</tr>
<tr>
<td>Pseudemydura umbrina</td>
</tr>
<tr>
<td>(Western Swamp Tortoise)</td>
</tr>
<tr>
<td>Botaurus poiciloptilus</td>
</tr>
<tr>
<td>(Australasian Bittern)</td>
</tr>
<tr>
<td>Leioproctus douglasillius</td>
</tr>
<tr>
<td>(Short-Tongued Bee)</td>
</tr>
<tr>
<td>Rostratula australis</td>
</tr>
<tr>
<td>(Australian Painted Snipe)</td>
</tr>
<tr>
<td>Calyptorhynchus banksii naso</td>
</tr>
<tr>
<td>(Forest Red-tailed Black Cockatoo)</td>
</tr>
<tr>
<td>Neopasiphae simplicior</td>
</tr>
<tr>
<td>(Native Bee)</td>
</tr>
<tr>
<td>Setonix brachyurus</td>
</tr>
<tr>
<td>(Quokka)</td>
</tr>
<tr>
<td>Calyptorhynchus baudinii</td>
</tr>
<tr>
<td>(Baudin's cockatoo)</td>
</tr>
<tr>
<td>Pseudocheirus occidentalis</td>
</tr>
<tr>
<td>(Western Ringtail Possum)</td>
</tr>
</tbody>
</table>

16.3 CONSERVATION OUTCOME

The conservation outcome for threatened species and ecological communities is:

“The viability and conservation status of listed threatened species and ecological communities in the Perth and Peel regions is maintained, and where possible improved, with measures and actions consistent with any approved Commonwealth recovery plans, threat abatement plans or conservation advice.”

This conservation outcome applies to threatened fauna and is included in the Strategic Conservation Plan. It is a key component to the protection of MNES and forms the highest level in the conservation outcomes framework (see Chapter 7).

The conservation outcome is supported by detailed objectives and (where relevant) commitments for the eleven fauna species discussed in this chapter.

16.4 BASELINE INFORMATION FOR THREATENED FAUNA

The following sections provide an outline of the resources and methods used in generating the baseline information used in the threatened fauna impact assessments. Reference should also be made to the overall description of information for the assessment outlined in Chapter 6.
16.4.1 Mapping

The baseline mapping for threatened fauna was specifically developed for the strategic assessment by the Department of Parks and Wildlife. Specific approaches were taken for each species. However, in general the mapping shows known and potential habitat across:

- the distribution of the species within Western Australia; and
- the Strategic Assessment Area.

Data

A range of data was used to inform the mapping process for threatened fauna. The following types of information were used variously across the species:

- Remnant vegetation: updated by Parks and Wildlife as part of the strategic assessment (see Chapter 6).
- Conservation category wetlands: including geomorphic, Ramsar, nationally important, and EPP lakes.
- Species records contained in NatureMap: NatureMap is a joint project of Parks and Wildlife and the Western Australian Museum. It presents the most comprehensive and authoritative source of information on the distribution of Western Australia’s flora and fauna.
- Commonwealth species mapping: broad level distribution maps generated by the Commonwealth Department of the Environment.
- WA distribution mapping: distribution mapping held by Parks and Wildlife.
- Bioregions: location of bioregions.
- Rainfall.
- Species records for associated habitat plant species.
- Reserve boundaries.
- EPP area for the Western Swamp Tortoise.

Mapping criteria

For each species, experts within Parks and Wildlife developed a set of criteria to map known and potential habitat. This process led to the mapping of a number of habitat types for each species for use in the assessment. The criteria (presented in Appendix B for each species) typically reflect known and potential locations that are buffered or intersected with associated habitat types.

It is critical to note that this mapping has been developed at a landscape scale for the purposes of the strategic assessment. It provides a broad scale understanding of known and potential habitat areas and is not intended for use at very fine scales.
16.5 IMPACT ASSESSMENT APPROACH FOR FAUNA

The overall approach to the impact assessment is provided in Part B of the report. In addition to this general approach, a tailored approach to the impact assessment for fauna has been developed which includes a specific methodology to the:

- presentation of information; and
- analysis of direct and indirect impacts.

16.5.1 Presentation of information for each species

The following information is provided for each fauna species:

- **Species background** – a summary of the background information for each species (detail provided in the species profiles at Appendix B).
- **Species mapping** – a summary of the approach used for the mapping (detail provided above in Section 16.4.1 with the mapping criteria for each species in Appendix B).
- **Conservation objectives** – identification and justification for the conservation objectives for each species.
- **Status of the species without conservation commitments** – description of potential impacts to known and potential habitat in relation to the classes of action without any additional conservation commitments. Also, identification of key indirect impacts which may affect the species.
- **Will conservation objectives be met without conservation commitments?** – analysis of the likelihood that the conservation objectives will be met without additional conservation commitments within the Strategic Conservation Plan.
- **What conservation commitments are required to meet the conservation objectives?** – (if required) definition of the conservation commitments that are necessary to meet the conservation objectives (includes avoidance, mitigation and offsets as appropriate).
- **Outcomes for the species** – draws the analysis together and makes conclusions about the likely acceptability of the outcome for each species. Also includes:
  - Those additional conservation measures that are likely to benefit the species but that sit outside the direct scope of the Strategic Conservation Plan.
  - A conclusion about the consistency of the outcome for each species with relevant Commonwealth plans and advice (e.g. recovery plan).
- **Mapping** – map or maps of the distribution of each species within the strategic assessment area.

16.5.2 Analysis of direct and indirect impacts to fauna

The overall approach to analysing impacts to MNES is presented in Chapter 8. At a more detailed level, direct and indirect impacts for fauna were addressed as follows.
Direct impacts

Direct impacts were assessed for each species based on an intersection of the fauna mapping (known and potential habitat) with the footprints for each class of action. This analysis considered:

- The extent or scale of loss in terms of hectares to known and potential habitat.
- The distribution of impacts, including whether they were broadly distributed or localised.
- Whether the impacts were discrete or contributed to the loss of other habitat areas through fragmentation or breaks in habitat connectivity (where relevant).

In addition, finer scale analysis was undertaken in relation to significant impact areas which considered issues such as local scale impacts and retention.

Indirect impacts

There are also a range of indirect impacts that have the potential to apply to fauna species across the strategic assessment area due to the classes of action. As outlined in Chapter 8, these include:

- **Direct mortality of individuals**: Typically occurs as a result of collision with vehicles or buildings, shooting, or poaching.
- **Spread of disease**: Relates to the increased risk of disease to fauna.
- **Spread of weeds**: Development and subsequent fragmentation of habitat areas can introduce new pathways for weed transportation.
- **Introduction of feral animals**: Feral animals are a threat to a range of listed fauna. The expansion of urban and rural residential areas has the potential to increase predation from domestic and feral animals, especially cats.
- **Increased risk of fire**: Fire and altered fire regimes are a potential consequence of development in the Perth Peel region.
- **Introduction of linear barriers**: Linear barriers such as fences, sound barriers and roads can influence fauna movement and predation by feral species.
- **Disturbance**: Disturbance relates to a range of impacts caused by human activity near sensitive fauna.
- **Noise and vibration**: Noise and vibration from construction, industrial, infrastructure and BRM activities can have a range of impacts.
- **Artificial lighting**: Artificial lighting is a likely impact in urban, industrial, and commercial areas; around infrastructure; or near BRM sites that use outdoor artificial lighting. Artificial light can affect the behaviour of nocturnal and diurnal species.
- **Alterations to surface water**: Alterations to surface water can affect surface water quality and hydrology which can impact a range of listed species.
- **Alterations to groundwater**: Alterations to groundwater can affect groundwater quality, including salinity and contamination, and hydrology, including recharge and groundwater levels. Alterations to groundwater can affect a range of groundwater sensitive species and habitats.
- **Impacts to air quality**: Potential impacts to air quality include increased dust and particulate pollution, contaminants from vehicle activity, and contamination from industrial activity.
Given the scale of the assessment, it has generally been assumed that potential indirect impacts need to be addressed for all key fauna habitat areas to ensure long-term viability. This is reflected in three ways:

- Species (and their habitats) that are particularly at threat from potential hydrological changes are identified. Several over-arching conservation commitments (see Section 16.5.3) aim to address indirect impacts. This includes the ongoing processes of State planning, assessments and approvals which will address these issues as development proceeds.
- Ongoing management of existing and future conservation reserves in the strategic assessment area needs to address edge effects to protect populations that are present.
- Species specific conservation commitments are provided for key populations that require ongoing management to address potential edge effects.

Based on this over-arching approach to fauna across the Strategic Assessment Area, potential indirect impacts are not addressed in detail in each assessment. However, key areas of concern in relation to indirect impacts are identified for relevant species.

### 16.5.3 Over-arching conservation commitments

Action Plan F of the Strategic Conservation Plan contains a set of over-arching conservation commitments that provide a range of benefits across the Strategic Assessment Area. These commitments will also provide ongoing benefits (in varying ways) to the eleven fauna species discussed in this Chapter (see Table 16-2).

The relevance of the over-arching commitments are identified throughout the impact assessments for each fauna species.

**Table 16-2: Over-arching commitments for MNES and the general benefit to fauna species**

<table>
<thead>
<tr>
<th>Over-arching conservation commitments for MNES</th>
<th>General benefit to fauna species</th>
</tr>
</thead>
</table>
| 1. For urban, industrial and rural residential development, undertake and implement statutory planning to achieve the specific commitments for MNES and State factors. As described in Action Plan A and B this will:  
  - have due regard for the planning undertaken during preparation of the Strategic Conservation Plan for urban and industrial expansion sites and new rural residential zones;  
  - consider additional opportunities for retention of native vegetation, fauna habitat and wetlands; and  
  - be informed by previous EPA advice and Ministerial Statement conditions, or in the absence of this, detailed investigations, within existing zoned urban and industrial areas. | Commitment will lead to further avoidance of impacts within the urban, industrial and rural residential classes of action. These areas provide habitat for a number of fauna species. |
| 2. Ensure direct and indirect impacts to conservation category wetlands (CCWs) are avoided (including through the application of appropriate buffers) within urban, industrial, and rural residential areas. | Commitment will ensure protection of habitat for wetland dependant species across the Strategic Assessment Area. |
Over-arching conservation commitments for MNES | General benefit to fauna species
---|---
3. Implement the infrastructure impact assessment process (which includes planning, avoidance, mitigation, and offsets) to achieve the outcomes and objectives for MNES and State factors (see Action Plan C). | Commitment will ensure new infrastructure considers potential impacts to fauna species (e.g. loss of connectivity).

4. Avoid impacts to Basic Raw Material areas defined as Exclusion Zones through implementing master planning (see Action Plan D). | Commitment will ensure BRM exclusion zones are avoided. These areas provide habitat for a number of fauna species.

5. Implement the conservation program detailed in Action Plan H. This includes:
   - incorporation of 170,000 ha of sites into the conservation reserve system;
   - continued implementation of the Bush Forever Program;
   - implementation of an ongoing offsets program to address residual impacts to MNES and State factors;
   - improving the management and protection of significant environmental values which have already been identified for retention;
   - establishment of the Peel Regional Park; and
   - protect selected Peel Regionally Significant Natural Areas for conservation. | Commitment will provide substantial additions to the conservation reserve system and provide for ongoing management of these sites. These areas provide habitat for a number of fauna species.

6. Implement environmental assessment and management measures, controls and standards for all development to reduce direct and indirect impacts. This will include, but is not limited to, controls on vegetation clearing, water quality and use, stormwater, dust, noise, emissions, public access. This process will involve:
   - ensuring controls / conditions placed on existing approvals continue to be implemented; and
   - ensuring that new proposals that are approved incorporate at a minimum the existing standard and expectations for control / mitigation / management of direct and indirect impacts. | Commitment ensures that potential indirect impacts to fauna species are considered in ongoing environmental assessment processes.
16.6 **BETTONGIA PENICILLATA OGILBYI (WOYLIE)**

### SPECIES BACKGROUND

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Endangered.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>WESTERN AUSTRALIAN STATUS</th>
<th>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Critically Endangered using IUCN criteria.</th>
</tr>
</thead>
</table>

### PROFILE SUMMARY

The following points provide key information about the ecology and distribution of the species:

- The Woylie is a small potoroid marsupial endemic to Australia. Their fur can be grey to reddish-brown with a pale grey fur underbelly. There is a distinctive black brush at the end of their tail and they have strongly clawed fore feet used for digging for food and nest making.

- The current distribution of the species is concentrated in south-west Western Australia, but there are also translocated populations in South Australia and New South Wales. There are only four remaining indigenous populations in the south-west of Western Australia; Perup, Kingston, Dryandra woodland, and Tutanning Nature Reserve. None of these are within the Strategic Assessment Area.

- There is a reintroduced population at Karakamia Wildlife Sanctuary, which is the only known population occurring within the Strategic Assessment Area. Karakamia is privately managed by the Australian Wildlife Conservancy and is a 275 ha conservation area eradicated of foxes and cats. The Karakamia Wildlife Sanctuary is in an area of Jarrah Forest at Gidgegannup. The Karakamia Woylie population has been stable at between 400 - 600 individuals for the last 10 years.

- Approximately 2,571,813 ha of known and potential habitat has been mapped across the range of the species. Areas of known habitat (43,495 ha) and potential habitat (299,960 ha) occur on the eastern edge of the Strategic Assessment Area within the Jarrah Forest. This habitat represents contiguous patches of vegetation to known species records located outside of the Strategic Assessment Area boundary.

- Given this species’ Commonwealth status of Endangered, all populations are considered important.

- The objectives of the Commonwealth Recovery Plan are to maintain current distribution and abundance across the species current range, and to increase abundance and range by:
  - reducing the impacts of processes that are causing species decline; and
  - establishing new wild populations in suitable habitat within the species former range (Yeatman and Groom 2012).

- There are four Threat Abatement Plans that may be relevant to this species:
  - The Threat Abatement Plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (Commonwealth of Australia 2014).
  - The Threat Abatement Plan for predation by European red fox (DEWHA 2008b).
The Threat Abatement Plan for predation by feral cats (DEWHA 2008c).

- The Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs (Department of Environment and Heritage 2005a).
- The species is also the subject of Commonwealth Conservation Advice (TSSC 2009a).

See Appendix B for further information.

### SPECIES MAPPING

**APPROACH TO MAPPING**

Habitat mapping for the Woylie was undertaken across its range (including within the Strategic Assessment Area). The mapping identifies:

- known habitat, comprising the locations and supporting remnant vegetation patches where the species has previously been recorded (referred to as type 1);
- potential habitat, comprising remnant vegetation patches within the species distribution that have the potential to support the species (referred to as type 2); and
- captive release locations, comprising the locations and supporting remnant vegetation patches where the species has previously been released into the wild (referred to as type 3).

The mapping criteria are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

**MAPS**

See Figure 16-2 for a map of habitat across the range of the species.

See Figure 16-3 for a map of habitat within the Strategic Assessment Area.

### CONSERVATION OBJECTIVES

**CONSERVATION OBJECTIVES**

The conservation objectives for the Woylie are to:

- Prevent impacts to known habitat in the Strategic Assessment Area.
- Maintain the potential for the species to occur within the Strategic Assessment Area.

**JUSTIFICATION**

The conservation objectives for the species were developed recognising the following:

- While large areas of potential habitat occur within the Strategic Assessment Area, the reintroduced population at Karakamia Wildlife Sanctuary is the only currently known population. Outside of Karakamia, areas of known habitat extend into the Strategic Assessment Area from known populations outside.
- Maintaining the potential for the species to occur within the Strategic Assessment Area is important in maintaining the distribution of the species.

### STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS

**KNOWN HABITAT (TYPE 1)**

Approximately 43,495 ha of known habitat has been mapped for the Woylie within the Strategic Assessment Area (see Figure 16-3). This equates to 2% of the total known habitat mapped for the species.

Avoidance of known habitat
All known habitat in the Strategic Assessment Area will be avoided. As part of this, approximately:
- 9,475 ha (22%) occurs within an IUCN I-IV reserve;
- 33,712 ha (78%) occurs within land managed by Parks and Wildlife; and
- 309 ha (<1%) occurs outside of the classes of action and is not within protected land.

### Potential Habitat and Captive Release Locations (Types 2 & 3)

Approximately 241,762 ha of potential habitat occurs within the Strategic Assessment Area, alongside a further 14,702 ha of captive release areas (see Figure 16-3). Combined, these total 256,465 ha or approximately 10% of total potential habitat mapped for the species.

#### Avoidance of potential habitat

251,592 ha (98%) of potential and captive release habitat in the Strategic Assessment Area will be avoided. Of this, approximately 72% occurs within IUCN I-IV reserves and land managed by Parks and Wildlife, including:
- 41,015 ha (16%) within IUCN reserve type IA or II (Nature Reserves or National Parks); and
- a further 140,830 ha (56%) within other land managed by Parks and Wildlife.

The remaining 70,107 ha (27%) of potential and captive release habitat that occurs outside of the classes of action is not within protected land.

#### Intersects with classes of action

4,513 ha (2%) of potential and captive release habitat is intersected by the classes of action:
- 1,909 ha (<1%) by the urban class of action;
- 61 ha (<0.1%) by the industrial class of action;
- 1785 ha (<1%) by the rural residential class of action;
- 131 ha (<0.1%) by the infrastructure class of action; and
- 627 ha (<1%) by the BRM class of action.

The majority of intersects with potential and captive release habitat occur to the east of Perth, between Bullsbrook and Jarrahdale. Some potential and captive release habitat will also be intersected further south within the Strategic Assessment Area, including Oakley, Dwellingup, Waroona and Wagerup.

### Indirect Impacts

Indirect impacts may affect the Woylie where new development occurs or where existing development intensifies adjacent to or near habitat. Woylie populations may be susceptible to the following indirect impacts (TSSC 2009a):
- habitat alteration and loss of connectivity;
- grazing and destruction of habitat by introduced species;
- predation by native and introduced species; and
- disease.

At their nearest point, the proposed classes of action are 3.7 km from known habitat and it is therefore considered unlikely for those areas to be significantly affected by indirect impacts. However, indirect impacts to potential habitat may occur where it intersects with the classes of action (2% of potential habitat). In particular, this may lead to habitat degradation and a loss of habitat connectivity in areas east and north of Mundaring due to clearing, as well as altered fire regimes associated with urban development. These potential impacts are considered unlikely to be significant to the species given the localised nature of the effects and the broad extent and availability of potential habitat across the Strategic Assessment Area (and more...
widely over the range of the species). At a landscape scale, ongoing management of threats within IUCN I-IV reserves that support the species will be an important aspect of maintaining long-term viability within the Strategic Assessment Area.

**WILL CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?**

**NEED FOR CONSERVATION COMMITMENTS**
Specific conservation commitments for the Woylie are not considered necessary in order to meet the conservation objectives. The classes of action do not intersect with any areas of known habitat and there are minimal intersects with potential habitat.

In addition, there are a range of relevant over-arching commitments in Action Plan F that have the potential to provide benefits to the species. These commitments provide conservation benefits across various parts of the Strategic Assessment Area and broadly relate to:

- the retention and protection of land (including management of protected areas);
- avoidance of impacts within the classes of action; and
- assessment and management of potential indirect impacts from development.

**ADDITIONAL CONSERVATION MEASURES**
In addition to the over-arching conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the species where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.
- Ongoing implementation of actions to benefit the species. For example, implementation of Recovery Plan actions and general management of threats and pressures across the landscape.

**OUTCOMES FOR THE SPECIES**

**KEY POINTS**
The following key points are relevant to the outcome for the Woylie:

- **The only known population for the species within the Strategic Assessment Area occurs within the Karakamia Wildlife Sanctuary.** This is an important population for the species (Yeatman & Groom 2012) and is managed for conservation by the Australian Wildlife Conservancy. Other areas of known habitat within the Strategic Assessment Area are based on known records which occur outside the Strategic Assessment Area boundary.

- **All areas of known habitat in the Strategic Assessment Area will be avoided.** Nearly all of this known habitat is protected in IUCN I-IV reserves (22%) and in land managed by Parks and Wildlife (78%).

- **The majority (98%) of potential and captive release habitat in the Strategic Assessment Area will be avoided.** This includes 16% of potential habitat occurring within IUCN I-IV reserves.

- **There will be no landscape scale loss of connectivity between potential and known habitat within and outside of the Strategic Assessment Area arising from clearing for the classes of action.**
- **There is little potential for indirect impacts on known habitat** and limited possibility of indirect impacts to potential habitat.

It is considered unlikely for the population status to be significantly altered by the classes of action. The overall outcome for the Woylie is considered to be an acceptable one which meets the conservation objectives through:

- retention of all known habitat and 98% of potential habitat within the Strategic Assessment Area; and
- maintenance of connectivity of potential habitat with known habitat and occurrences in south-west Western Australia.

### CONSISTENCY WITH COMMONWEALTH PLANS

- The outcomes and conservation objectives for the Woylie are not inconsistent with the relevant Threat Abatement Plans.
- The outcomes and conservation objectives for the Woylie are not inconsistent with the species’ Commonwealth Recovery Plan (Yeatman and Groom 2012).
- These outcomes and conservation objectives have been set with consideration for the Commonwealth Conservation Advice for the species (TSSC 2009a).
Figure 16-2: Distribution and habitat of the Woylie within Western Australia

Legend

Strategic Assessment Area
Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
Figure 16-3: Distribution and habitat of the Woylie within the Strategic Assessment Area

Legend

Strategic Assessment Area
Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
16.7 **BOTAURUS POICILOPTILUS** (AUSTRALASIAN BITTERN)

### SPECIES BACKGROUND

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Endangered.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Endangered using IUCN criteria.</td>
</tr>
</tbody>
</table>

### PROFILE SUMMARY

The following points provide key information about the ecology and distribution of the Australasian Bittern:

- The Australasian Bittern is a large, stocky, thick necked heron-like bird with mottled brown and dark brown to black plumage. It prefers wetlands with tall dense vegetation, where it forages in still, shallow water, often at the edges of pools or waterways, or from platforms or mats of vegetation over deep water (Marchant and Higgins, 1990; Pizzey and Knight, 1997 as cited in TSSC 2011).
- In the south-west of Western Australia, the Australasian Bittern is present between Moora in the north, east to Cape Arid and west to Northam.
- Suitable habitat for the Australasian Bittern within the Strategic Assessment Area has been identified at Thomson Lake, Forrestdale Lake, Jandabup Lake, Kogolup Lake, Benger Swamp and Herdsman Lake. A much broader area of potential habitat has been mapped across the Strategic Assessment Area.
- The Strategic Assessment Area is considered to support approximately 44,270 ha of known and potential habitat, or 13% of the total mapped habitat for species mapped within West Australia.
- Given the species’ Endangered status, all populations of the species are considered to be important.
- There is no Commonwealth Recovery Plan for this species; however the Conservation Advice for the species (TSSC 2011) identifies research priorities and local priority actions.
- There are two Threat Abatement Plans that may be relevant to the species:
  - The Threat Abatement Plan for predation by European red fox (DEWHA 2008b).
  - The Threat Abatement Plan for predation by feral cats (DEWHA 2008c).

See Appendix B for further information.

### SPECIES MAPPING

<table>
<thead>
<tr>
<th>APPROACH TO MAPPING</th>
<th>Habitat mapping for the Australasian Bittern was undertaken across its range (including within the Strategic Assessment Area). The mapping identifies:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Known habitat, comprising all conservation category wetlands within 1 km of Australasian Bittern records (referred to as type 1).</td>
</tr>
<tr>
<td></td>
<td>Potential habitat, comprising:</td>
</tr>
</tbody>
</table>

wetlands that have been identified as being important for waders (referred to as type 2); areas of conservation category wetland that intersect with the Commonwealth’s distribution of the Australasian Bittern (referred to as type 3); and conservation category wetlands and other permanent wetlands that have intersected with the Australasian Bittern distribution (referred to as type 4).

The criteria for known and potential habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

MAPS

See Figure 16-4 for a map of habitat across the range of the species.

See Figure 16-5 for a map of habitat within the Strategic Assessment Area.

CONSERVATION OBJECTIVE

CONSERVATION OBJECTIVE

The conservation objective for the Australasian Bittern is:

- Maintain the long-term viability of the Australasian Bittern within the Strategic Assessment Area through the protection of known habitat and maintenance of a mosaic and diversity of potential wetland habitats for use by the species.

JUSTIFICATION

The conservation objective for the species has been developed recognising the following key attributes:

- The Strategic Assessment Area incorporates the northern extent of the species’ range within West Australia. It is important to continue to protect and maintain this extent and the long-term viability of the species within this area. The northern extent incorporates some important wetland habitat for the species.
- The majority of known habitat (type 1) for the species occurs in the central portion of the Strategic Assessment Area, while potential habitat types 2, 3 and 4 extend through the Strategic Assessment area from the north to the south mainly on the Swan Coastal Plain.

STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS

KNOWN HABITAT (TYPE 1)

1,120 ha of known habitat has been mapped for the Australasian Bittern within the Strategic Assessment Area (see Figure 16-5). This equates to <1% of the total known habitat mapped for the species.

Avoidance of known habitat

A total of approximately 1,087 ha (97%) of known habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 488 ha (44%) occurs within IUCN reserves I-IV.
- 13 ha (1%) occurs within other land managed by Parks and Wildlife.

The main areas of protection for the species are conservation category wetlands along the Swan Coastal Plain, including Forrestdale Lake, Herdsman Lake and Jandabup Lake.

The remaining 586 ha (52%) of known habitat occurs outside of the classes of action and is not within protected land.
Intersects with classes of action

A total of approximately 33 ha (3%) of known habitat is intersected by the following classes of action:
- 5 ha (<1%) by the urban class of action;
- 17 ha (1.5%) by the industrial class of action; and
- 11 ha (1%) by the infrastructure class of action.

These intersects all apply to conservation category wetlands (the majority along the edges of Herdsman Lake), which will be protected from direct and indirect impacts by over-arching commitments in Action Plan F.

POTENTIAL HABITAT (TYPES 2, 3 & 4)

Approximately 43,150 ha of potential habitat occurs within the Strategic Assessment Area. This equates to approximately 21% of the total potential habitat mapped for the species.

Avoidance of potential habitat

A total of approximately 41,172 ha (95%) of potential habitat (type 2, 3 and 4) will be avoided within the Strategic Assessment Area. Of this approximately:
- 10,360 ha (24%) occurs within IUCN reserve categories I to IV.
- 12,586 ha (29%) occurs within other land managed by Parks and Wildlife.

The remaining 18,226 ha (37%) of potential habitat occurs outside of the classes of action and is not within protected land.

Intersects with classes of action

A total of approximately 1,979 ha (5%) of potential habitat is intersected by the following classes of action:
- 1,162 ha (3%) by the urban class of action;
- 231 ha (<1%) by the industrial class of action;
- 179 ha (<1%) by the rural residential class of action;
- 396 ha (<1%) by the infrastructure class of action;
- 3 ha (<0.1%) by the BRM class of action; and
- 8 ha (<0.1%) by the Pines class of action.

The majority (97%) of intersects with potential habitat are within conservation category wetlands (such as Yangebup Lake, Kenwick Swamp, Canning River Floodplain, Lake Joondalup and Lake Walyungup), which will be protected from direct and indirect impacts by commitments relating to conservation category wetlands in Action Plan F.

INDIRECT IMPACTS

Indirect impacts may affect the species where new development occurs or where existing development intensifies adjacent to or near habitat. The Australian Bittern may be susceptible to the following indirect impacts (TSSC 2011):
- reduction in extent and quality of habitat due to water diversion;
- habitat alteration and drainage of swamps;
- peat mining;
- reduced water quality and pollution;
- predation by introduced species such as foxes (*Vulpes vulpes*) and cats (*Felis catus*);
- overgrazing by livestock; and
- inappropriate fire regimes.
Of particular relevance to the classes of action would be potential reductions in water quality, increases in pollution, predation and water diversion. At a landscape scale, ongoing management of threats within IUCN I-IV reserves that support the species will be an important aspect of maintaining long-term viability within the Strategic Assessment Area.

**WILL CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?**

**NEED FOR CONSERVATION COMMITMENTS**

Specific conservation commitments for the Australasian Bittern are considered necessary to meet the conservation objective for the species.

While the majority of known (98%) and potential (96%) habitat for the species will be avoided within the Strategic Assessment Area, the potential for indirect impacts to wetland habitats puts achieving the conservation objectives at risk.

It should be noted that two of the over-arching conservation commitments in Action Plan F will provide substantial benefits to the species. These are presented below along with specific commitments for the Australasian Bittern.

**WHAT CONSERVATION COMMITMENTS ARE REQUIRED TO MEET THE CONSERVATION OBJECTIVES?**

**RELEVANT OVER-ARCHING CONSERVATION COMMITMENTS**

The two relevant over-arching conservation commitments in Action Plan F are:

- Ensure direct and indirect impacts to conservation category wetland (CCWs) are avoided (including through the application of appropriate buffers) within urban, industrial, and rural residential areas.
- Implement environmental assessment and management measures, controls and standards for all development to reduce direct and indirect impacts. This will include, but is not limited to, controls on vegetation clearing, water quality and use, stormwater, dust, noise, emissions, public access. This process will involve:
  - ensuring controls / conditions placed on existing approvals continue to be implemented; and
  - ensuring that new proposals that are approved incorporate at a minimum the existing standard and expectations for control / mitigation / management of direct and indirect impacts.

These commitments go a long way to ensuring that habitat for the species is protected from both direct and indirect impacts. In particular, this is the case because 100% of known habitat and 97% of potential habitat that intersects with the classes of action are CCWs.

**SPECIFIC CONSERVATION COMMITMENTS**

In addition, to ensure specific measures are taken for this species the following conservation commitments are provided for the Australasian Bittern:

- Manage indirect impacts to this species on a site specific basis, paying particular attention to sites directly adjacent, or in close proximity to the classes of action footprint. This will be done via:
  - continuing to implement existing groundwater management arrangements and potential future site supplementation;
  - maintaining vegetated buffers at all sites where they currently exist and seeking to develop buffer zones where they currently do not;
  - controlling access to sites to minimise disturbance to shorebirds in a way most
appropriate to the individual site; and/or
  o educating the neighbouring community about the Australasian Bittern and what they can do to assist with their conservation.

- Protect important occurrences and manage for conservation by continuing to implement the Bush Forever Program as detailed in Action Plan H.

**ADDITIONAL CONSERVATION MEASURES**

In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the species where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.
- Ongoing implementation of actions to benefit the species. For example, general management of threats and pressures across the landscape.

**OUTCOMES FOR THE SPECIES**

**KEY POINTS**

The assessment has identified the following key issues relevant to the outcome for the Australasian Bittern:

- **In the south-west of Western Australia, the Australasian Bittern is present between Moora in the north, east to Cape Arid and west to Northam.** Suitable habitat within the Strategic Assessment Area has been identified at Thomson Lake, Forrestdale Lake, Jandabup Lake, Kogolup Lake, Benger Swamp and Herdsman Lake.

- **The majority of known (97%) and potential (95%) habitat within the Strategic Assessment Area will be avoided.** Of these areas, 44% of known and 24% of potential habitat occurs within IUCN I-IV reserves.

- **The classes of action intersect with 3% of known habitat and 5% of potential habitat.** Nearly all of these areas are conservation category wetlands (100% of the known habitat areas and 97% of the potential habitat) and over-arching commitments within Action Plan F to protect conservation category wetlands will ensure habitat is not subject to direct or indirect impacts.

- **Potential indirect impacts more generally will be managed through both over-arching and species specific conservation commitments to protect habitat.**

- **Broader landscape scale connectivity with the northern and southern distribution of the species will be maintained through retention of known and potential habitat.**

It is considered unlikely for the population status to be significantly altered by the classes of action. The overall outcome for the Australasian Bittern is considered to be an acceptable one which meets the conservation objectives through:

- retention of known and potential habitat; and
- management of potential indirect impacts.

**CONSISTENCY WITH COMMONWEALTH PLANS**

- The outcomes and conservation objectives for the Australasian Bittern are not inconsistent with the relevant Threat Abatement Plans.

- These outcomes and conservation objectives have been set with consideration for the Commonwealth Conservation Advice for the species (TSSC 2011).
Figure 16-4: Distribution and habitat of the Australasian Bittern within Western Australia

Legend
- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3
- Habitat Type 4

Datum/Projection:
GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
Figure 16-5: Distribution and habitat of the Australasian Bittern within the Strategic Assessment Area.
### SPECIES BACKGROUND

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Vulnerable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Vulnerable using IUCN criteria.</td>
</tr>
</tbody>
</table>

### PROFILE SUMMARY

The following points provide key information regarding the ecology and distribution of the Forest Red-tailed Black cockatoo:

- The Forest Red-tailed Black cockatoo is one of three Red-tailed Black cockatoo subspecies that occurs in Western Australia. The male is distinguished by broad red tail panels and the female has yellow or whitish spots on the feathers of the head and upper wing coverts, the tail feathers are bright red-orange to yellow on the inner margins and have variable black horizontal barring (Johnstone and Storr 1998 as cited in DEC 2008).

- The subspecies is endemic to the sub-humid and south-west zones of Western Australia (Mawson and Johnstone 1997 as cited in DEC 2008). Its current distribution is throughout the south-west of Western Australia; north of Perth and east out into the Darling Scarp to Avon Valley National Park, Brookton, Narrogin, Kojonup, and out to the Stirling Ranges.

- Approximately 2,614,943 ha of habitat has been mapped within the Swan Coastal Plain and Jarrah Forest IBRA regions across the range of the subspecies. Areas of habitat (approximately 374,900 ha or 14%) occur along the majority of western, eastern and southern portions of the Strategic Assessment Area.

- The subspecies inhabits dense forests receiving more than 600 mm of annual average rainfall, dominated by Jarrah (*Eucalyptus marginata*), Karri (*Eucalyptus diversicolor*) and Marri (*Corymbia calophylla*) (Saunders et al. 1985 and Saunders and Ingram 1995 as cited in DEC 2008). It nests in the hollows of tall long-lived trees and forages within Jarrah and Marri woodlands, Karri forests, and Wandoo and Blackbutt woodlands (SEWPac 2012).

- Observational data indicates that the movements of the Forest Red-tailed Black cockatoo are irregular and they can be found on the Swan Coastal Plain at any time of year in search of food (Sedgwick 1949; Stranger 1997; R. Johnstone, pers. comm. as cited in DEC 2008). In recent years there has been a very dynamic expansion of feeding from the Darling Range, both west onto the Swan Coastal Plain and east into the wheatbelt (Johnstone and Kirkby 2010). Movement onto the Swan Coastal Plain is likely due in part to the discovery of Cape Lilac (*Melia azedarach*) as a food source. The movement onto the Swan Coastal Plain has led to the inaccurate assumption that this subspecies is common in the Perth region (Johnston et. al. 2013).

- The subspecies is believed to breed from February to December, with a peak between
October and December, and in years with good autumn rainfall a peak in breeding may also occur in April-May (Johnstone and Kirkby 2010 and SEWPaC 2012). This occurs in the north and east of their range on the margins of the forest (Higgins 1999 as cited in DEC 2008).

- The subspecies’ current population is estimated to be 10,000 - 15,000 birds and it occurs as a single population (DoE 2015a and Johnstone and Kirkby 2010).

- Potential feeding and roosting habitat for the Forest Red-tailed Black cockatoo occurs throughout the Strategic Assessment Area, while breeding occurs on the margins of the forest in the north and east of their range outside of the Strategic Assessment Area.

- The use of feeding habitat appears to be driven by the presence of Marri, which occurs at highest densities in the Jarrah Forest and on the eastern edge of the Swan Coastal Plain. While Marri and Jarrah fruits make up approximately 90% of their diet, the introduced Cape Lilac is becoming of mounting importance as a feed tree for the subspecies in the Perth region (Johnstone et al. 2013).

- Habitat within the Strategic Assessment Area is considered critical to the survival of the subspecies. A total of 374,900 ha of potential habitat has been mapped for the Forest Red-tailed Black cockatoo within the Strategic Assessment Area, comprising 75,929 ha on the Swan Coastal Plain and 298,971 ha of Jarrah Forest habitat.

- The population of Forest Red-tailed Black cockatoos within the Strategic Assessment Area is part of a single contiguous population and is considered an important population.

- The main threats to the Forest Red-tailed Black cockatoo include habitat loss and destruction, competition for and loss of nest hollows, fire, illegal shooting and poaching (DEC 2008 and Johnstone and Kirkby 2010). Climate change is an additional threat that is likely to exacerbate the threatening processes as a result of changes to biodiversity and ecosystem function (Chambers et al. 2005 as cited in DEC 2008).

- The objective of the Commonwealth Recovery Plan is to stop further decline in the breeding populations of the Forest Red-tailed Black cockatoo and to ensure its persistence throughout its range in the south-west of Western Australia (DEC 2008).

- There are two Threat Abatement Plans that may be relevant to the subspecies:
  o The Threat Abatement Plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoE 2014).
  o The Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species (Department of Environment and Heritage 2005).

- Key knowledge gaps identified for Forest Red-tailed cockatoo include (Johnstone and Kirkby 2008 and DEC 2008):
  o Breeding biology and ecology: breeding range, timing of nesting events, nest tree and nest hollow characteristics, clutch size, incubation period, fledging period and nesting success.
  o Seasonal movement patterns, including changes in feeding patterns based on availability of resources.
  o Population dynamics of breeding and non-breeding birds.
  o Map and monitor important breeding, feeding and roosting sites throughout the subspecies’ range.
  o Development of non-lethal means to deter birds from orchards.

See Appendix B for further information.
### SPECIES MAPPING

**APPROACH TO MAPPING**

Habitat mapping for the Forest Red-tailed Black cockatoo was undertaken across the Jarrah and Swan Coastal Plain IBRA regions within the Strategic Assessment Area. The mapping identifies potential habitat for the subspecies based on native vegetation containing the Forest Red-tailed Black cockatoos’ preferred feeding species within its current distribution.

The following plant species were included as target species in the feeding habitat layer for the Forest Red-tailed Black cockatoo and are also used by Carnaby’s cockatoo: Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*), Parrot Bush (*Banksia sessilis*), Wandoo (*E. wandoo*), Flooded Gum (*E. rudis*) and Tuart (*E. gomphocephala*) (Parks and Wildlife, 2015 pers. comm.).

Roosting and breeding site data was unavailable and therefore has not been mapped. However, roosting and areas of suitable breeding habitat occur within the mapped extent of feeding habitat for the subspecies. Given the subspecies primarily uses the Strategic Assessment Area for feeding, and that breeding or roosting is unlikely to extend outside of feeding areas, potential habitat mapping based on feeding habitat is considered adequate for the purpose of this assessment.

The criteria for known and potential habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

### MAPS

See Figure 16-6 for a map of distribution and habitat across the range of the subspecies.

See Figure 16-7 for a map of habitat within the Strategic Assessment Area.

See Figure 16-8a-e for maps of habitat intersected by class of action footprints.

### CONSERVATION OBJECTIVES

**CONSERVATION OBJECTIVES**

The conservation objectives for the Forest Red-tailed Black cockatoo are to:

- *Ensure the continued use of the Strategic Assessment Area by the subspecies.*
- *Avoid and protect habitat in the Strategic Assessment Area that is required to maintain the north-western extent of the subspecies’ distribution and population.*
- *Maintain habitat connectivity across the Strategic Assessment Area between the north-eastern and southern extent of the subspecies’ range.*
- *Undertake research to improve knowledge about the subspecies and inform conservation effort and management in the Strategic Assessment Area.*

**JUSTIFICATION**

The conservation objectives for the species have been developed recognising the following key attributes:

- The Strategic Assessment Area is considered critical to the survival of the subspecies as it supports feeding, roosting and potential breeding habitat for the Forest Red-tailed Black cockatoo. It is important to maintain and protect this habitat in order to ensure the Strategic Assessment Area is able to sustain continued presence of the subspecies.
- The Strategic Assessment Area represents the north-western extent of the subspecies’ range. Maintaining the full range of a species is recognised as one of the primary aims of biodiversity conservation as it assists in the maintenance of variation and improves the species’ capacity to cope and respond to different conditions and changes in the
environ
ment.

- The majority of potential habitat for the subspecies occurs in the eastern portion of the Strategic Assessment Area and partly on the Swan Coastal Plain. Maintaining connectivity between these areas and to other areas of the subspecies’ range is important to ensure the continued use of habitat by the subspecies across its entire known range.

- It is important that key knowledge gaps, such as population dynamics, seasonal movement patterns, breeding biology and ecology, are addressed to ensure conservation efforts are focused where they are required.

### STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS

| SPECIES HABITAT | 374,900 ha of potential habitat has been mapped for the Forest Red-tailed Black cockatoo within the Strategic Assessment Area (see Figure 16-7). This equates to 14% of the total potential habitat mapped for the subspecies. The Jarrah Forest IBRA region holds 80% of the potential habitat for the species, with the remaining 20% across the Swan Coastal Plain. The two regions will be considered separately when analysing the classes of action intersects below.

**Avoidance of habitat**

A total of approximately 316,478 ha (84%) of potential habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 64,589 ha (17%) occurs within IUCN reserve categories I to IV.
- 251,889 ha (67%) occurs within other land managed by Parks and Wildlife.

The main areas of protection are: Dwellingup State Forest (73,284 ha), Jarrahdale State Forest (69,998 ha) and Mundaring (23,769 ha).

The remaining 43,591 ha (12%) of habitat occurring outside of the classes of action is not within protected land. These areas are mostly situated on the Darling Scarp and in the southern portion of the Strategic Assessment Area. It is broadly expected that some level of decline in vegetation will occur over time to these areas, but also that large portions will remain.

In summary, a total of 96% of the potential habitat is avoided by the classes of action with some of this in secure conservation managed land.

**Intersects with classes of action**

The classes of action intersect with approximately 14,830 ha (4%) of the potential habitat for the Forest Red-tailed cockatoo within the Strategic Assessment Area. This is broken down across regions as follows:

**Jarrah Forest**

Within the Jarrah Forest, the classes of action intersect with approximately 4,328 ha (1%) of potential habitat for the Forest Red-tailed Black cockatoo within the Strategic Assessment Area (Figure 16-8a-e):

- 1,360 ha (<1%) with the urban class of action;
- 25 ha (<0.1%) with the industrial class of action;
- 1,832 ha (<1%) with the rural residential class of action;
- 994 ha (<1%) with the basic raw materials (BRM) class of action; and
- 115 ha (<0.1%) with the infrastructure class of action.
Within the Swan Coastal Plain, the classes of action intersect with approximately 10,503 ha (3%) of potential habitat for the Forest Red-tailed Black cockatoo within the Strategic Assessment Area (Figure 16-8a-e):

- 5,365 ha (1.5%) with the urban class of action;
- 2,120 ha (<1%) with the industrial class of action;
- 883 ha (<1%) with the rural residential class of action;
- 540 ha (<1%) with the basic raw materials (BRM) class of action; and
- 1,592 ha (<1%) with the infrastructure class of action.

The classes of action primarily intersect with habitat areas on the Swan Coastal Plain within the western half of the Strategic Assessment Area. Vegetation within this western half tends to contain lower densities of Marri compared to the Jarrah Forest and areas along the eastern edge of the Swan Coastal Plain. The presence of Marri appears to be a key driver in the use of feeding habitat, however the subspecies has been observed more frequently across the Swan Coastal Plain foraging on Cape Lilac, which has become an increasingly important food source. Loss of potential habitat across both regions could have an impact on the total feeding potential of the subspecies.

The areas most intersected by the classes of action include:

- west of Ellenbrook between Pinjar and Ballajura (Figure 16-8);
- towards the northern extent of the Darling scarp, between Brigadoon, Mundaring and Chidlow (Figure 16-);
- Shenton Park west of the Perth CBD (Figure 16-);
- between Beeliar and Kwinana, along the western extent of the subspecies’ range (Figure 16-8);
- the Armadale locality (Figure 16-8d);
- east of Pinjarra (Figure 16-8e); and
- west of the Peel-Harvey Estuary (Figure 16-8e).

### HABITAT CONNECTIVITY

Existing habitat connectivity

Habitat connectivity is recognised as important in maintaining the subspecies’ use of resources within the Strategic Assessment Area. Breaks in habitat of more than 4 km have been shown to prevent black cockatoos reaching resources (SEWPaC 2012). In the absence of specific information for the Forest Red-tailed Black cockatoo on connectivity requirements, information on Carnaby’s cockatoo has been used for this assessment. According to the profile information on the Australian Government’s Species Profile and Threats Database (DoE 2015a):

“Saunders and Ingram (1995) describe a lack of connectivity between patches as “strongly implicated in the failure of Carnaby’s cockatoo to survive in heavily cleared and fragmented rural landscapes”. Movement corridors with breaks of less than 4 km between other foraging, movement corridors, breeding and roosting sites are therefore important to allow the birds to move between these areas.”

In order to understand the level of habitat connectivity across the Strategic Assessment Area, GIS analysis of mapped Forest Red-tailed Black cockatoo habitat was undertaken. The analysis calculated the distances between polygons of potential habitat and their nearest neighbours in order to identify any patches isolated by 4 km or more. The analysis showed...
that based on the current mapped extent of habitat, the greatest distance between two patches was 1.6 km. This suggests that habitat connectivity in terms of distance between patches across the Strategic Assessment Area is currently adequate for the Forest Red-tailed Black cockatoo to move across the landscape (DoE 2015a).

In addition to distance between patches, patch size may also influence the subspecies use of feeding areas across the landscape. The density of feeding resources needs to be high enough to compensate for the energy used in locating the food. If feeding effort is too great in a landscape where habitat is patchily distributed, then the birds may move in search of more dense, better quality feeding areas. The level of fragmentation that may be tolerated by the subspecies is not known and will depend on a range of factors in addition to patch size such as feed type, seed production and landscape context. It is generally recognised in conservation planning that larger habitat patches are more resilient to the effects of fragmentation compared with smaller remnants (Bolger et al. 2000; Ross et al. 2002; Ferraz et al. 2003; Krauss et al. 2010; and Gibson et al. 2013 as cited in Ramalho et al. 2014). In a study looking into the effects of fragmentation on plant species richness and abundance in patches of remnant Banksia woodlands around Perth, Ramalho et al. (2014) found that remnants smaller than 5-10 ha are highly vulnerable to fragmentation effects, suggesting a minimum patch size of 10 ha is most suitable for the management and protection of bushland remnants.

In the absence of a minimum patch size or density figure specific for the Forest Red-tailed Black cockatoo, patch size connectivity across the Strategic Assessment Area was analysed with reference to 10 ha patches. This analysis was undertaken across two regions (Swan Coastal Plain and Jarrah Forest) within the Strategic Assessment Area, in recognition of the different patterns of development within each region, as well as the differences in feeding habitat. To reflect the high mobility of this subspecies relative to the precision of the GIS data used for this analysis, patches separated by less that 20m were considered to be contiguous and treated as a single entity.

The Swan Coastal Plain contains the largest number of patches larger than 10 ha, while the Jarrah Forest contains the largest total area of patches larger than 10 ha, due to a single very large patch of over 258,000 ha (Table 16-3).

Across the Swan Coastal Plain region, patches larger than 10 ha make up 88% of the total mapped habitat for Baudin’s cockatoo within the Strategic Assessment Area (Table 16-3). Within the Jarrah Forest, patches larger than 10 ha comprise 99% of the total mapped habitat for the Forest Red-tailed Black cockatoo.

### Table 16-3: Existing habitat within the Strategic Assessment Area

<table>
<thead>
<tr>
<th></th>
<th>Swan Coastal Plain</th>
<th>Jarrah Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patches</td>
<td>5,622</td>
<td>1,333</td>
</tr>
<tr>
<td>Number of patches &gt;10 ha</td>
<td>617</td>
<td>228</td>
</tr>
<tr>
<td>Area of patches &gt;10 ha</td>
<td>67,135 ha</td>
<td>296,181 ha</td>
</tr>
</tbody>
</table>

### Potential impacts to habitat connectivity

Large areas of habitat along key movement corridors, such as the majority of the Darling scarp, will be retained within Parks and Wildlife managed land. This will help ensure the ongoing maintenance of important ecological linkages for the subspecies, including providing...
for connectivity between habitat areas within the Strategic Assessment Area with the subspecies' broader southern range.

Potential impacts to Forest Red-tailed Black-cockatoo habitat connectivity from the classes of action have been assessed. When overlayed on the mapped habitat, the class of action footprints increase the maximum distance between two patches of feeding habitat from 1.6 km to 2.2 km. Whilst this analysis shows a reasonable loss of connectivity (27%), it is still within the required breaks of 4 km or less, considered necessary to allow movement between habitat areas (SEWPaC 2012). Importantly, key movement corridors such as the Darling scarp are protected, which ensures connectivity with the southern distribution of the species. Potential impacts from the classes of action are not expected to significantly interfere with Forest Red-tailed Black cockatoo habitat connectivity as it relates to distance between patches.

The number of patches over 10 ha in area on the Swan Coastal Plain is anticipated to decline by 15% from 617 to 522 as a result of the class of action footprints (Table 16-4). In the Jarrah Forest, the number of patches over 10 ha in area will remain the same (228) as a result of the class of action footprints.

The total area of habitat within patches larger than 10 ha on the Swan Coastal Plain is expected to decline by 12% or 8,207 ha (Table 16-4). The total area of habitat within patches larger than 10 ha in the Jarrah Forest is expected to decline by 1% or 4,255 ha. This indicates that foraging behaviour may be affected more so on the Swan Coastal Plain due to loss or fragmentation of habitat patches.

### Table 16-4: Forest Red-tailed Black-cockatoo habitat patches after intersection with proposed classes of action

<table>
<thead>
<tr>
<th></th>
<th>Swan Coastal Plain</th>
<th>Jarrah Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patches &gt;10ha</td>
<td>522</td>
<td>228</td>
</tr>
<tr>
<td>Variance in number of patches &gt;10 ha</td>
<td>-95 (decrease)</td>
<td>0</td>
</tr>
<tr>
<td>Percentage variance of patches &gt;10 ha</td>
<td>15% (decrease)</td>
<td>0</td>
</tr>
<tr>
<td>Total habitat in patches &gt;10 ha</td>
<td>58,929</td>
<td>291,926</td>
</tr>
<tr>
<td>Net loss of habitat in patches &gt;10 ha</td>
<td>8,207</td>
<td>4,255</td>
</tr>
<tr>
<td>Percentage decrease in area of habitat in patches &gt;10 ha</td>
<td>12%</td>
<td>1%</td>
</tr>
</tbody>
</table>

### INDIRECT IMPACTS

Indirect impacts may affect the Forest Red-tailed Black cockatoo where new development occurs or where existing development intensifies adjacent to or near habitat. The subspecies may be susceptible to the following indirect impacts (DEC 2008 and Johnstone and Kirkby 2010):

- competition for and loss of nest hollows;
- fire; and
- direct mortality.

Direct mortality may result from vehicle strikes, illegal poaching of eggs and nestlings and illegal shooting by orchardists and farmers. An increasing human population within and
adjacent to habitat as a result of the classes of action is expected to increase the risk indirect impacts to the subspecies.

The indirect impacts relevant to the subspecies are also relevant to Carnaby’s cockatoo. However, the level of risk to Carnaby’s cockatoo from these impacts is likely to be higher due to the extent of Carnaby’s cockatoo habitat across the whole of the Strategic Assessment Area and the greater level of overlap between key cockatoo habitat and urbanised areas.

Consequently, a set of measures will be implemented under Action Plan F to address these potential indirect impacts to Carnaby’s cockatoo, and these measures will similarly benefit the Forest Red-tailed Black cockatoo. In addition, a number of over-arching conservation commitments will reduce the risk of indirect impacts to the subspecies.

**WILL CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?**

| NEED FOR CONSERVATION COMMITMENTS | Specific conservation commitments for the Forest Red-tailed Black cockatoo are considered necessary to meet the conservation objectives for the species. While the majority (96%) of potential habitat for the species will be avoided within the Strategic Assessment Area, the potential for fragmentation of habitat and indirect impacts to habitat puts achieving the conservation objectives at risk.

However, commitments for Carnaby’s cockatoo are considered adequate to maintain habitat and mitigate impacts to the Forest Red-tailed Black cockatoo. This is based on the fact that habitat mapped for the Forest Red-tailed Black cockatoo overlaps with 87% of Carnaby’s cockatoo habitat mapped within the Strategic Assessment Area. Consideration of habitat values for the Forest Red-tailed Black cockatoo will form part of the ongoing processes for protecting land for black cockatoos. In particular, the retention of Swan Coastal Plain Banksia habitat through urban and industrial areas, and the planting of species of trees suitable for cockatoo feeding (including exotics like Cape Lilac) in open space across urban, industrial and rural residential areas will provide for the continued use of the Strategic Assessment Area by the species.

The Commonwealth Recovery Plan (DEC 2008) outlines a set of recovery actions, including undertaking research and monitoring to stop further decline and to ensure the persistence of the subspecies throughout its range. Existing arrangements for the funding and implementation of these recovery actions are considered adequate in addressing key knowledge gaps relevant to conservation.

**WHAT CONSERVATION COMMITMENTS ARE RELEVANT TO THE SPECIES?**

| CARNABY’S COCKATOO CONSERVATION COMMITMENTS | In addition to the relevant over-arching commitments, the following commitments are provided for Carnaby's cockatoo (NB: in summary form, see Chapter 15 for full detail):

- Maintain cockatoo habitat and habitat connectivity within and outside the Strategic Assessment Area by:
  - Limiting clearing of feeding habitat to no more than the current class of action footprints.
  - Replacing 5000 ha of pines habitat through replanting.
  - Avoiding clearing of habitat at the local scale as part of detailed planning for urban and industrial expansion areas.

- Mitigate impacts of clearing of cockatoo habitat through:
  - Rehabilitating habitat disturbed by BRM extraction not required for future classes of
action.
- Rehabilitating habitat disturbed by infrastructure construction but not required for permanent structures or maintenance.

- Offset residual impacts to habitat through:
  - Protecting and managing of land through creation of new conservation reserves within and outside the Strategic Assessment Area.
  - Restoring Swan Coastal Plain feeding habitat.
  - Recreation of breeding habitat within and outside of the Strategic Assessment Area.
- Improve knowledge about the species and inform conservation efforts through ongoing monitoring programs, research, education, and improvements to management.

**ADDITIONAL CONSERVATION MEASURES**

In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the subspecies. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the subspecies where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.
- Ongoing implementation of actions to benefit the subspecies. For example, implementation of Recovery Plan actions and general management of threats and pressures across the landscape.

**OUTCOMES FOR THE SPECIES**

**KEY POINTS**

The assessment has identified a number of key points for the outcome of the Forest Red-tailed Black cockatoo:

- **The Strategic Assessment Area occurs at the north-western extent of the species range.** It comprises 11% of the total distribution mapped for the species, 5% of which occurs on the Swan Coastal Plain and 6% in the Jarrah Forest IBRA regions.

- **The majority of potential habitat (84%) in the Strategic Assessment Area will be avoided.** This includes 17% of potential habitat occurring within IUCN I-IV reserves and 67% within Parks and Wildlife managed lands.

- **The classes of action intersect with 4% of potential habitat available within the Strategic Assessment Area.** Of this, 1% occurs within the Jarrah Forest and 3% on the Swan Coastal Plain.

- **Habitat within the Strategic Assessment Area will be more fragmented on the Swan Coastal Plain** as a result of the classes of action. The total area of habitat within patches larger than 10 ha will decrease by 12% on the Swan Coastal Plain and 1% in the Jarrah Forest. However, key movement corridors such as the southern portion of the Darling scarp are avoided, which ensures connectivity with the southern distribution of the species.

It is considered unlikely for the population status to be significantly altered by the classes of action. This reflects the context of the Strategic Assessment Area with the subspecies’ broader range. The overall outcome for the Forest Red-tailed Black cockatoo is considered to be an acceptable one which meets the conservation objectives through:

- retention of known and potential habitat;
- maintenance of habitat connectivity; and
- mitigation and offsets of residual impacts.

**CONSISTENCY WITH COMMONWEALTH PLANS**

- The outcomes and conservation objectives for the Forest Red-tailed Black cockatoo are not inconsistent with the relevant Threat Abatement Plans.
- The outcomes and conservation objectives for the Forest Red-tailed Black cockatoo are not inconsistent with the Commonwealth Recovery Plan (DEC 2008).
- These outcomes and conservation objectives have been set with consideration for the Commonwealth Conservation Advice for the subspecies (TSSC 2009b).
Figure 16-6: Distribution and habitat of the Forest Red-tailed Black Cockatoo within Western Australia
Figure 16-7: Distribution and habitat of the Forest Red-tailed Black Cockatoo within the Strategic Assessment Area

Legend
- **Strategic Assessment Area**
- **Forest Red-tailed Black Cockatoo**
  - Habitat
  - Core Distribution
  - Vagrant Distribution

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DAEPaW
Prepared by: SM Date: 18/11/2015
Figure 16-8a: Distribution of impacts for the Forest Red-tail Black Cockatoo - North-west Sub-Region
Figure 16.8b: Distribution of impacts for the Forest Red-tail Black Cockatoo - North-east Sub-Region
Figure 16-8c: Distribution of impacts for the Forest Red-tail Black Cockatoo - Central Sub-Region

Legend

- **Strategic Assessment Area**
- **Within Classes of Action**
  - Potential Habitat
- **Outside Classes of Action**
  - Potential Habitat

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW (Dec 2014)
Prepared by: SM  Date: 19/11/2015
Figure 16-8d: Distribution of impacts for the Forest Red-tail Black Cockatoo - South Metro Peel Sub-Region
Figure 16-8e: Distribution of impacts for the Forest Red-tail Black Cockatoo - South Metro Peel Sub-Region

Legend

- **Strategic Assessment Area**
- **Within Classes of Action**
  - Potential Habitat
- **Outside Classes of Action**
  - Potential Habitat

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW (Dec 2014)
Prepared by: SM Date: 19/11/2015
16.9  **CALYPTORHYNCHUS BAUDINII (BAUDIN'S COCKATOO)**

### SPECIES BACKGROUND

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Vulnerable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Endangered using IUCN criteria.</td>
</tr>
</tbody>
</table>

### PROFILE SUMMARY

The following points provide key information regarding the ecology and distribution of Baudin's cockatoo:

- Baudin’s cockatoo is one of two white-tailed black cockatoo species that occurs in Western Australia. It is mostly dull black in colour, with pale whitish margins on the feathers, large rounded white patches on the coverts, and rectangular white panels on the tail feathers (DoE 2015a). It is often confused with Carnaby’s cockatoo (*Calyptorhynchus latirostris*), but can be distinguished by its longer upper bill and slight variations in its calls.

- The current distribution of Baudin’s cockatoo is from Albany extending north to Gidgegannup, east to Mount Helena, Wandering, Quindanning, Kojonup, Frankland and King River and to the eastern margin of the Swan Coastal Plain including West Midland, Byford, North Dandalup, Yarloop, Wokalup and Bunbury (Johnstone 1997 and Johnstone and Storr 1998 as cited in DEC 2008). The species also occurs in the Stirling and Porongurup Ranges and east along the south coast to Waychinicup National Park (Johnstone and Kirkby 2008).

- The Strategic Assessment Area represents the northern extent of Baudin’s cockatoo and covers the majority of the northern Jarrah Forest and the southern portion of the Swan Coastal Plain. Its northern-most extent ranges from Avon Valley National Park in the north-east and down to Port Kennedy in the south-west. The extent of occurrence of the species within the Strategic Assessment Area is estimated to be 6,064 km², or approximately 10.6% of the entire mapped extent of the species.

- The total population of the species is estimated to be between 12,000 – 15,000 individuals with a declining trend. This estimate is of low reliability (Garnett et al. 2011 as cited in DoE 2015a; Johnstone and Kirkby 2008; Johnstone and Kirkby 2010).

- The species is most commonly known from forested areas. Birds will forage at all levels of the forest from the canopy to the ground, often feeding in the understorey on proteaceous trees and shrubs, primarily Banksia, and in orchards both in trees and on fruit that has fallen on the ground (Johnstone and Kirkby 2008). The species has also been observed in more open agricultural areas and on the margins of the wheatbelt.

- Connectivity between breeding, roosting and feeding habitats is important for the species to assist their movement through the landscape and to ensure the continued use of habitat by the species across its entire known range.

- During the breeding season (August onwards), the species is sedentary, nesting in the Karri forests of the south-west (DoE 2015a). After breeding (March onwards), the species’ range expands and some of the birds move in response to availability of food...
resources (Saunders 1974b as cited in DEC 2008).

- The Strategic Assessment Area is primarily used for feeding and roosting in the non-breeding season, with isolated occurrences of breeding observed in the Perth Hills region at Wungong Catchment and Serpentine. Much of the population congregates on the central and northern parts of the Darling Scarp (on the eastern side of the Strategic Assessment Area) between March and September. The species then moves onto the Swan Coastal Plain to forage prior to returning to the south-west forests for breeding (Johnstone and Kirkby 2010).

- The use of feeding habitat appears to be driven by the presence of Marri, which occurs at highest densities in the Jarrah Forest and on the eastern edge of the Swan Coastal Plain.

- There are many large roost sites primarily within the Jarrah Forest in the Strategic Assessment Area, a number of which are used every year by Baudin’s cockatoo (Johnstone and Kirkby 2008).

- Habitat within the Strategic Assessment Area is considered critical to the survival of the species. A total of 328,717 ha of potential habitat has been mapped for Baudin’s cockatoo within the Strategic Assessment Area, comprising 40,042 ha on the Swan Coastal Plain and 288,675 ha within Jarrah Forest habitat. The Jarrah Forest within the northern Darling Range likely contains the majority, if not all, breeding habitat for the species within the Strategic Assessment Area.

- The population of Baudin’s cockatoo within the Strategic Assessment Area is part of a single contiguous population and is considered an important population.

- The main threats to Baudin’s cockatoo include killing by illegal shooting, feral Honey Bees, foraging and breeding habitat loss, nest hollow shortage and competition for available nest hollows (DEC 2008). Climate change is an additional threat that is likely to exacerbate the threatening processes as a result of changes to biodiversity and ecosystem function (Chambers et al. 2005 as cited in DEC 2008).

- The objective of the Commonwealth Recovery Plan is to stop further decline in the breeding populations of Baudin’s cockatoo and to ensure its persistence throughout its range in the south-west of Western Australia (DEC 2008).

- There are two Threat Abatement Plans that may be relevant to the species:
  o The Threat Abatement Plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoE 2014).
  o The Threat Abatement Plan for Beak and Feather Disease affecting endangered psittacine species (Department of Environment and Heritage 2005).

- Key knowledge gaps identified for Baudin’s cockatoo include (Johnstone and Kirkby 2008 and DEC 2008):
  o breeding biology and ecology: breeding range, timing of nesting events, nest tree and nest hollow characteristics, clutch size, incubation period, fledging period and nesting success;
  o seasonal movement patterns, including changes in feeding patterns based on availability of resources;
  o populations dynamics of breeding and non-breeding birds;
  o map and monitor important breeding, feeding and roosting sites throughout the species’ range; and
Strategic Assessment for the Perth and Peel Regions

- development of non-lethal means to deter birds from orchards.
  See Appendix B for further information.

SPECIES MAPPING

APPROACH TO MAPPING
Habitat mapping for Baudin’s cockatoo was undertaken across the Jarrah and Swan Coastal Plain IBRA regions within the Strategic Assessment Area. The mapping identifies potential habitat for the species based on native vegetation containing Baudin’s cockatoos’ preferred feeding species within its current distribution.

The following plant species were included as target species in the feeding habitat layer for Baudin’s cockatoo: Marri (Corymbia calophylla), Jarrah (Eucalyptus marginata), Wandoo (E. wandoo), Flooded Gum (E. rudis), Banksia littoralis, B. ilicifolia, Hakea undulata, H. prostrata, H. trifurcata and Dryandra [sic] spp. (Parks and Wildlife, 2015 pers. comm.).

Roosting and breeding site data was unavailable and therefore has not been mapped. However, breeding and roosting areas occur within the mapped extent of habitat for the species. Given Baudin’s cockatoo primarily use the Strategic Assessment Area for feeding, and that breeding or roosting is unlikely to extend outside of feeding areas, potential habitat mapping based on feeding habitat is considered adequate for the purpose of this assessment.

The criteria for known and potential habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

MAPS
See Figure 16-9 for a map of distribution and habitat across the range of the species.
See Figure 16-10 for a map of habitat within the Strategic Assessment Area.
See Figure 16-11a-d for maps of habitat intersected by class of action footprints

CONSERVATION OBJECTIVES

CONSERVATION OBJECTIVES
The conservation objectives for Baudin’s cockatoo are to:

- Ensure the continued use of the Strategic Assessment Area by the species.
- Avoid and protect habitat in the Strategic Assessment Area that is required to maintain the northern extent of the species distribution.
- Maintain habitat connectivity across the Strategic Assessment Area and with the southern extent of the species’ range.
- Undertake research to improve knowledge about the species and inform conservation effort and management in the Strategic Assessment Area.

JUSTIFICATION
The conservation objectives for the species have been developed recognising the following key attributes:

- The Strategic Assessment Area is considered critical to the survival of the species as it supports feeding, roosting and potential breeding habitat for Baudin’s cockatoo. It is important to maintain and protect this habitat in order to ensure the Strategic Assessment Area is able to sustain continued presence of the species.
- The Strategic Assessment Area represents the northern extent of the species’ range. Maintaining the full range of a species is recognised as one of the primary aims of
biodiversity conservation as it assists in the maintenance of variation and improves the species' capacity to cope and respond to different conditions and changes in the environment.

- The majority of potential habitat for the species occurs in the eastern portion of the Strategic Assessment Area and partly on the Swan Coastal Plain. Maintaining connectivity between these areas and to other areas of the species' range is important to ensure the continued use of habitat by the species across its entire known range.
- It is important that key knowledge gaps, such as population dynamics, seasonal movement patterns, breeding biology and ecology, are addressed to ensure conservation efforts are focused where they are required.

### STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS

| SPECIES HABITAT | 328,716 ha of potential habitat has been mapped for Baudin’s cockatoo within the Strategic Assessment Area (see Figure 16-10). This equates to 14% of the total potential habitat mapped for Baudin’s cockatoo across the entire Jarrah Forest and Swan Coastal Plain IBRA regions. The Jarrah Forest IBRA region holds 88% of the potential habitat for the species, with the remaining 12% across the Swan Coastal Plain. The two regions will be considered separately when analysing the classes of action intersects below. |

#### Avoidance of habitat

A total of approximately 320,204 ha (97%) of potential habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 53,622 ha (16%) occurs within IUCN reserve categories I to IV.
- 176,214 ha (54%) occurs within other land managed by Parks and Wildlife.

The main areas of protection are: Dwellingup State Forest (73,284 ha), Jarrahdale State Forest (69,998 ha), Mundaring (23,769 ha) and Lane Pool Reserve (14,843 ha).

The remaining 90,368 ha (27%) of habitat occurring outside of the classes of action is not within protected land. These areas are mostly situated on the Darling Scarp and in the southern portion of the Strategic Assessment Area. It is broadly expected that some level of decline in vegetation will occur over time to these area, but also that large portions will remain.

In summary, the classes of action avoid approximately 98% of the potential habitat with some of this in conservation managed land.

### Intersects with classes of action

The classes of action intersect with approximately 8,512 ha (3%) of the potential habitat for Baudin’s cockatoo within the Strategic Assessment Area. This is broken down across regions as follows:

#### Jarrah Forest

Within the Jarrah Forest, the classes of action intersect with approximately 3,538 ha (1%) of potential habitat for the Baudin’s cockatoo within the Strategic Assessment Area (Figure 16-11a-d):

- 1,358 ha (<1%) with the urban class of action;
- 25 ha (<0.1%) with the industrial class of action;
- 1,444 ha (<1%) with the rural residential class of action;
- 595 ha (<1%) with the basic raw materials (BRM) class of action; and
Within the Swan Coastal Plain, the classes of action intersect with approximately 4,973 ha (2%) of potential habitat for the Baudin's cockatoo within the Strategic Assessment Area (Figure 16-11a-d):

- 2,598 ha (<1%) with the urban class of action;
- 827 ha (<1%) with the industrial class of action;
- 810 ha (<1%) with the rural residential class of action;
- 173 ha (<0.1%) with the basic raw materials (BRM) class of action; and
- 564 ha (<1%) with the infrastructure class of action.

The classes of action primarily intersect with habitat areas on the Swan Coastal Plain within the western half of the Strategic Assessment Area. Vegetation within this western half tends to contain lower densities of Marri compared to the Jarrah Forest and areas along the eastern edge of the Swan Coastal Plain. The presence of Marri appears to be a key driver in the use of feeding habitat by the species and loss of potential habitat along the western Swan Coastal Plain is expected to have less of an impact on total feeding potential.

The areas most intersected by the classes of action include:

- towards the northern extent of the Darling scarp, between Brigadoon, Mundaring and Chidlow (Figure 16-11a);
- the Armadale locality (Figure 16-11b);
- east of Pinjarra (Figure 16-11d); and
- between Huntingdale and Mandurah on the western extent of the species’ range and down the western edge of the Peel-Harvey Estuary (Figure 16-11d).

### Existing habitat connectivity

Habitat connectivity is recognised as important in maintaining the species’ use of resources within the Strategic Assessment Area. Breaks in habitat of more than 4 km have been shown to prevent black cockatoos reaching resources (SEWPaC 2012). In the absence of specific information for Baudin’s cockatoo on connectivity requirements, information on Carnaby’s cockatoo has been used for this assessment. According to the profile information on the Australian Government’s Species Profile and Threats Database (DoE 2015a):

“Saunders and Ingram (1995) describe a lack of connectivity between patches as “strongly implicated in the failure of Carnaby’s cockatoo to survive in heavily cleared and fragmented rural landscapes”. Movement corridors with breaks of less than 4 km between other foraging, movement corridors, breeding and roosting sites are therefore important to allow the birds to move between these areas.”

In order to understand the level of habitat connectivity across the Strategic Assessment Area, GIS analysis of mapped Baudin’s Cockatoo habitat was undertaken. The analysis calculated the distances between polygons of potential habitat and their nearest neighbours in order to identify any patches isolated by 4 km or more. The analysis showed that based on the current mapped extent of habitat, the greatest distance between two patches was 1.5 km. This suggests that habitat connectivity in terms of distance between patches across the Strategic Assessment Area is currently adequate for Baudin’s cockatoo to move across the landscape (DoE 2015a).

In addition to distance between patches, patch size may also influence the species use of...
feeding areas across the landscape. The density of feeding resources needs to be high enough to compensate for the energy used in locating the food. If feeding effort is too great in a landscape where habitat is patchily distributed, then the birds may move in search of more dense, better quality feeding areas. The level of fragmentation that may be tolerated by the species is not known and will depend on a range of factors in addition to patch size such as feed type, seed production and landscape context. It is generally recognised in conservation planning that larger habitat patches are more resilient to the effects of fragmentation compared with smaller remnants (Bolger et al. 2000; Ross et al. 2002; Ferraz et al. 2003; Krauss et al. 2010; and Gibson et al. 2013 as cited in Ramalho et al. 2014). In a study looking into the effects of fragmentation on plant species richness and abundance in patches of remnant Banksia woodlands around Perth, Ramalho et al. (2014) found that remnants smaller than 5-10 ha are highly vulnerable to fragmentation effects, suggesting a minimum patch size of 10 ha is most suitable for the management and protection of bushland remnants.

In the absence of a minimum patch size or density figure specific for Baudin’s cockatoo, patch size connectivity across the Strategic Assessment Area was analysed with reference to 10 ha patches. This analysis was undertaken across two regions (Swan Coastal Plain and Jarrah Forest) within the Strategic Assessment Area, in recognition of the different patterns of development within each region, as well as the differences in feeding habitat. To reflect the high mobility of this species relative to the precision of the GIS data used for this analysis, patches separated by less than 20m were considered to be contiguous and treated as a single entity.

The Swan Coastal Plain contains the largest number of patches larger than 10 ha, while the Jarrah Forest contains the largest total area of patches larger than 10 ha, due to a single very large patch of over 258,000 ha (Table 16-5).

Across the Swan Coastal Plain region, patches larger than 10 ha make up 87% of the total mapped habitat for Baudin’s cockatoo within the Strategic Assessment Area (Table 16-5). Within the Jarrah Forest, patches larger than 10 ha comprise 99% of the total mapped habitat for Baudin’s cockatoo.

<table>
<thead>
<tr>
<th>Table 16-5: Existing habitat within the Strategic Assessment Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>Total number of patches</td>
</tr>
<tr>
<td>Number of patches &gt;10 ha</td>
</tr>
<tr>
<td>Area of patches &gt;10 ha</td>
</tr>
</tbody>
</table>

Potential impacts to habitat connectivity

Large areas of habitat along key movement corridors, such as the majority of the Darling scarp, will be retained within Parks and Wildlife managed land. This will help ensure the ongoing maintenance of important ecological linkages for the species, including providing for connectivity between habitat areas within the Strategic Assessment Area with the species broader southern range.

Potential impacts to Baudin’s cockatoo habitat connectivity from the classes of action have been assessed. When overlayed on the mapped habitat, the class of action footprints increase the maximum distance between two patches of feeding habitat from 1.5 km to 1.9
km. Whilst this analysis shows a reasonable loss of connectivity (21%), it is still within the required breaks of 4 km or less, considered necessary to allow movement between habitat areas (SEWPaC 2012). Importantly, key movement corridors such as the Darling scarp are protected, which ensures connectivity with the southern distribution of the species. Potential impacts from the classes of action are not expected to significantly interfere with Forest Red-tailed Black cockatoo habitat connectivity as it relates to distance between patches.

The number of patches over 10 ha in area on the Swan Coastal Plain is anticipated to decline by 11% from 384 to 343 as a result of the class of action footprints (Table 16-6). In the Jarrah Forest, the number of patches over 10 ha in area is expected to increase by 1.4% from 211 to 214 as a result of the class of action footprints. In some cases, a single large patch will be split into several smaller patches which artificially increases the number of patches above the 10 ha threshold.

The total area of habitat within patches larger than 10 ha on the Swan Coastal Plain is expected to decline by 11% or 3,785 ha (Table 16-6). The total area of habitat within patches larger than 10 ha in the Jarrah Forest is expected to decline by 1% or 3,439 ha. This indicates that foraging behaviour may be affected more so on the Swan Coastal Plain due to loss or fragmentation of habitat patches.

Table 16-6: Baudin’s cockatoo habitat patches after intersection with proposed classes of action

<table>
<thead>
<tr>
<th></th>
<th>Swan Coastal Plain</th>
<th>Jarrah Forest</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total number of patches &gt;10ha</td>
<td>343</td>
<td>214</td>
</tr>
<tr>
<td>Variance in number of patches &gt;10 ha</td>
<td>-41 (decrease)</td>
<td>3 (increase)</td>
</tr>
<tr>
<td>Percentage variance of patches &gt;10 ha</td>
<td>11% decrease</td>
<td>1.4% increase</td>
</tr>
<tr>
<td>Total habitat in patches &gt;10 ha</td>
<td>30,414</td>
<td>282,526</td>
</tr>
<tr>
<td>Net loss of habitat in patches &gt;10 ha</td>
<td>3,785</td>
<td>3,439</td>
</tr>
<tr>
<td>Percentage decrease in area of habitat in patches &gt;10 ha</td>
<td>11%</td>
<td>1%</td>
</tr>
</tbody>
</table>

**INDIRECT IMPACTS**

Indirect impacts may affect Baudin’s cockatoo where new development occurs or where existing development intensifies adjacent to or near habitat. Baudin’s cockatoo may be susceptible to the following indirect impacts (DEC 2008):

- competition for and loss of nest hollows;
- feral Honey Bees (*Apis mellifera*); and
- direct mortality.

Direct mortality may result from vehicle strikes, illegal poaching of eggs and nestlings and illegal shooting by orchardists and farmers. An increasing human population within and adjacent to habitat as a result of the classes of action is expected to increase the risk indirect impacts to the species.

The indirect impacts relevant to the subspecies are also relevant to Carnaby’s cockatoo. However, the level of risk to Carnaby’s cockatoo from these impacts is likely to be higher due to the extent of Carnaby’s cockatoo habitat across the whole of the Strategic Assessment Area and the greater level of overlap between key cockatoo habitat and urbanised areas. Consequently, a set of measures will be implemented under Action Plan F to address these
potential indirect impacts to Carnaby’s cockatoo, and these measures will similarly benefit Baudin’s cockatoo. In addition, a number of over-arching conservation commitments will reduce the risk of indirect impacts to the species.

WILL CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?

Specific conservation commitments for Baudin’s cockatoo are considered necessary to meet the conservation objectives for the species. While the majority (97%) of potential habitat for the species will be avoided within the Strategic Assessment Area, the potential for fragmentation of habitat and indirect impacts to habitat puts achieving the conservation objectives at risk.

However, commitments for Carnaby’s cockatoo are considered adequate to maintain habitat and mitigate impacts to Baudin’s cockatoo. This is based on the fact that habitat mapped for Baudin’s cockatoo overlaps with 76% of Carnaby’s cockatoo habitat mapped within the Strategic Assessment Area. Consideration of habitat values for the Baudin’s Black cockatoo will form part of the ongoing processes for protecting land for black cockatoos.

The Commonwealth Recovery Plan (DEC 2008) outlines a set of recovery actions, including undertaking research and monitoring to stop further decline and to ensure the persistence of Baudin’s cockatoo throughout its range. Existing arrangements for the funding and implementation of these recovery actions are considered adequate in addressing key knowledge gaps relevant to conservation.

WHAT CONSERVATION COMMITMENTS ARE RELEVANT TO THE SPECIES?

In addition to the relevant over-arching commitments, the following commitments are provided for Carnaby’s cockatoo (NB: in summary form, see Chapter 15 for full detail):

- Maintain cockatoo habitat and habitat connectivity within and outside the Strategic Assessment Area by:
  - Limiting clearing of feeding habitat to no more than the current class of action footprints.
  - Replacing 5000 ha of pines habitat through replanting.
  - Avoiding clearing of habitat at the local scale as part of detailed planning for urban and industrial expansion areas.
- Mitigate impacts of clearing of cockatoo habitat through:
  - Rehabilitating habitat disturbed by BRM extraction not required for future classes of action.
  - Rehabilitating habitat disturbed by infrastructure construction but not required for permanent structures or maintenance.
- Offset residual impacts to habitat through:
  - Protecting and managing of land through creation of new conservation reserves within and outside the Strategic Assessment Area.
  - Restoring Swan Coastal Plain feeding habitat.
  - Recreation of breeding habitat within and outside of the Strategic Assessment Area.
- Improve knowledge about the species and inform conservation efforts through ongoing monitoring programs, research, education, and improvements to management.
### ADDITIONAL CONSERVATION MEASURES

In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the species where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.
- Ongoing implementation of actions to benefit the species. For example, implementation of Recovery Plan actions and general management of threats and pressures across the landscape.

### OUTCOMES FOR THE SPECIES

#### KEY POINTS

The assessment has identified a number of key points relevant to the outcome for Baudin’s cockatoo:

- **The Strategic Assessment Area occurs at the northern extent of the species range.** It comprises 11% of the total distribution mapped for the species, 4% of which occurs on the Swan Coastal Plain and 7% in the Jarrah Forest IBRA regions.

- **The majority of potential habitat (97%) in the Strategic Assessment Area will be avoided.** This includes 16% of potential habitat occurring within IUCN I-IV reserves and 54% within Parks and Wildlife managed lands.

- **The classes of action intersect with 3% of potential habitat available within the Strategic Assessment Area.** Of this, the 1% occurs within the Jarrah Forest and 2% on the Swan Coastal Plain.

- **Habitat within the Strategic Assessment Area will be more fragmented on the Swan Coastal Plain** as a result of the classes of action. The total area of habitat within patches larger than 10 ha will decrease by 11% on the Swan Coastal Plain and 1% in the Jarrah Forest. However, key movement corridors such as the southern portion of the Darling scarp are avoided, which ensures connectivity with the southern distribution of the species.

It is considered unlikely for the population status to be significantly altered by the classes of action. This reflects the context of the Strategic Assessment Area with the species’ broader range. The overall outcome for Baudin’s cockatoo is considered to be an acceptable one which meets the conservation objectives through:

- retention of known and potential habitat;
- maintenance of habitat connectivity; and
- mitigation and offsets of residual impacts.

#### CONSISTENCY WITH COMMONWEALTH PLANS

- The outcomes and conservation objectives for Baudin’s cockatoo are not inconsistent with the relevant Threat Abatement Plans.
- The outcomes and conservation objectives for Baudin’s cockatoo are not inconsistent with the Commonwealth Recovery Plan (DEC 2008).
Figure 16-9: Distribution and habitat of the Baudin’s Cockatoo within Western Australia

Legend

- **Strategic Assessment Area**
- **Baudin’s Cockatoo**
  - Distribution
  - Habitat

Datum/Projection:
GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
Figure 16-10: Distribution and habitat of the Baudin’s Cockatoo within the Strategic Assessment Area

Legend
- Strategic Assessment Area
- Baudin’s Cockatoo
  - Distribution
  - Habitat

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
Figure 16-11a: Distribution of impacts for Baudin’s cockatoo - North-east Sub-Region

Legend

- Strategic Assessment Area
- Within Classes of Action
  - Potential Habitat
- Outside Classes of Action
  - Potential Habitat

Datum/Projection:
GDA 1994 MGA Zone 50
Data Source: DPaW (Dec 2014)
Prepared by: SM Date: 19/11/2015
Figure 16-11b: Distribution of impacts for Baudin’s cockatoo - Central Sub-Region

Legend
- Strategic Assessment Area
  - Within Classes of Action
    - Potential Habitat
  - Outside Classes of Action
    - Potential Habitat

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW (Dec 2014)
Prepared by: SM Date: 19/11/2015
Figure 16-11d: Distribution of impacts for Baudin’s cockatoo - South Metro Peel Sub-Region

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW (Dec 2014)

Legend
- Strategic Assessment Area
- Within Classes of Action
- Potential Habitat
- Outside Classes of Action
- Potential Habitat

Prepared by: SM Date: 19/11/2015
16.10  *Dasyurus geoffroii* (Chuditch)

**SPECIES BACKGROUND**

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Vulnerable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Endangered using IUCN criteria.</td>
</tr>
</tbody>
</table>

**PROFILE SUMMARY**

The following points provide key information about the ecology and distribution of the Chuditch:

- The Chuditch, also known as the Western Quoll, is the largest carnivorous marsupial in Western Australia. It is the size of a small domestic cat and can primarily be distinguished from other mammals within its present range by its white spotted brown fur (DEC 2012a).

- The species formerly ranged across nearly 70% of the continent, occurring in every mainland State and Territory. It is now restricted to the south-west of Western Australia within an estimated 5% of its former range. There has been a reduction in the historical range of the Chuditch due to the introduction of feral predators such as foxes. Within the Strategic Assessment Area, the Chuditch has been recorded from Gooseberry Hill, East Martin, Upper Swan Valley, High Wycombe, Wandi and Yalgorup National Park. Approximately 402,367 ha of known and potential habitat has been mapped for the species within the Strategic Assessment Area.

- Translocation of captive bred Chuditch has been undertaken across six areas where they formally occurred. These programs have been successful in Julimar National Park, Lake Magenta Nature Reserve and Kalbarri National Park, which has extended the population further north.

- Small fragmented populations in the outer metropolitan areas of the Swan Coastal Plain have been recorded, with more concentrated populations of the species known to occur within Jarrah Forest.

- The population within the Strategic Assessment Area is considered an important population as it represents a significant extent of the area of occupancy, extent of occurrence, and a significant proportion of the total population of the species.

- The objectives of the Commonwealth Recovery Plan are to reduce of potential threats to the Chuditch and increase population densities to ensure long-term survival (DEC 2012a).

- There are two Threat Abatement Plans that may be relevant to this species:
  - The Threat Abatement Plan for predation by European red fox (DEWHA 2008b).
  - The Threat Abatement Plan for predation by feral cats (DEWHA 2008c).

See Appendix B for further information.

**SPECIES MAPPING**

| APPROACH TO | Habitat mapping for the Chuditch was undertaken across its range (including within the |
MAPPING
Strategic Assessment Area. The mapping identifies:
- Known habitat, comprising the locations and supporting remnant vegetation patches where the species has previously been recorded (referred to as type 1).
- Potential habitat, comprising remnant vegetation patches within the species distribution that have the potential to support the species (referred to as type 2).
The criteria for known and potential habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

MAPS
See Figure 16-12 for a map of habitat across the range of the species.
See Figure 16-13 for a map of habitat within the Strategic Assessment Area.

CONSERVATION OBJECTIVES

CONSERVATION OBJECTIVES
The conservation objectives for the Chuditch, drawing from the Commonwealth Recovery Plan (DEC 2012) are to:
- Minimise potential threats from future development to maintain the long-term viability of the Chuditch within the Strategic Assessment Area.
- Protect and maintain a connected network of known and potential habitat within the Strategic Assessment Area.

JUSTIFICATION
The two conservation objectives for the species have been developed recognising the following key attributes:
- The Strategic Assessment Area incorporates a significant proportion of the northern extent of the current species range, with exception of a re-introduced population in Kalbarri. It is important to continue to protect and maintain this extent and the long-term viability of the species within this area.
- The majority of known habitat for the species occurs in the eastern portion of the Strategic Assessment Area and partly to the south. In particular, the Jarrah Forest south of Mundaring is recognised as important habitat for the species. Maintaining connectivity to these areas is important for the species’ continued use of the Strategic Assessment Area.
- Potential habitat for the species occurs throughout the north, east and southern portions of the Strategic Assessment Area. This potential habitat occurs close to the northern extent of the species’ mapped extent; however is considered important for maintaining connectivity.

STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS

KNOWN HABITAT (TYPE 1)
100,659 ha of known habitat has been mapped for the Chuditch within the Strategic Assessment Area (see Figure 16-13). This equates to <1% of the total known habitat mapped for the species.

The Jarrah Forest is considered more significant for the species within the Strategic Assessment Area, and contains 93% of its known habitat, with the remaining 7% of known habitat on the Swan Coastal Plain.

Avoidance of known habitat
A total of 98,465 ha (97%) of known habitat will be avoided within the Strategic Assessment Area.
Area. Of this approximately:

- 18,133 ha (18%) occurs within IUCN reserve categories I to IV.
- 57,704 ha (57%) occurs within other land managed by Parks and Wildlife.

The main areas of protection for the species are Dwellingup, Jarrahdale and Mundaring State Forests.

The remaining 22,701 ha (22%) of known habitat occurs outside of the classes of action and is not within protected land.

Of note is the decision to remove East Keralup from the future urban development footprint, which contains known habitat for the Chuditch. The species has been recorded in the area immediately adjacent to the East Keralup landholding, and is thought to possibly also occur within East Keralup itself in association with the Serpentine River. This reservation will help to create linkages between larger, more intact bushland which will be significant for the maintenance of Chuditch populations.

**Intersects with classes of action**

A total of 2,118 ha (2%) of known habitat intersects with the classes of action.

Within the Jarrah Forest, approximately 1,414 ha (1%) of known habitat intersects with the classes of action as follows:

- 532 ha (<1%) by the urban class of action;
- 12 ha (<0.1%) by the industrial class of action;
- 635 ha (<1%) by the rural residential class of action;
- 47 ha (<0.1%) by the infrastructure class of action (namely proposed red roads); and
- 188 ha (<1%) by the BRM class of action.

On the Swan Coastal Plain, approximately 704 ha (<1%) of known habitat intersects with the classes of action as follows:

- 512 ha (<1%) by the urban class of action;
- 50 ha (<0.1%) by the industrial class of action;
- 30 ha (<0.1%) by the rural residential class of action; and
- 112 ha (<0.1%) by the infrastructure class of action (namely proposed red roads).

Potential impacts will affect the eastern and southern areas of known habitat. In the Jarrah Forest, known habitat to the north of and surrounding Mundaring is expected to be impacted the most as a result of urban, infrastructure and rural residential classes of action. The rural residential class of action is also likely to fragment known habitat around Kenwick, Roleystone and Dwellingup.

On the Swan Coastal Plain, some fragmentation is expected as a result of infrastructure and industrial classes of action in Anketell, Singleton and around Pinjarra. The urban class of action will impact areas east of Singleton, near Furnissdale, Yunderup and Pinjarra.

**POTENTIAL HABITAT (TYPE 2)**

301,707 ha of potential habitat occurs within the Strategic Assessment Area (see Figure 16-13). This equates to approximately 10% of total potential habitat mapped for the species.

The majority of potential habitat occurs within Jarrah Forest (67%) with the remainder (33%) across the Swan Coastal Plain.

**Avoidance of potential habitat**

The majority (95%) of potential habitat will be avoided within the Strategic Assessment Area.
Of this, approximately 69% occurs within Parks and Wildlife managed lands:
- 60,759 ha (21%) within IUCN reserve categories I to IV; and
- 145,079 ha (48%) within State Forest managed by Parks and Wildlife.

The remaining 26% of potential habitat occurs outside of the classes of action and is not within protected land.

**Intersects with classes of action**

14,020 ha (5%) of potential habitat is intersected by the classes of action. Within the Jarrah Forest, approximately 2,277 ha (<1%) of potential habitat intersects with the classes of action as follows:
- 424 ha (<1%) by the urban class of action;
- 10 ha (<0.1%) by the industrial class of action;
- 972 ha (<1%) by the rural residential class of action;
- 63 ha (<0.1%) by the infrastructure class of action; and
- 808 ha (<1%) by the BRM class of action.

On the Swan Coastal Plain, approximately 11,743 ha (4%) of potential habitat intersects with the classes of action as follows:
- 7,048 ha (2%) by the urban class of action;
- 1,778 ha (<1%) by the industrial class of action;
- 614 ha (<1%) by the rural residential class of action;
- 1,468 ha (<1%) by the infrastructure class of action; and
- 835 ha (<1%) by the BRM class of action.

The classes of action intersect with a greater area of potential habitat on the Swan Coastal Plain, which provides habitat connectivity to the eastern parts of the Strategic Assessment Area and connectivity with the species to the south. Potential habitat is most at risk of fragmentation on the northern Swan Coastal Plain near Yanchep, and further south in the locality of Kwinana.

**INDIRECT IMPACTS**

Indirect impacts may affect the Chuditch where new development occurs or where existing development intensifies adjacent to or near habitat. Chuditch populations may be susceptible to the following indirect impacts (DEC 2012a):
- predation by and competition with introduced species such as foxes and cats;
- altered fire regimes;
- habitat alteration and fragmentation;
- deliberate and accidental mortality from poisoning, shooting and road kills; and
- disease.

Indirect impacts have the potential to affect known and potential Chuditch habitat, primarily through fragmentation and alteration of habitats as a result of the classes of action. Incidences of deliberate and accidental mortality will likely increase with a growing population in denser areas of urban and industrial development. Other indirect impacts are also likely to increase within the Strategic Assessment Area, particularly in habitat on the Swan Coastal Plain and north of Mundaring in the Jarrah Forrest.

At a landscape scale, ongoing management of threats within IUCN I-IV reserves that support the species will be an important aspect of maintaining long-term viability within the Strategic Assessment Area.
## WILL THE CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?

<table>
<thead>
<tr>
<th>NEED FOR CONSERVATION COMMITMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specific conservation commitments for the Chuditch are considered necessary to meet the conservation objectives for the species. While the majority of known (97%) and potential (95%) habitat for the species will be avoided within the Strategic Assessment Area, potential impacts put achieving the conservation objectives at risk. In particular:</td>
</tr>
<tr>
<td>- habitat loss from the urban, industrial and rural class of actions that could result in habitat fragmentation; and</td>
</tr>
<tr>
<td>- potential indirect impacts from the classes of action.</td>
</tr>
<tr>
<td>It should be noted that there are a number of relevant over-arching commitments in Action Plan F that have the potential to provide benefits to the species. These commitments provide conservation benefits across various parts of the Strategic Assessment Area and broadly relate to:</td>
</tr>
<tr>
<td>- the retention and protection of land (including management of protected areas);</td>
</tr>
<tr>
<td>- avoidance of impacts within the classes of action; and</td>
</tr>
<tr>
<td>- assessment and management of potential indirect impacts from development.</td>
</tr>
<tr>
<td>Of particular importance is the commitment to establish the Peel Regional Park, as this encompasses known and potential habitat for the Chuditch associated with the Serpentine River and Peel-Harvey Estuary, and will maintain important ecological linkages for the species between the Swan Coastal Plain and Jarrah Forrest.</td>
</tr>
</tbody>
</table>

## WHAT CONSERVATION COMMITMENTS ARE REQUIRED TO MEET THE CONSERVATION OBJECTIVES?

<table>
<thead>
<tr>
<th>CONSERVATION COMMITMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>In addition to the relevant over-arching commitments, the following specific commitments are provided for the Chuditch:</td>
</tr>
<tr>
<td>1. Plan and design infrastructure to minimise impacts to the species’ habitat with a particular focus on minimising habitat fragmentation.</td>
</tr>
<tr>
<td>2. Maintain effective and functional habitat linkages in the Chidlow and Mundaring areas to maintain connectivity.</td>
</tr>
<tr>
<td>3. Actively manage indirect impacts to the species within all National Parks. Including through:</td>
</tr>
<tr>
<td>a. Programs to reduce feral predators.</td>
</tr>
<tr>
<td>b. Management of access to important areas.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADDITIONAL CONSERVATION MEASURES</th>
</tr>
</thead>
<tbody>
<tr>
<td>In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:</td>
</tr>
<tr>
<td>- Ongoing protection of the species where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.</td>
</tr>
<tr>
<td>- Ongoing implementation of actions to benefit the species. For example, implementation of Recovery Plan actions and general management of threats and pressures across the landscape.</td>
</tr>
</tbody>
</table>
OUTCOMES FOR THE SPECIES

**KEY POINTS**

The assessment has identified the following key issues relevant to the outcome for the Chuditch:

- **The species is now restricted to the south-west of Western Australia within an estimated 5% of its former range.** Within the Strategic Assessment Area, the Chuditch has been recorded from Gooseberry Hill, East Martin, Upper Swan Valley, High Wycombe, Wandi and Yalgorup National Park.

- **The majority of known (97%) and potential habitat (95%) in the Strategic Assessment Area will be avoided.** This includes 18% of known and 21% of potential habitat occurring within IUCN I-IV reserves. A conservation commitment is provided to ensure active management within National Parks for the species (including feral predator control and management of access).

- **The classes of action intersect with 2% of known habitat available within the Strategic Assessment Area.** Of this, <1% occurs on the Swan Coastal Plain and 1% occurs with the Jarrah Forest. Potential direct impacts to known habitat will affect areas mainly in the north-east near Mundaring and to the south near Kwinana and Mandurah. There is a greater potential impact within the Swan Coastal Plain region which may affect connectivity to the southern distribution of the species.

- **The classes of action also intersect with 5% of potential habitat available within the Strategic Assessment Area.** Of this, 4% occurs on the Swan Coastal Plain and <1% occurs with the Jarrah Forest. Direct impacts to potential habitat may fragment habitat in the north-west and southern parts of the Strategic Assessment Area.

- In order to meet the conservation objectives for the species, **conservation commitments are provided to minimise fragmentation from infrastructure and to maintain connectivity in the Chidlow and Mundaring areas.**

It is considered unlikely for the population status to be significantly altered by the classes of action. The overall outcome for the Chuditch is considered to be an acceptable one which meets the conservation objectives through:

- retention of 97% of known habitat and 95% of potential habitat within the Strategic Assessment Area;

- maintenance of connectivity in the Chidlow and Mundaring areas; and

- management of threats to the species within protected areas.

**CONSISTENCY WITH COMMONWEALTH PLANS**

- The outcomes and conservation objectives for the Chuditch are not inconsistent with the relevant Threat Abatement Plans.

- The outcomes and conservation objectives for the Chuditch are not inconsistent with the species’ Commonwealth Recovery Plan (DEC 2012a).
Figure 16-12: Distribution and habitat of the Chuditch within Western Australia.

Legend
- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3

Datum/Projection:
GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM  Date: 19/11/2015
Figure 16-13: Distribution and habitat of the Chuditch within the Strategic Assessment Area

Legend
- **Strategic Assessment Area**
- **Distribution**

**Habitat Type:**
- Pink: Habitat Type 1
- Orange: Habitat Type 2
- Green: Habitat Type 3

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM  Date: 19/11/2015
16.11  **LEIOPROCTUS DOUGLASIELLUS (SHORT-TONGUED BEE) AND NEOPASIPHAE SIMPLICIOR (NATIVE BEE)**

*Leioproctus douglasiellus* and *Neopasiphae simplicior* are addressed together in the impact assessment because of the overlap in habitat preferences for both species.

### SPECIES BACKGROUND

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Both species listed as Critically Endangered.</th>
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<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Both species listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Endangered using IUCN criteria.</td>
</tr>
</tbody>
</table>

**PROFILE SUMMARY**

#### *Leioproctus douglasiellus*

The following points provide key information about the ecology and distribution of the Short-Tongued Bee:

- *L. douglasiellus* is a small black bee, which belongs to a group of species characterised by short tongues. Females are approximately 8 mm in length, with a wing length of almost 5 mm.
- The species occurs in wetland areas and prefers vegetation associated with inundation (DoE 2014). It is thought that *Goodenia pulchella*, *Goodenia filiformis* and *Anthotium humile var. junciforme* are preferred food plants.
- The species is only known from three locations, all within the Strategic Assessment Area between Cannington and Forrestdale in the south-eastern metropolitan area. It does potentially occur further afield mostly within the Strategic Assessment Area. Approximately 32,949 ha of potential habitat has been mapped for *L. douglasiellus* with 82% of this occurring within the Strategic Assessment Area.
- Given the Commonwealth status of Critically Endangered for this species, all populations are considered important populations.
- There is no Commonwealth Recovery Plan for the species, however the Conservation Advice identifies research priorities and local priority actions.
- There are no relevant Threat Abatement Plans for this species.

#### *Neopasiphae simplicior*

The following points provide key information about the ecology and distribution of the Native Bee:

- *N. simplicior* is a small species of bee. It is black in colour and smaller than other species belonging to the same genus, with less modified antennae and legs.
- Similar to *L. douglasiellus*, the species occurs in wetland areas and prefers vegetation associated with inundation. It has been collected from the flowers of *Goodenia filiformis*, *Lobelia tenuior*, *Argianthus preissianus* and *Velleia* sp.
- The species is only known from three locations which all occur within the Strategic Assessment Area. These include, Forrestdale Lake (approximately 25 km south-east of...
Perth in the City of Armadale), the Armadale Golf Course (recorded in 1987), and at Cannington (recorded in 1954 and now likely to be historical) (DoE 2015a).

- It is now thought to occur as a single population within the bushland of the Forrestdale Lake Nature Reserve adjacent to Forrestdale Lake and the Armadale Golf Course. This population is likely to represent the sole remaining population of the species on the Swan Coastal Plain (DoE 2015a).
- Given this species’ Commonwealth status of Critically Endangered, all populations are considered important populations.
- There is no Commonwealth Recovery Plan for this species, however, the Conservation Advice identifies research priorities and local priority actions.
- There are no relevant Threat Abatement Plans for this species.

See Appendix B for further information about both species.

**SPECIES MAPPING**

**APPROACH TO MAPPING**

Combined habitat mapping for both species was undertaken together. This mapping identified:

- Known habitat, comprising the locations, supporting clay-based wetlands and remnant vegetation patches where the species has previously been recorded (referred to as type 1).
- Potential habitat, comprising clay-based wetlands and remnant vegetation patches within the species distribution that have the potential to support the species (referred to as type 2).

The criteria for known and potential habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1

**MAPS**

See Figure 16-14 for a map of habitat across the ranges of both species.

See Figure 16-15 for a map of habitat for both species within the Strategic Assessment Area.

**CONSERVATION OBJECTIVES**

The conservation objectives for *L. douglasiellus* and *N. simplicior* are:

- *Maintain the long-term viability of the species within the Strategic Assessment Area through protecting and maintaining known habitat.*
- *Ensure adequate representation of potential habitat outside of classes of action.*
- *Gain a better understanding of the potential importance of the Perth-Peel area to the species in order to inform management and conservation planning.*

**JUSTIFICATION**

The conservation objectives for both species have been developed recognising the following key attributes:

- There is little known about either species.
- All known habitat occurs within the Strategic Assessment Area.
- The majority of potential habitat occurs within the Strategic Assessment Area.
### Status of the Species Without Conservation Commitments

**Known Habitat (Type 1)**

All known habitat (2,158 ha) for the two species occurs within the Strategic Assessment Area (see Figure 16-15).

**Avoidance of known habitat**

A total of 1,950 ha (90%) of known habitat will be avoided. Of this approximately:

- 903 ha (42%) occurs within IUCN reserve category IA (Strict Nature Reserve).
- 17 ha (<1%) occurs within other land managed by Parks and Wildlife.


The remaining 1,019 ha (48%) of known habitat that occurs outside of the classes of action is not within protected land.

**Intersects with classes of action**

A total of 219 ha (10%) of known habitat intersects with the classes of action:

- 78 ha (4%) by the urban class of action;
- 109 ha (5%) by the industrial class of action;
- 8 ha (<1%) by the rural residential class of action; and
- 26 ha (1%) by the infrastructure class of action.

The classes of action have the potential to affect portions of known habitat near Bullsbrook, and north-east of Kwinana. There is potential for habitat loss and fragmentation in these areas due mainly to proposed urban and industrial development.

97% of the known habitat intersecting with the classes of action is contained within conservation category wetlands which are protected from direct and indirect impacts by overarching commitments in Action Plan F. In particular, important habitat in Carousel Swamp in Cannington will be addressed through these commitments.

**Potential Habitat (Type 2)**

Approximately 30,791 ha of potential habitat occurs within the Strategic Assessment Area (see Figure 16-15). This is approximately 81% of the total potential habitat that has been mapped for the two species.

**Avoidance of potential habitat:**

A total of 27,347 ha (89%) of potential habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 8,691 ha (28%) occurs within IUCN reserve categories I to IV.
- 2,258 ha (7%) occurs within other land managed by Parks and Wildlife.

The remaining 16,198 ha (53%) of potential habitat that occurs outside of the classes of action is not within protected land.

**Intersects with class of action**

3,644 ha (12%) of potential habitat is intersected by the classes of action:

- 1,994 ha (7%) by the urban class of action;
- 684 ha (2%) by the industrial class of action;
- 313 ha (1%) by the rural residential class of action;
- 636 ha (2%) by the infrastructure class of action; and
- 17 ha (<0.1%) by the BRM class of action.
29% of the potential habitat that intersects with the classes of action occurs within conservation category wetlands (such as Balannaup Lake, Ellenbrook Floodplain, Carousel Swamp, Tamworth Hill Swamp and Becher Point Wetlands). These areas are protected from direct and indirect impacts by over-arching commitments in Action Plan F.

**INDIRECT IMPACTS**

Indirect impacts may affect the two bee species where new development occurs or where existing development intensifies adjacent to or near habitat. Populations may be susceptible to the following indirect impacts (TSSC 2013c, TSSC 2008e and DoE 2015a):

- altered fire regimes;
- altered hydrological processes;
- habitat fragmentation; and
- competition with feral Honey Bees.

Of particular relevance to the classes of action would be potential alterations to hydrological processes and habitat fragmentation. These impacts may occur at all sites within the Strategic Assessment Area, but are likely to be more pronounced in close proximity to future urban developments, such as Bullsbrook and north-east of Kwinana.

Ongoing management of threats within IUCN I-IV reserves that support the species will be an important aspect of maintaining long-term viability within the Strategic Assessment Area.

### WILL CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?

**NEED FOR CONSERVATION COMMITMENTS**

Specific conservation commitments for the two bee species are considered necessary to meet the conservation objectives.

While the majority of known (90%) and potential (89%) habitat for the two species will be avoided within the Strategic Assessment Area, potential direct and indirect impacts (in particular to known habitat) need to be addressed.

It should be noted that two of the over-arching conservation commitments in Action Plan F will provide substantial benefits to the species. These are presented below along with specific commitments for the two bees.

### WHAT CONSERVATION COMMITMENTS ARE REQUIRED TO MEET THE CONSERVATION OBJECTIVES?

**RELEVANT OVER-ARCHING CONSERVATION COMMITMENTS**

The two relevant over-arching conservation commitments in Action Plan F are:

- **Ensure direct and indirect impacts to conservation category wetland (CCWs) are avoided (including through the application of appropriate buffers) within urban, industrial, and rural residential areas.**

- **Implement environmental assessment and management measures, controls and standards for all development to reduce direct and indirect impacts. This will include, but is not limited to, controls on vegetation clearing, water quality and use, stormwater, dust, noise, emissions, public access. This process will involve:**
  
  - ensuring controls / conditions placed on existing approvals continue to be implemented; and
  
  - ensuring that new proposals that are approved incorporate at a minimum the existing standard and expectations for control / mitigation / management of direct and indirect impacts.
Given that 97% of known habitat and 29% of potential habitat that intersects with the classes of action are associated with conservation category wetlands, these commitments will go a long way to ensuring that habitat for the two species is protected from both direct and indirect impacts.

**SPECIFIC CONSERVATION COMMITMENTS**

In addition, to ensure specific measures are taken for the species the following conservation commitments are provided for *L. douglasiellus* and *N. simplicior*:

- Protect and manage the known population of *L. douglasiellus* at Carousel Swamp in Cannington.
- Offset residual impacts by increasing the extent of protected areas that support known habitat, including:
  - extending the Kenwick Wetlands management boundary
  - extending the Forrestdale Lake Nature Reserve and Gibbs Road Nature Reserve boundary
- Continue to manage protected areas supporting the two species to reduce threats. Including management of off road vehicle access, weed control, fire control and control of feral bees.

**ADDITIONAL CONSERVATION MEASURES**

In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the two species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the species where they occur outside the class of action footprints and protected areas through the application of existing planning and approval processes.
- Ongoing implementation of actions to benefit the species. For example, general management of threats and pressures across the landscape.

**OUTCOMES FOR THE SPECIES**

**KEY POINTS**

The assessment has identified a number of key points relevant to the outcome for *L. douglasiellus* and *N. simplicior*:

- **The Strategic Assessment Area supports all known habitat for both species.** They are addressed together in this assessment given their overlap in habitat preferences.
- **The majority of known (90%) and potential (89%) habitat for the two species within the Strategic Assessment Area will be avoided.** This includes 42% of known habitat and 28% of potential habitat occurring in IUCN I-IV reserves. A conservation commitment is provided to ensure active management for the species within these reserves (including management of off road vehicle access, weed control, fire control and control of feral bees).
- **The classes of action intersect with 10% of the known habitat and 12% of potential habitat.** Of particular concern are potential impacts to the known population of *L. douglasiellus* which occurs at Carousel Swamp in Cannington. However:
  - 97% of known and 29% of potential habitat will be protected through over-arching commitments to protect conservation category wetlands; and
  - the population at Carousel Swamp is protected by a specific conservation commitment.
A commitment for offsets to compensate for residual impacts to known and potential habitat is provided. These offsets include extensions to the Kenwick Wetlands management boundary, the Forrestdale Lake Nature Reserve and Gibbs Road Nature Reserve boundary.

It is considered unlikely for the population status for either species to be significantly altered by the classes of action. The overall outcomes for *L. douglasiellus* and *N. simplicior* are considered to be acceptable and considered likely to meet the conservation objectives through:

- retention of the majority of known and potential habitat;
- management of threats to the species within protected areas; and
- offsets for residual impacts.

The outcomes and conservation objectives for these two species have taken into consideration the Commonwealth Conservation Advice for each species (TSSC 2013c, TSSC 2008e).
Figure 16-14: Distribution and habitat of the short-tongue bee within Western Australia

Legend
- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
Figure 16-15: Distribution and habitat of the short-tongue bee within the Strategic Assessment Area

Legend
- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
16.12 *PSEUDOCECHIRUS OCCIDENTALIS* (WESTERN RINGTAIL POSUM)

### SPECIES BACKGROUND

<table>
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<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Vulnerable.</th>
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<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Endangered using IUCN criteria.</td>
</tr>
</tbody>
</table>

### PROFILE SUMMARY

The following points provide key information about the ecology and distribution of the Western Ringtail Possum:

- The species is an arboreal marsupial. It is dark brown above (though sometimes dark grey) with cream or grey fur on the belly, chest and throat. It is smaller than the Common Brush-tail Possum and has darker shorter hair, smaller ears and the absence of a brush tail (Parks and Wildlife 2014a). The tail is narrow and pale towards the tip.

- The current extent of the species includes:
  - areas along the south coast from east of Albany to west of Walpole;
  - the west coast from Mandurah to Augusta; and
  - inland populations in the lower Collie River Valley at Harvey, Perup Nature Reserve, and surrounding forest blocks near Manjimup.

- It is thought that the species exists in multiple populations due to fragmentation.

- Across its range the species is often found in association with Peppermint (*Agonis flexuosa*) woodlands, but is also known to occur in Tuart and Jarrah/Marri woodlands, and a diverse range of vegetation types on the south coast.

- The species occurs within the south-west corner of the Strategic Assessment Area where it has a patchy distribution along the Swan Coastal Plain south of Mandurah and east near Serpentine. Within this range there are three distinct areas of known habitat. In addition there are translocated individuals at Lane Poole Reserve, Yalgorup National Park and Karakamia Sanctuary.

- The animals that occur in the south-west of the Strategic Assessment Area are considered to be within a single population. This population is considered an important population as it forms the northern extent of the species range.

- Known habitat within the Strategic Assessment Area comprises approximately 4% of the total known habitat mapped for the species. Potential habitat within the Strategic Assessment Area comprises <1% of the total potential habitat mapped for the species.

- There is no Commonwealth approved Recovery Plan for the species. However, the objectives of the State approved Recovery Plan are to improve the population status, leading to future removal of the Western Ringtail Possum from the threatened species list of the EPBC Act and the WC Act (Parks and Wildlife 2014a).

- There are three Threat Abatement Plans that may be relevant to this species:
  - The Threat Abatement Plan for predation by European red fox (DEWHA 2008b).
The Threat Abatement Plan for predation by feral cats (DEWHA 2008c).

The Threat Abatement Plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoE 2014).

- The species is the subject of Commonwealth Conservation Advice (TSSC 2013d).

See Appendix B for further information.

**SPECIES MAPPING**

**APPROACH TO MAPPING**

Habitat mapping for the Western Ringtail Possum was undertaken across its range (including within the Strategic Assessment Area). The mapping identifies:

- known habitat, comprising the locations and supporting remnant vegetation patches where the species has previously been recorded (referred to as type 1); and
- potential habitat, comprising remnant vegetation patches within the species distribution that have the potential to support the species (referred to as type 2).

The criteria for known and potential habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

**MAPS**

See Figure 16-16 for a map of habitat across the range of the species.

See Figure 16-17 for a map of habitat within the Strategic Assessment Area.

**CONSERVATION OBJECTIVE**

The conservation objective for the Western Ringtail Possum is to:

- Maintain the long-term viability of the Western Ringtail Possum within the Strategic Assessment Area by protecting and maintaining a connected network of known and potential habitat within the Strategic Assessment Area.

**JUSTIFICATION**

The conservation objective for the species has been developed recognising the following key attributes:

- The Strategic Assessment Area incorporates the northern extent of the species range. It is important to continue to protect this extent and maintain this extent and the long-term viability of the species within this area.
- The majority of habitat for the species occurs to the south of the Strategic Assessment Area. Maintaining connectivity to this area is important.
- A large proportion of the vegetation in the south west coastal part of the Strategic Assessment Area still persists and much of this is in formal conservation estate. Retention and management of this large, intact and connected area provides a very good opportunity for the species to persist.

**STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS**

**KNOWN HABITAT (TYPE 1)**

Approximately 2,066 ha of known habitat occurs within the south-west corner of the Strategic Assessment Area across three distinct locations (see Figure 16-17). This equates to approximately 4% of the total known habitat mapped for the species.

Avoidance of known habitat
A total of approximately 1,946 ha (94%) of known habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 1,273 ha (62%) occurs within IUCN reserve type II (Yalgorup National Park).

The remaining 673 ha (33%) of known habitat that occurs outside of the classes of action is not within protected land.

**Intersects with classes of action**

A total of approximately 120 ha (6%) of known habitat intersects with the following classes of action:

- 78 ha (4%) by the urban class of action;
- 30 ha (1.5%) by the rural residential class of action; and
- 12 ha (<1%) by the infrastructure class of action (namely water infrastructure).

Potential impacts will affect the northern-most area of known habitat, with the remaining two patches retained within Yalgorup National Park. Within this northern-most area, there are significant risks of impacts leading to fragmentation in an east-west direction in Bouvard and the south of Dawesville (Panarama). This is as a result of urban and rural residential classes of action.

This portion of known habitat has been identified as a stronghold for the northern extent of the Western Ringtail Possum (Parks and Wildlife, pers. comm. 2015). In addition, the loss and fragmentation of native vegetation cover is identified as one of the principle factors threatening Western Ringtail Possum populations, due to their reliance on midstorey and overstorey vegetation for food, shelter and protection from predators (Parks and Wildlife 2014a). The long-term viability of populations is further dependent on sufficient size and connectivity between habitat remnants (Parks and Wildlife 2014a).

It is imperative to maintain habitat connectivity in this region as Western Ringtail Possums are known to descend to the ground more frequently when habitat linkages are not maintained appropriately. Therefore it is necessary to ensure that quality habitat with sufficient canopy cover is maintained in these regions.

### POTENTIAL HABITAT (TYPE 2)

Approximately 16,585 ha of potential habitat occurs within the south-west corner of the Strategic Assessment Area (see Figure 16-17). This equates to <1% of total potential habitat mapped for the species. This habitat provides particular value for the species because a large proportion of the vegetation in the south-west portion of the Strategic Assessment Area is still intact and much of this is in formal conservation estate. Retention and management of this large, intact and connected area provides a very good opportunity for the species to persist and ensure connectivity between the northern and southern populations.

**Avoidance of potential habitat:**

A total of approximately 16,210 ha (98%) of potential habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 7,386 ha (45%) occurs within IUCN reserve categories I to IV; and
- 1,156 ha (7%) occurs within State Forest managed by Parks and Wildlife.

The remaining 7,660 ha (46%) of potential habitat that occurs outside of the classes of action is not within protected land.

**Intersects with class of action**

383 ha (2%) of potential habitat is intersected by the classes of action:

- 210 ha (1%) by the urban class of action;
• 130 ha (<1%) by the rural residential class of action;
• 16 ha (<0.1%) by the infrastructure class of action; and
• 27 ha (<1%) by the BRM class of action.

Intersects with the urban class of action occur in the localities of Preston Beach and Dawesville (see Figure 16-17). Impacts to this potential habitat may result in local scale fragmentation and disruption to connectivity. The rural residential class of action will impact potential habitat in the Lake Clifton locality, south of the Peel-Harvey Estuary.

**INDIRECT IMPACTS**

Indirect impacts may affect the Western Ringtail Possum where new development occurs or where existing development intensifies adjacent to or near habitat. Populations may be susceptible to the following indirect impacts (Parks and Wildlife 2014a):

- habitat degradation and fragmentation;
- inappropriate fire regimes;
- predation by native and introduced species;
- competition for tree hollows;
- timber harvesting; and
- disease.

Of particular relevance to the classes of action would be potential habitat degradation and fragmentation, predation and competition.

At a landscape scale, ongoing management of threats within IUCN I-IV reserves that support the species will be an important aspect of maintaining long-term viability within the Strategic Assessment Area.

**WILL THE CONSERVATION OBJECTIVE BE MET WITHOUT CONSERVATION COMMITMENTS?**

**NEED FOR CONSERVATION COMMITMENTS**

Specific conservation commitments for the Western Ringtail Possum are considered necessary to meet the conservation objectives.

While the majority of known (94%) and potential (98%) habitat for the species will be avoided within the Strategic Assessment Area, potential impacts put achieving the conservation objectives at risk. In particular:

- potential loss of local east-west connectivity within known habitat within the Dawesville area; and
- a potential lack of clarity about the active management of threats to the species within the Yalgorup National Park.

It should be noted that there are a range of relevant over-arching commitments in Action Plan F that have the potential to provide benefits to the species. These commitments provide conservation benefits across various parts of the Strategic Assessment Area and broadly relate to:

- the retention and protection of land (including management of protected areas);
- avoidance of impacts within the classes of action; and
- assessment and management of potential indirect impacts from development.

Of particular importance are the commitments to establish the Peel Regional Park and expand the Yalgorup National Park, as this encompasses potential habitat for the Western Ringtail Possum. This will help maintain important ecological linkages for the species on the eastern side of the Peel-Harvey Estuary and maintain connectivity to the southern populations via Yalgorup National Park.
WHAT CONSERVATION COMMITMENTS ARE REQUIRED TO MEET THE CONSERVATION OBJECTIVES?

**CONSERVATION COMMITMENTS**

In addition to the relevant over-arching commitments, the following specific commitments are provided for the Western Ringtail Possum:

1. Retain viable corridor/s of vegetation in the Dawesville / Panarama urban development area to act as an effective and functional east-west habitat linkage to maintain habitat connectivity.

2. Actively manage threats to the species within the Yalgorup National Park and along the urban/woodland interface. Including:
   - Continued feral baiting programs.
   - Reduce habitat degradation by limiting access from increased development adjacent to known habitat.
   - Phytophthora dieback, monitoring and control.

**ADDITIONAL CONSERVATION MEASURES**

In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the species where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.
- Ongoing implementation of actions to benefit the species. For example, general management of threats and pressures across the landscape.

OUTCOMES FOR THE SPECIES

**KEY POINTS**

The assessment has identified a number of key points relevant to the outcome for the Western Ringtail Possum:

- The species occurs within the south-west corner of the Strategic Assessment Area where it has a patchy distribution along the Swan Coastal Plain south of Mandurah and east near Serpentine. Known habitat within the Strategic Assessment Area comprises approximately 4% of the total known habitat mapped for the species. Potential habitat within the Strategic Assessment Area comprises <1% of the total potential habitat for the species.

- The majority of known (94%) and potential habitat (98%) in the Strategic Assessment Area will be avoided. This includes 62% of known and 45% of potential habitat occurring within IUCN I-IV reserves. A conservation commitment is provided to ensure active management within Yalgorup National Park for the species (including feral predator control and management of Phytophthora dieback, monitoring and control).

- The classes of action intersect with 6% of known and 2% of potential habitat within the Strategic Assessment Area. The most significant potential impacts will be in the Dawesville area. The remaining two areas of known habitat are protected within Yalgorup National Park.

- In the Dawesville area, potential impacts may lead to fragmentation of habitat in an east-west direction. In order to meet the conservation objective for the species, a conservation commitment is provided to maintain an effective and functional east-west ecological linkage(s) through retention and management of
habitat on parcels of urban and rural residential land. It is considered unlikely for the population status to be significantly altered by the classes of action. The overall outcome for the Western Ringtail Possum is considered to be an acceptable one which meets the conservation objectives through:

- retention of 94% of known habitat and 98% of potential habitat within the Strategic Assessment Area;
- maintenance of connectivity in both the Dawesville area and to the southern part of the species range; and
- management of threats to the species within the Yalgorup National Park.

**CONSISTENCY WITH COMMONWEALTH PLANS**

- The outcomes and conservation objectives for the Western Ringtail Possum are not inconsistent with the relevant Threat Abatement Plans.
- The outcomes and conservation objectives have been set with consideration for the Commonwealth Conservation Advice for the species (TSSC 2013d).
Figure 16-16: Distribution and habitat of the Western Ringtail Possum within Western Australia

Legend
- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
Figure 16-17: Distribution and habitat of the Western Ringtail Possum within the Strategic Assessment Area
## 16.13 *PSEUDEMYDURA UMBRINA* (WESTERN SWAMP TORTOISE)

### SPECIES BACKGROUND

<table>
<thead>
<tr>
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<th>Critically Endangered.</th>
</tr>
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<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Critically Endangered using IUCN criteria.</td>
</tr>
</tbody>
</table>

### PROFILE SUMMARY

The following points provide key information about the ecology and distribution of the Western Swamp Tortoise:

- The species is a short-necked freshwater tortoise and is the smallest of Australian freshwater tortoises. Adult males grow up to 155 mm or a weight of 550 g, and females do not exceed 135 mm carapace length or a weight of 410 g (Burbidge et. al. 2010).

- It inhabits shallow, ephemeral, winter- and spring-wet swamps on clay or sand over clay soils with nearby suitable refuges for aestivation (Burbidge et. al. 2010).

- Historically the species was found in ephemeral swamps extending from Perth Airport to Pearce Royal Australian Air Force Base at Bullsbrook. It now only occurs across two surviving natural populations (both within the Strategic Assessment Area) located at Twin Swamps and Ellen Brook Nature Reserves (Burbidge et. al. 2010). Known habitat within these two nature reserves and supporting water surface catchments has been mapped as 896 ha.

- There is an Environmental Protection Policy (EPP) that applies to areas surrounding known habitat. The Policy aims to protect habitat through a range of measures (EPA 2010, Government of WA 2012b). The remaining habitat for the species within the EPP boundary is mapped as potential habitat and comprises 755 ha.

- Captive bred animals have also been released outside the Strategic Assessment Area to Lake Wannamal Nature Reserve and Moore River Nature Reserve (Burbidge et. al. 2010). This translocated habitat comprises 2,563 ha.

- Given the species is Critically Endangered, all wild and translocated populations are considered to be important populations.

- The objectives of the Commonwealth approved Recovery Plan are to decrease the chance of extinction of the Western Swamp Tortoise by creating at least three wild naturally recruiting populations, increasing the total number of mature individuals in the wild to more than 50 and conducting a translocation at a fourth site (Burbidge et. al. 2010).

- There are three relevant Threat Abatement Plans for this species:
  - The Threat Abatement Plan for predation by European red fox (DEWHA 2008b).
  - The Threat Abatement Plan for predation by feral cats (DEWHA 2008c).
  - The Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs (Department of Environment and Heritage 2005a).
There is no Commonwealth Conservation Advice for this species. See Appendix B for further information.

**SPECIES MAPPING**

**APPROACH TO MAPPING**

Habitat mapping for the Western Swamp Tortoise was undertaken across its range (including within the Strategic Assessment Area). The mapping identifies:

- **Known habitat** (referred to as type 1), which is comprised of:
  - known locations within the Twin Swamps and Ellen Brook Nature Reserves buffered to 100 m;
  - the surface water catchment around each reserve; and
  - the catchments that directly supply water to the wetlands within these reserves.
- **Potential habitat** (referred to as type 2), which is comprised of two levels:
  - the remaining areas within the EPP boundary; and
  - potential habitat identified at the Perth airport site as per the recovery plan (Burbidge et. al. 2010).
- **Translocation habitat** (referred to as type 3), comprising existing translocated populations and future potential translocation/re-introduction sites.

The criteria for known, potential and translocation habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

**MAPS**

See Figure 16-18 for a map of habitat across the range of the species.

See Figure 16-19 for a map of habitat within the Strategic Assessment Area.

**CONSERVATION OBJECTIVES**

**CONSERVATION OBJECTIVES**

The conservation objectives for the Western Swamp Tortoise are to:

- **Maintain the long-term viability of the species within the Strategic Assessment Area by continuing to protect and manage populations at Ellenbrook Nature Reserve and Twin Swamps Nature Reserve.**
- **Protect the potential translocation site for the species at the Perth airport.**

**JUSTIFICATION**

The conservation objectives for the species have been developed recognising the following key attributes:

- All known populations currently exist within nature reserves and it is critical that efforts remain in place to protect these areas.
- Management of potential indirect impacts is an important component of maintaining the long-term viability of the species.
- The Recovery Plan for the species identifies a site at the Perth airport for potential translocation.
STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS

| KNOWN HABITAT (TYPE 1) | There is 896 ha of known habitat within the Strategic Assessment Area, located primarily within the Ellen Brook and Twin Swamps Nature Reserves, and the surface water catchments that directly supply water to the wetlands within these reserves within the EPP Area (see Figure 16-19).

**Avoidance of known habitat**

A total of 875 ha (98%) of known habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 80 ha (9%) occurs within IUCN reserve type IA (Ellen Brook Nature Reserve);
- 155 ha (18%) occurs within IUCN reserve type IV (Twin Swamps Nature Reserve).

The remaining 640 ha (73%) of known habitat that occurs outside of the classes of action is not within protected lands.

It is important to note that, approximately 231 ha (26%) of known habitat is part of conservation category wetlands. These areas will be subject to the over-arching commitments to protect the wetlands from direct and indirect impacts.

**Intersects with class of action**

Approximately 19 ha (2%) of known habitat is intersected by the classes of action:

- <0.11 ha (<0.1%) by the industrial class of action
- 14 ha (1.5%) by the infrastructure class of action;
- 5 ha (<1%) by the BRM class of action.

The proposed BRM extraction will intersect known habitat south-west of Ellen Brook Nature Reserve and the proposed infrastructure class of action is located along existing roads within the EPP area.

| POTENTIAL HABITAT (TYPE 2) | 1,719 ha of potential habitat for the species has been mapped within the Strategic Assessment Area (see Figure 16-19). This incorporates the area within the EPP boundary outside and surrounding the Ellen Brook and Twin Swamps Nature Reserves, as well as potential habitat mapped at the Perth Airport site (noting that this is in addition to the translocation habitat at the airport), including areas of historical occurrence of the species (Burbidge et al. 2010). This habitat is important for the long-term viability of the species, particularly in relation to potential indirect impacts on the two nature reserves (e.g. ground water changes).

**Avoidance of potential habitat**

A total of 1,667 ha (97%) of potential habitat is avoided, however none of this habitat occurs within protected lands (i.e. IUCN I-IV reserves) or land managed by Parks and Wildlife. It should be noted that there has been development on this land previously due to some of it being privately owned.

It is important to note that, approximately 396 ha (23%) of potential habitat is part of conservation category wetlands. These areas will be subject to the over-arching commitments to protect the wetlands from direct and indirect impacts.

**Intersects with class of action**

52 ha (3%) of potential habitat is intersected by the classes of action:

- 1 ha (<0.1%) by the urban class of action;
- 2 ha (<1%) by the industrial class of action;
• 34 ha (2%) by the infrastructure class of action;
• 14 ha (<1%) by the BRM class of action.

The potential urban footprint occurs along the western edge of railway Parade, the proposed industrial class of action is along the northern edge of the EPP boundary, the proposed BRM extraction is located south of Ellen Brook Nature Reserve, and the proposed infrastructure footprint is located along existing roads within the EPP area.

### TRANSLOCATION HABITAT (TYPE 3)

A total of 180 ha of translocation habitat for the species has also been mapped within the Strategic Assessment Area. This area is located at the northern end of the Perth Airport site (noting that this is in addition to potential habitat at the airport) and is Commonwealth-owned land (see Figure 16-19).

**Avoidance of translocation habitat**

A total of 178 ha (99%) of translocation habitat is avoided, however none of this habitat occurs within protected lands (i.e. IUCN I-IV reserves) or land managed by Parks and Wildlife. A portion of this avoided translocation habitat has been marked for future conservation reserves as part of the conservation program outlined in Action Plan H.

A further 50 ha (28%) of translocation habitat is part of conservation category wetlands. These areas will be subject to the over-arching commitments to protect the wetlands from direct and indirect impacts.

**Intersects with class of action**

2 ha (1%) of the translocation habitat is intersected by the infrastructure class of action, associated with road widening activities to the north of the Perth Airport site.

### INDIRECT IMPACTS

Indirect impacts may affect the Western Swamp Tortoise where new development occurs or where existing development intensifies adjacent to or near habitat. Populations may be susceptible to the following indirect impacts (Burbidge et. al. 2010):

- habitat degradation as a result of altered hydrological processes;
- wildfire or inappropriate fire regimes;
- clay mining; and
- predation by introduced species.

It is important to note that land use surrounding Ellen Brook and Twin Swamps Nature Reserves is currently restricted via the EPP which aims to avoid or minimise indirect impacts to the species (Government of WA 2012b). This is relevant to all landowners and public authorities managing land within the EPP area.

Ongoing management of threats within Ellen Brook and Twin Swamps Nature Reserves that support the species will be an important aspect of maintaining the long-term viability of the species within the Strategic Assessment Area.

### WILL THE CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?

### NEED FOR CONSERVATION COMMITMENTS

Specific conservation commitments for the Western Swamp Tortoise are considered necessary to meet the conservation objectives.

While the majority of known (98%) and the potential (98%) habitat for the species will be avoided within the Strategic Assessment Area, there is the potential for development within the EPP boundary area. In order to meet the conservation objectives it will be critical that the EPP
continues to be implemented.

In addition, it will be important to continue to protect the potential translocation site at Perth airport.

It should be noted that two of the over-arching conservation commitments in Action Plan F will provide additional support for protecting habitat from direct and in particular indirect. These are presented below along with specific commitments for the Western Swamp Tortoise.

**WHAT CONSERVATION COMMITMENTS ARE REQUIRED TO MEET THE CONSERVATION OBJECTIVES?**

### RELEVANT OVER-ARCHING CONSERVATION COMMITMENTS

The two relevant over-arching conservation commitments in Action Plan F are:

- **Ensure direct and indirect impacts to conservation category wetland (CCWs) are avoided** (including through the application of appropriate buffers) within urban, industrial, and rural residential areas.

- **Implement environmental assessment and management measures, controls and standards for all development to reduce direct and indirect impacts.** This will include, but is not limited to, controls on vegetation clearing, water quality and use, stormwater, dust, noise, emissions, public access. This process will involve:
  - ensuring controls / conditions placed on existing approvals continue to be implemented; and
  - ensuring that new proposals that are approved incorporate at a minimum the existing standard and expectations for control / mitigation / management of direct and indirect impacts.

These commitments support the requirements of the EPP and go a long way to ensuring that habitat for the species is protected from indirect impacts.

### SPECIFIC CONSERVATION COMMITMENTS

In addition, to ensure specific measures are taken for this species the following conservation commitments are provided for the Western Swamp Tortoise:

- **Protect known and possible future habitat, including**:
  - the Ellenbrook Nature Reserve and Twin Swamps Nature Reserve
  - the potential translocation site at Perth airport.

### ADDITIONAL CONSERVATION MEASURES

In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the species where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.

- Ongoing implementation of actions to benefit the species. For example, implementation of Recovery Plan actions and general management of threats and pressures across the landscape.

### OUTCOMES FOR THE SPECIES

**KEY POINTS**

The assessment has identified the following key points relevant to the outcome for the Western Swamp Tortoise:

- The species now only occurs across two surviving natural populations (both
within the Strategic Assessment Area) located at Twin Swamps and Ellen Brook Nature Reserves. Potential habitat within the Strategic Assessment Area is contained within the EPP boundary surrounding these two reserves and at Perth airport. A potential translocation site is also present at Perth Airport.

- **The majority of known habitat (98%) will be avoided in the Strategic Assessment Area.** 27% of this occurs within IUCN reserves I-IV.

- **The majority of potential (97%) and translocation (99%) habitat in the Strategic Assessment Area will be avoided.** None of this habitat occurs within IUCN I-IV reserves or in Parks and Wildlife managed lands; however 23% of potential habitat and 28% of translocation habitat occurs within areas that will be protected through the overarching commitment to protect conservation category wetlands.

- **The classes of action intersect with 2% of known habitat, 3% of potential habitat and 1% of translocation habitat.** Potential impacts to known habitat are expected as a result of the infrastructure and BRM classes of action within the EPP area.

- **Indirect impacts to known and potential habitat will be reduced with the continued implementation of the EPP.** In addition, a commitment is made to protect the potential translocation site at Perth airport.

It is considered unlikely for the population status to be significantly altered by the classes of action. The overall outcome for the Western Swamp Tortoise is considered to be an acceptable one which meets the conservation objectives through:

- retention of 98% of known habitat, 97% of potential habitat, and 99% of translocation habitat within the Strategic Assessment Area;

- ongoing protection of the species within the Twin Swamps and Ellen Brook Nature Reserves; and

- ongoing implementation of the EPP to manage indirect impacts.

**CONSISTENCY WITH COMMONWEALTH PLANS**

- The outcomes and conservation objectives for the Western Swamp Tortoise are not inconsistent with the relevant Threat Abatement Plans.

- The outcomes and conservation objectives for the Western Swamp Tortoise are not inconsistent with the species’ Commonwealth Recovery Plan (Burbidge et. al. 2010).
Figure 16-18: Distribution and habitat of the Western Swamp Tortoise within Western Australia

Legend
- Strategic Assessment Area
- Habitat Type 1
- Habitat Type 2

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: JL Date: 18/11/2015
Figure 16-19: Habitat of the Western Swamp Tortoise within the Strategic Assessment Area

Legend
- Strategic Assessment Area

Habitat type:
- Habitat Type 1
- Habitat Type 2 (EPP Boundary)

Datum/Projection:
GDA 1994 MGA Zone 50

Data Source: DPaW

Prepared by: JL Date: 19/11/2015
### 16.14 *ROSTRATULA AUSTRALIS* (AUSTRALIAN PAINTED SNIPE)

#### SPECIES BACKGROUND

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Endangered and Migratory.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Endangered using IUCN criteria; and under Schedule 3 - Migratory birds protected under an international agreement.</td>
</tr>
</tbody>
</table>

#### PROFILE SUMMARY

The following points provide key information about the ecology and distribution of the Australian Painted Snipe:

- The Australian Painted Snipe is a stocky wading bird with a pinkish bill and females are larger and more colourful than males. It has a chestnut-coloured head, with white around the eye and a white crown stripe, and metallic green back and wings, barred with black and chestnut. There is a pale stripe extending from the shoulder into a 'V' down its upper back. The adult male is smaller and duller with buff spots on the wings and without any chestnut colouring on the head, nape or throat (DoE 2015a).

- The species inhabits brackish wetlands such as lakes, swamps and claypans with good understorey cover of grasses, rushes, low scrub, open timber or samphire. It has been recorded in all states and territories of Australia. Most records are from south-east, while there are a number of scattered records across northern Australia. There are a number of historical records from around the Perth region.

- It is considered to occur in a single, contiguous breeding population across its range.

- The species has been recorded within the Strategic Assessment Area at Alfred Cove, Pearce airbase, Bullsbrook and Herdsman Lake accounting for only 0.5% of its total known habitat. Considering also potential habitat, the Strategic Assessment Area accounts for 44,260 ha of habitat mapped for the Australian Painted Snipe, or 8% of the total known and potential habitat for the species.

- There is no Commonwealth Recovery Plan for this species; however the Conservation Advice for the species identifies research priorities and local priority actions (TSSC 2013e).

- There are two Threat Abatement Plans that may be relevant to this species:
  - The Threat Abatement Plan for predation by European red fox (DEWHA 2008b).
  - The Threat Abatement Plan for predation by feral cats (DEWHA 2008c).

See Appendix B for further information.

#### SPECIES MAPPING

<table>
<thead>
<tr>
<th>APPROACH TO MAPPING</th>
<th>Habitat mapping for the Australian Painted Snipe was undertaken across its range (including the Strategic Assessment Area). The mapping identifies:</th>
</tr>
</thead>
</table>
Known habitat, comprising areas within 100 m of conservation category wetlands where the species has been recorded (referred to as type 1).

Potential habitat, comprising:
- areas of wetland that have been identified as important for waders (referred to as type 2); and
- conservation category wetlands and other permanent wetlands that intersect with the Commonwealth distribution mapping of the species (referred to as type 3).

**MAPS**

See Figure 16-20 for a map of habitat across the range of the species.

See Figure 16-21 for a map of habitat within the Strategic Assessment Area.

**CONSERVATION OBJECTIVE**

The conservation objective for the Australian Painted Snipe is:

- Maintain the long-term viability of the species within the Strategic Assessment Area through the protection and maintenance of a mosaic and diversity of suitable wetland habitats for use by the species.

**JUSTIFICATION**

The conservation objective for the species has been developed recognising the following key attributes:

- The Strategic Assessment Area incorporates the southern extent of the species’ range within Western Australia. It is important to continue to protect and maintain this extent.

**STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS**

**KNOWN HABITAT (TYPE 1)**

988 ha of known habitat has been mapped for the Australian Painted Snipe within the Strategic Assessment Area (see Figure 16-21). This equates to 0.5% of the total known habitat mapped for the species across its current known range within Western Australia.

**Avoidance of known habitat**

A total of 953 ha (96%) of known habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 349 ha (35%) is within IUCN reserve categories I to IV.
- 6 ha (<1%) occurs within other land managed by Parks and Wildlife.

A further 595 ha (61%) of known habitat occurs outside of the classes of action and is not within protected land.

**Intersects with classes of action**

A total of 37 ha (4%) of known habitat is intersected by the classes of action:

- 29 ha (3%) by the urban class of action;
- 2 ha (<1%) by the industrial class of action; and
- 6 ha (<1%) by the infrastructure class of action (namely from pipelines and pump stations).

The majority (95%) of known habitat intersects apply to conservation category wetlands such as Herdsman Lake, Yangebup Lake, Kogolup Lake which are protected from direct and indirect impacts by over-arching commitments in Action Plan F.
### POTENTIAL HABITAT (TYPE 2 & 3)

Approximately 43,294 ha of potential habitat occurs within the Strategic Assessment Area (see Figure 16-21). This is approximately 12% of the total potential habitat mapped for the species within Western Australia.

**Avoidance of potential habitat**

A total of 41,491 ha (96%) of known habitat will be avoided within the Strategic Assessment Area. Of this approximately:

- 10,502 ha (24%) is within IUCN reserve categories I to IV.
- 2,234 ha (5%) occurs within other land managed by Parks and Wildlife.

The remaining 28,575 ha (66%) of potential habitat occurs outside of the classes of action and is not within protected land.

**Intersects with class of action**

1,983 ha (5%) of potential habitat is intersected by the classes of action:

- 1,147 ha (3%) by the urban class of action;
- 246 ha (<1%) by the industrial class of action;
- 179 ha (<1%) by the rural residential class of action;
- 401 ha (1%) by the infrastructure class of action;
- 3 ha (<0.1%) by the BRM class of action; and
- 8 ha (<0.1%) by the Pines class of action.

The majority (97%) of these intersects relate to conservation category wetland such as Lake Pinjar, Carousel Swamp, Long Swamp, Ellenbrook Floodplain, Kenwick Swamp, Tomah Road Swamp, Becher Point Wetlands and Lake Coogee which are protected from direct and indirect impacts by over-arching commitments in Action Plan F.

### INDIRECT IMPACTS

Indirect impacts may affect the Australian Painted Snipe where new development occurs or where existing development intensifies adjacent to or near habitat. Populations may be susceptible to the following indirect impacts (OEH 2014):

- habitat degradation as a result of altered hydrological processes;
- altered fire regimes;
- habitat alteration as a result of crops and weeds;
- grazing and trampling of habitat by livestock; and
- predation by introduced species.

Of particular relevance to the classes of action would be altered hydrological processes, altered fire regimes and predation.

At a landscape scale, ongoing management of threats within IUCN I-IV reserves that support the species will be an important aspect of maintaining long-term viability within the Strategic Assessment Area.

### WILL THE CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?

**NEED FOR CONSERVATION COMMITMENTS**

Specific conservation commitments for the Australian Painted Snipe are considered necessary to meet the conservation objective for the species. While the majority of known (96%) and potential (96%) habitat for the species will be avoided within the Strategic Assessment Area, potential impacts put achieving the conservation
objectives at risk. In particular, potential indirect impacts to wetland habitats.

It should be noted that two of the over-arching conservation commitments in Action Plan F will provide substantial benefits to the species. These are presented below along with specific commitments for the Australian Painted Snipe.

### WHAT CONSERVATION COMMITMENTS ARE REQUIRED TO MEET THE CONSERVATION OBJECTIVES?

<table>
<thead>
<tr>
<th>RELEVANT OVER-ARCHING CONSERVATION COMMITMENTS</th>
<th>The two relevant over-arching conservation commitments in Action Plan F are:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Ensure direct and indirect impacts to conservation category wetland (CCWs) are avoided (including through the application of appropriate buffers) within urban, industrial, and rural residential areas.</td>
</tr>
<tr>
<td></td>
<td>• Implement environmental assessment and management measures, controls and standards for all development to reduce direct and indirect impacts. This will include, but is not limited to, controls on vegetation clearing, water quality and use, stormwater, dust, noise, emissions, public access. This process will involve:</td>
</tr>
<tr>
<td></td>
<td>o ensuring controls / conditions placed on existing approvals continue to be implemented; and</td>
</tr>
<tr>
<td></td>
<td>o ensuring that new proposals that are approved incorporate at a minimum the existing standard and expectations for control / mitigation / management of direct and indirect impacts.</td>
</tr>
</tbody>
</table>

Given that 95% of known habitat and 97% of potential habitat that intersects with the classes of action are associated with conservation category wetlands, these commitments will go a long way to ensuring that habitat for the species is protected from both direct and indirect impacts.

<table>
<thead>
<tr>
<th>SPECIFIC CONSERVATION COMMITMENTS</th>
<th>In addition, to ensure specific measures are taken for this species the following conservation commitments are provided for the Australian Painted Snipe:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Manage indirect impacts to this species on a site specific basis, paying particular attention to sites directly adjacent, or in close proximity to the classes of action footprint. This will be done via:</td>
</tr>
<tr>
<td></td>
<td>o continuing to implement existing groundwater management arrangements and potential future site supplementation;</td>
</tr>
<tr>
<td></td>
<td>o maintaining vegetated buffers at all sites where they currently exist and seeking to develop buffer zones where they currently do not;</td>
</tr>
<tr>
<td></td>
<td>o controlling access to sites to minimise disturbance to shorebirds in a way most appropriate to the individual site; and/or</td>
</tr>
<tr>
<td></td>
<td>o educating the neighbouring community about the Australian Painted Snipe and what they can do to assist with their conservation.</td>
</tr>
<tr>
<td></td>
<td>• Protect important occurrences and manage for conservation by continuing to implement the Bush Forever Program as detailed in Action Plan H.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ADDITIONAL CONSERVATION MEASURES</th>
<th>In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Ongoing protection of the species where it occurs outside the class of action footprints</td>
</tr>
</tbody>
</table>
and protected areas through the application of existing planning and approval processes.

- Ongoing implementation of actions to benefit the species. For example, general management of threats and pressures across the landscape.

### OUTCOMES FOR THE SPECIES

**KEY POINTS**

The assessment has identified the following key issues relevant to the outcome for the Australian Painted Snipe:

- **The species has been recorded within the Strategic Assessment Area at Alfred Cove, Pearce airbase, Bullsbrook and Herdsman Lake.** This habitat accounts for <1% of its total known habitat within Western Australia.

- **The majority of known (96%) and potential (96%) habitat within the Strategic Assessment Area will be avoided.** This includes 35% of known and 24% of potential habitat occurring within IUCN I-IV reserves.

- **The classes of action intersect with 4% of known habitat and 5% of potential habitat within the Strategic Assessment Area.** Nearly all of these areas are conservation category wetlands (95% of the known habitat areas and 97% of the potential habitat) and over-arching commitments within Action Plan F to protect conservation category wetlands will ensure habitat is not subject to direct or indirect impacts.

- **Potential indirect impacts more generally will be managed through both over-arching and species specific conservation commitments to protect habitat.** It is considered unlikely for the population status to be significantly altered by the classes of action. The overall outcome for the Australian Painted Snipe is considered to be an acceptable one which meets the conservation objectives through:
  - retention of known and potential habitat; and
  - management of potential indirect impacts.

**CONSISTENCY WITH COMMONWEALTH PLANS**

- The outcomes and conservation objectives for the Australian Painted Snipe are not inconsistent with the relevant Threat Abatement Plans.

- These outcomes and conservation objectives have been set with consideration for the Commonwealth Conservation Advice for the species (TSSC 2013e).
Figure 16-20: Distribution and habitat of the Australian Painted Snipe within Western Australia

Legend
- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
Figure 16-21: Distribution and habitat of the Australian Painted Snipe within the Strategic Assessment Area

Legend
- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
16.15  **SETONIX BRACHYURUS (QUOKKA)**

**SPECIES BACKGROUND**

<table>
<thead>
<tr>
<th>COMMONWEALTH STATUS</th>
<th>Listed as Vulnerable.</th>
</tr>
</thead>
<tbody>
<tr>
<td>WESTERN AUSTRALIAN STATUS</td>
<td>Listed as Specially Protected under the <em>Wildlife Conservation Act 1950</em>, published under Schedule 1 – Fauna that is rare or is likely to become extinct, with an endorsed ranking of Vulnerable using IUCN criteria.</td>
</tr>
</tbody>
</table>

**PROFILE SUMMARY**

- The Quokka is a small wallaby with thick, coarse, grey-brown fur with lighter underparts. The ears are short and rounded. It is mostly nocturnal and a browsing herbivore, favouring leaves and stems.
- The species current distribution includes Rottnest and Bald Islands, northern Jarrah forest, central Jarrah forest, southern forest, the south coast and the Stirling Range National Park.
- The Quokka’s habitat requirements in the northern Jarrah Forest comprise a complex mosaic of recently burnt areas and long unburnt areas (de Tores et al. 2004 and Hayward et al. 2007 as cited in DEC 2013).
- The Strategic Assessment Area represents the northern limit of the species mainland geographic range and supports one of the seven known populations within the northern Jarrah forest. It supports 251,927 ha (10%) of the total 2,634,290 ha of mapped habitat for the Quokka across the south west of Australia.
- The population within the Strategic Assessment Area is considered an important population as it represents the northern-most extent of the species.
- The objective of the Commonwealth approved Recovery Plan is to at least maintain the species current distribution and abundance (DEC 2013).
- There are four Threat Abatement Plans that may be relevant to this species:
  - The Threat Abatement Plan for predation by European red fox (DEWHA 2008b).
  - The Threat Abatement Plan for predation by feral cats (DEWHA 2008c).
  - The Threat Abatement Plan for predation, habitat degradation, competition and disease transmission by feral pigs (Department of Environment and Heritage 2005a).
  - The Threat Abatement Plan for disease in natural ecosystems caused by *Phytophthora cinnamomi* (DoE 2014).
- There is no Commonwealth Conservation Advice for the species. See Appendix B for further information.

**SPECIES MAPPING**

<table>
<thead>
<tr>
<th>APPROACH TO MAPPING</th>
<th>Habitat mapping for the Quokka was undertaken across its range (including within the Strategic Assessment Area). The mapping identifies:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>known habitat, comprising the locations and supporting remnant vegetation patches</td>
</tr>
</tbody>
</table>

See Appendix B for further information.
where the species has previously been recorded (referred to as type 1);
- potential habitat, comprising remnant vegetation patches within the species distribution that have the potential to support the species (referred to as type 2); and
- captive release locations, comprising the locations and supporting remnant vegetation patches where the species has previously been released into the wild (referred to as type 3).

The criteria for known and potential habitat are provided in Appendix B and more information about the general approach to fauna habitat mapping is provided in Section 16.4.1.

**MAPS**

See Figure 16-22 for a map of habitat across the range of the species.
See Figure 16-23 for a map of habitat within the Strategic Assessment Area.

**CONSERVATION OBJECTIVE**

**CONSERVATION OBJECTIVE**

The conservation objective for the Quokka is to:

- Maintain the long-term viability of the species within the Strategic Assessment Area through the protection and maintenance of a connected network of known and potential habitat.

**JUSTIFICATION**

The conservation objective for the species was developed recognising the following key attributes:

- The Strategic Assessment Area contains the northern extent of the species’ current range on the mainland. It is important to maintain this extent and the long-term viability of the species within this area.
- The species occurs on the mainland in small, fragmented groups at risk of local extinction. Maintaining connectivity across the landscape is important to protect these groups.

**STATUS OF THE SPECIES WITHOUT CONSERVATION COMMITMENTS**

**KNOWN HABITAT (TYPE 1)**

Approximately 12,167 ha of known habitat has been mapped for the Quokka within the Strategic-Assessment Area (see Figure 16-23). This equates to <1% of the total known habitat mapped for the species. It is important to note that habitat mapped on Rottnest Island is not considered part of the Strategic Assessment Area.

**Avoidance of known habitat**

A total of 12,009 ha (99%) of known habitat within the Strategic Assessment Area is avoided. Of this:

- 1,531 ha (13%) falls within IUCN I-IV reserves; and
- 8,213 ha (68%) falls within land managed by Parks and Wildlife.

The remaining 2,265 ha (19%) of known habitat occurs outside of the classes of action and is not within protected land.

**Intersects with classes of action**

A total of approximately 157 ha (1%) of known habitat is intersected by the classes of action:

- 101 ha (<1%) by the urban class of action;
- 4 ha (<0.1%) by the industrial class of action; and
Most of the potentially impacted areas are associated with the urban and rural residential classes of action. These intersects occur on the Darling Scarp near Roleystone, and Dwellingup.

### POTENTIAL HABITAT AND CAPTIVE RELEASE LOCATIONS (TYPES 2 & 3)

Approximately 239,761 ha of potential habitat occurs within the Strategic Assessment Area, including 142,257 ha of captive release areas (see Figure 16-23). This equates to 9% of total potential habitat mapped for the species.

#### Avoidance of potential habitat

The majority (238,061 ha, or 99%) of potential habitat will be avoided within the Strategic Assessment Area. Of this, 85% occurs within IUCN I-IV reserves and land managed by Parks and Wildlife:

- 37,118 ha (16%) within IUCN reserve type IA or II (Nature Reserves or National Parks); and
- 165,954 ha (70%) within State Forest managed by Parks and Wildlife.

The remaining 34,932 ha (15%) of potential habitat occurs outside of the classes of action and is not within protected land.

#### Intersects with classes of action

A total of approximately 1,757 ha (<1%) of potential habitat is intersected by the classes of action:

- 555 ha (<1%) by the urban class of action;
- 454 ha (<1%) by the industrial class of action;
- 360 ha (<1%) by the rural residential class of action;
- 109 ha (<0.1%) by the infrastructure class of action; and
- 279 ha (<1%) by the BRM classes of action.

The majority of intersects with potential habitat occur on the western edge of the species distribution, along the Darling Scarp. Potential habitat is also intersected surrounding Sawyers Valley, Armadale, Whitby and Dwellingup.

#### INDIRECT IMPACTS

Indirect impacts may affect the Quokka where new development occurs or where existing development intensifies adjacent to or near habitat. Quokka populations may be susceptible to the following indirect impacts (DEC 2013):

- altered fire and hydrogeological regimes;
- predation by introduced species;
- disturbance from recreational activities; and
- disease and *Phytophthora* dieback.

All indirect impacts to the species have the potential to increase as a result of the classes of action. However, these are not likely to be significant given:

- the relatively small intersects with known (1%) and potential (<1%) habitat;
- the localised nature of these effects; and
- the broad extent and availability of potential habitat across the Strategic Assessment Area and over the species’ distribution.

At a landscape scale, ongoing management of threats within IUCN I-IV reserves that support the species will be an important aspect of maintaining long-term viability within the Strategic Assessment Area.
WILL CONSERVATION OBJECTIVES BE MET WITHOUT CONSERVATION COMMITMENTS?

NEED FOR CONSERVATION COMMITMENTS

Specific conservation commitments for the Quokka are not considered necessary. There are minimal intersects between the classes of action and known and potential habitat. In addition, there are a range of relevant over-arching commitments in Action Plan F that have the potential to provide benefits to the species. These commitments provide conservation benefits across various parts of the Strategic Assessment Area and broadly relate to:

- the retention and protection of land (including management of protected areas);
- avoidance of impacts within the classes of action; and
- assessment and management of potential indirect impacts from development.

ADDITIONAL CONSERVATION MEASURES

In addition to the conservation commitments, there are a set of additional conservation measures that will benefit the species. These measures are provided for context and sit outside the direct scope of the Strategic Conservation Plan. They include:

- Ongoing protection of the species where it occurs outside the class of action footprints and protected areas through the application of existing planning and approval processes.
- Ongoing implementation of actions to benefit the species. For example, implementation of Recovery Plan actions and general management of threats and pressures across the landscape.

OUTCOMES FOR THE SPECIES

KEY POINTS

The following key points are relevant to the outcome for the Quokka:

- The Strategic Assessment Area represents the northern limit of the species mainland geographic range and supports one of the seven known populations within the northern Jarrah Forest.

- The majority of known (99%) and potential habitat (99%) in the Strategic Assessment Area will be avoided. This includes 13% of known and 16% of potential habitat occurring within IUCN I-IV reserves.

- The classes of actions intersect with 1% of known and <1% of potential habitat within the Strategic Assessment Area.

- There is little potential for indirect impacts on known habitat.

It is considered unlikely for the population status to be significantly altered by the classes of action. The overall outcome for the Quokka is considered to be an acceptable one which meets the conservation objectives through retention of 99% of known habitat and 99% of potential habitat within the Strategic Assessment Area.

CONSISTENCY WITH COMMONWEALTH PLANS

- The outcomes and conservation objectives for the Quokka are not inconsistent with the species’ Commonwealth Recovery Plan (DEC 2013).

- The outcomes and conservation objectives for the Quokka are not inconsistent with the relevant Threat Abatement Plans.

- These outcomes and conservation objectives have been set with consideration for the Commonwealth Conservation Advice for the species.
Figure 16-22: Distribution and habitat of the Quokka within Western Australia

Legend

- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015
Figure 16-23: Habitat of the Quokka within the Strategic Assessment Area

Legend

- Strategic Assessment Area
- Distribution

Habitat Type:
- Habitat Type 1
- Habitat Type 2
- Habitat Type 3

Datum/Projection: GDA 1994 MGA Zone 50
Data Source: DPaW
Prepared by: SM Date: 19/11/2015