

City of Swan

Gnangara Road Project Environmental Assessment of Carnaby's Cockatoo Habitat

July 2013

Executive summary

The City of Swan is proposing to upgrade a section of Gnangara Road in the suburb of Lexia, Perth. GHD Pty Ltd (GHD) was commissioned by the City of Swan to undertake a targeted Carnaby's Black Cockatoo assessment of the northern extent of Gnangara Road. The results of this assessment will be used to inform a referral document to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

GHD have completed a desktop and targeted field assessment for Black Cockatoo within the Project Area. Foraging, roosting and potential breeding habitat for the Carnaby's Black Cockatoo was identified during the field assessment. It is considered unlikely that the Baudin's or Red-tailed Black Cockatoos would regularly occur within the Project Area as the habitat within the Project Area for Baudin's or Red-tailed Black Cockatoos is very limited, and the Project Area is not within the documented breeding range for either species.

It was determined that the proposed Project may result in the loss of an estimated 5.63 ha of known and potential Carnaby's Black Cockatoo habitat including:

- 26 potential breeding trees (two with hollows deemed suitable for nesting).
- 5.63 ha of foraging habitat, including 4.72 ha of pine plantation and 0.91 ha of native vegetation.
- 4.72 ha of potential roosting habitat in the form of pine plantation on the northern side of Gnangara Road.

An assessment of the likely impacts on Carnaby's Black Cockatoo against the significant impact criteria (*Environmental Protection and Biodiversity Conservation Act 1999* Policy Statement 1.1; DEWHA, 2009) was undertaken to determine whether the impacts of the proposed action on Carnaby's Black Cockatoo are likely to be significant impacts.

The assessment determined that the proposed Project is *unlikely to have a significant impact* on the Carnaby's Black Cockatoo or its habitats within the Project Area.

GHD have recommended management measures to reduce the potential impacts to the Carnaby's Black Cockatoo and its habitats within the Project Area, and surrounding areas including:

Planning (Pre-construction) Phase Measures

- Design principles that would demonstrate, avoidance of, the minimisation of impacts to the Carnaby's Black Cockatoo and its habitat.
- Offsets for lost habitat and habitat protection and enhancement of retained habitats alongside the road.
- Fauna sensitive road design (e.g. signage, speed restrictions).
- Pest animal, weed and fire control protocols.

Construction phase measures

- Clearing of habitat would best be completed during the breeding season (i.e. when breeding birds are within their breeding range, away from the Project Area).
- Demarcate all native vegetation and Black Cockatoo habitat to be retained via erection of orange para-webbing fencing, so that "No Go" zones are clearly delineated and noted by construction workers, and any accidental loss of native vegetation and habitat is avoided.

- Induct all staff and contractors working within the Project Area regarding the Black Cockatoo constraints (e.g. areas that can be cleared and areas that are to be retained) and required actions regarding these values.
- Implement weed, fire and pathogen management practices.

It is recommended that these management and mitigation measures are included in the environmental or construction management plan for the Project.

This report is subject to, and must be read in conjunction with, the limitations set out in Appendix B and the assumptions and qualifications contained throughout the Report.

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1. Introduction

1.1 Background

The City of Swan is proposing to upgrade a section of Gnangara Road in the suburb of Lexia, Perth (herein referred to as the Project). A survey undertaken by WorleyParsons (2012) to identify the environmental values of a section of Gnangara Road from west of Beechboro Road east to Drumpellier Drive (the Project Area) which recorded foraging habitat for Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*). The proposed road upgrade may require clearing of this habitat including foraging habitat in the form of pine plantation within the extent of the Project Area.

GHD Pty Ltd (GHD) was commissioned by the City of Swan to undertake a targeted Carnaby's Black Cockatoo assessment of the northern extent of Gnangara Road (herein referred to as the Project Area). The results of this assessment will be used to inform a referral document to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC).

1.2 Purpose of this report

The purpose of this assessment is to determine the:

- Type (e.g. foraging breeding and /or roosting) and extent of Black Cockatoo habitat within the Project Area.
- Potential impacts of the proposed Project upon Black Cockatoos and their habitat within the Project Area.
- Significance of the potential impacts on Carnaby's Black Cockatoos by undertaking significant impact assessment in accordance with the DSEWPaC Significant impact guidelines 1.1 (DEWHA 2009).
- Appropriate impact amelioration measures that will avoid, then minimise the identified impacts where possible to the Carnaby's Black Cockatoo species that would be potentially impacted by the proposed Project.

This assessment takes into account all three threatened species of Black Cockatoos, including Carnaby's Black Cockatoo, Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*).

1.3 Scope of works

The scope of works, as set out in the Project brief was to develop and undertake a targeted survey of the Project Area for Carnaby's Black Cockatoo with the data to be used as part of a referral of proposed actions under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act). Surveys were to be based on the survey requirements under the EPBC Act Referral Guidelines for Three Threatened Black Cockatoos (DSEWPaC 2012).

1.4 Project Area

The Project Area includes a section of Gnangara Road from west of Beechboro Road North to Drumpellier Drive, and consists of approximately 5.1 kilometres (km) of alignment and is 35.9 hectares (ha) (Figure 1).

The Project Area includes:

• 4.72 ha of pine plantation located north of Gnangara Road in the Gnangara-Moore River State Forest.

- 5.16 ha of existing sealed road surface.
- 26.02 ha of road side reserve north and south of the existing road.

The Project Area includes part of the Gnangara-Moore River State Forest (Class A Reserve), which consists of 65,984 ha extending from the Project Area north through to near Moore River. The standing area of pine plantation was approximately 15, 000 ha in 2009/2010 (Stock *et al.* 2013). The Project Area includes 4.72 ha of this pine plantation, which is part of a discrete block of pine of approximately 254 ha¹.

The area pine plantation is currently registered as a public off-road vehicle area.

South of Gnangara Road is Whiteman Park. This park represents an area of 1,547.9 ha of remnant native vegetation including marri, jarrah and banksia woodlands, extensive heathlands, melaleuca wetlands and unique ephemeral damp lands. The park is partly made up of a Bush Forever Site (Site 304), is reserved for parks and recreation in the Metropolitan Region Scheme and is managed by the Department of Planning.

For the purposes of this assessment, the Project Area was further delineated as either the northern side of Gnangara Road or the southern side of Gnangara Road.

The limitations and assumptions of this report are detailed in Appendix B.

¹ Area calculation taken from 2012 aerial photography of the Project area and locality

2. Methodology

2.1 Desktop assessment

2.1.1 Databases and relevant literature

A desktop review of relevant databases and literature was undertaken in order identify Black Cockatoo habitat requirements, local population status, regional context and existing landuse surrounding the Project Area. The desktop review included:

- A review of the DSEWPaC Protected Matters database (DSEWPaC 2013a) to identify Black Cockatoos listed under the EPBC Act potentially occurring within the Project Area and surrounds.
- A search of the Department of Environment and Conservation (DEC) NatureMap database (DEC 2013).
- Black Cockatoo species previously recorded within the Project Area and surrounds.
- A review of relevant literature including the references outlined in Table 1.

Table 1 Relevant literature

Literature	Reference
EPBC Act 1999 Referral Guidelines for Three Threatened Black Cockatoos: Carnaby's Black Cockatoo, Baudin's Black Cockatoo and Forest Red-tailed Black Cockatoo	DSEWPaC 2012
Carnaby's Black Cockatoo (Calyptorhynchus latirostris) Recovery Plan	DEC 2012a
Baudin's Black Cockatoo (<i>Calyptorhynchus baudinii</i>) and Forest Red- tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>) Recovery Plan	DEC 2008
Black Cockatoo on the Swan Coastal Plain	Johnstone et al. 2011
Pine as Fast Food: Foraging Ecology of an Endangered Cockatoo in a Forestry Landscape	Stock et al. 2013
Carnaby's Black Cockatoo identification of nocturnal roost sites and the 2010 Great Cocky Count	Burnham et al. 2010
Pines and the ecology of Carnaby's cockatoos in the Gnangara Sustainability Strategy study area	Finn <i>et al.</i> 2009
Food Resources of Carnaby's cockatoo (<i>Calyptorhynchus latirostris</i>) in the Gnangara Sustainability Strategy Study Area.	Valentine & Stock 2008
Carnaby's Black-Cockatoo 2013 Symposium	DEC (2013)
Endangered Black Cockatoos in Western Australia, Proceedings of a symposium about their biology, status, threats and efforts to restore their habitat and populations	Kendrick 2011
Proceedings of the Carnaby's Black Cockatoo Symposium	Burbidge 2009
Potential habitat for the Carnaby's Black Cockatoo which may require further assessment – Metropolitan Region Scheme	Department of Planning 2011
Methods for mapping Carnaby's cockatoo habitat on the Swan Coastal Plain and Jarrah Forest	Glossop et al. 2011

2.1.2 Review of previous study

In the preparation phase of the Project, the Department of Planning commissioned WorleyParsons (2012) to prepare an Environmental Desktop Study of the Project Area. This study included a review of existing literature and identification of constraints relating to the existing environment throughout and surrounding the Gnangara Road Reservation.

As part of this study WorleyParsons undertook searches of the EPBC Protected Matters Search Tool and the NatureMap tool in order to identify areas of known threatened fauna populations and species that may potentially occur in the Project Area.

A summary of the WorleyParsons (2012) report is provided in Section 3.1.1.

2.2 Field survey

The GHD field survey was conducted by two qualified Zoologists on 16 April 2013 and consisted of a targeted Black Cockatoo habitat assessment. The Project Area was assessed for all suitable Black Cockatoo habitat including breeding, foraging and roosting habitat. For the purpose of this assessment, the DSEWPaC (2012) referral guidelines were used to define breeding, foraging and night roosting habitat.

This targeted survey was undertaken with regard to the EPBC Act 1999 *Referral Guidelines for Three Threatened Black Cockatoos* (DSEWPaC 2012) and the *Survey guidelines for Australia's threatened birds* (DSEWPaC 2010).

Nomenclature follows that used by the Western Australian Museum and DEC NatureMap database (DEC, 2007), as it is deemed to contain the most up-to-date species information for Western Australia, with the exception of birds, which uses Christidis and Boles (2008).

The Project Area was covered on foot over the course of one day, with all of the vegetation assessed for suitability as Black Cockatoo habitat. The data recorded for the Project Area is detailed in Section 2.2.1.

The information collected during the field survey was mapped including foraging, breeding and roosting areas. This information was used to inform the likelihood of occurrence process and the impact assessment of the three species of Black Cockatoo within the Project Area.

Breeding, foraging and roosting habitat is discussed below and described further in Appendix C.

2.2.1 Data recorded during field survey

Breeding habitat

During the field survey the following breeding habitat data was recorded via Global Positioning System (GPS):

- Number, location and species of potential breeding trees (suitable habitat trees as defined in Appendix C) with DBH greater than 500 mm within the Project Area that contain hollows.
- Number, location and species of potential breeding trees with DBH greater than 500 mm within the Project Area without hollows.
- Number, location and species of actual breeding trees (i.e. with signs of use) with DBH greater than 500 mm within the Project Area that contain hollows.
- Condition of the breeding habitat within the Project Area.

Foraging habitat

During the field survey the following foraging habitat data was recorded:

- Presence and extent of foraging habitat (e.g. Proteaceous species such as *Banksia*).
- Location of signs of foraging use by Black Cockatoos (recorded via GPS) within the Project Area and a description (including type of use, species of plants being used, extent of use).
- Condition of the foraging habitat within the Project Area.

Roosting habitat

- Number, location and species of roosting trees within the Project Area.
- Location of signs of use of roosting by Black Cockatoos (recorded via GPS) within the Project Area and a description.

General habitat assessment

A general assessment of the type, condition and extent of habitats within the Project Area was also undertaken including:

- Habitat structure (e.g. vegetation type, presence/absence of overstorey, midstorey, understorey, ground cover).
- Presence/absence of waterways including type, extent and habitat quality within waterways.
- Quality of the habitat specifically in relation to use of habitat by Black Cockatoos i.e. the condition of the understorey is a standard component of most ecological habitat quality surveys, but is of limited relevance to considerations for some Black Cockatoos, particularly in relation to breeding habitat which may consist of mature woodland canopy with little or no understorey (DSEWPaC 2012).
- Land use or disturbance history.
- Location of habitat within the surrounding landscape, habitat connectivity and identification of wildlife corridors within and immediately adjacent to the Project Area.

3.1 Desktop assessment

3.1.1 Review of previous study

The EPBC search (dated 10/11/2011) by WorleyParsons (2012) identified Forest Red-tailed Black Cockatoo and Carnaby's Black Cockatoo as potentially occurring within the Project Area. The Naturemap search by WorleyParsons (2012) identified Carnaby's Black Cockatoo in the vicinity of the Project Area. WorleyParsons (2012) stated that the likelihood of encountering any of the conservation significant species identified by the NatureMap search was low due to previous disturbance and specificity of habitat however mitigation measures and contingency plans should be implemented

The report by WorleyParsons (2012) found that the northern section of the Swan Coastal Plain is home to large populations of Carnaby's Black Cockatoos and is accordingly registered as an Important Bird Area (IBA). The Northern Swan Coastal Plain supports between 4,600-15,000 Carnaby's Black Cockatoos in the non-breeding season (Birdata 2013). The report by WorleyParsons (2012) stated that 'While the construction works are not expected to impact the available habitat, the increase in traffic noise may deter some birds from roosting in the area, and vehicle strikes will invariably rise'.

3.1.2 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo, is listed as Endangered under the EPBC Act and Schedule 1 under the *Wildlife Conservation Act 1950*. Carnaby's Cockatoo is endemic to the south-west of Western Australia, with a widespread distribution from the lower Murchison south to Esperance (Berry 2008; DEC 2012a; DSEWPaC 2012).

Breeding takes place between late July and January/February and most breeding occurs in the inland parts of the species distribution (Burbidge 2009; DEC 2012a). During the non-breeding season (January to July) the majority of the birds move to the higher rainfall coastal regions of their range including the mid-west coast, Swan Coastal Plain and south coast (DEC 2012a). This seasonal shift brings 4,600 to 15,000 Carnaby's Black Cockatoos out onto the northern Swan Coastal Plain (Stock *et al.* 2013). These areas have better natural water sources over the summer period and historically had extensive areas of proteaceous woodlands and shrublands to provide feed for young birds, and good resources for adult birds to stock up for the following breeding season (DEC 2012a; Kendrick 2011).

During February, March, April and occasionally lingering into May-June, large transit flocks forage at major food sources including *Banksia* or Kwongan heaths and *Pinus* plantations on the northern Swan Coastal Plain between Lancelin and Perth (Johnstone *et al.* 2011). North of the Swan River, Carnaby's Cockatoos are known to feed on a range of food sources, including *Pinus* spp., three Banksias (*Banksia sessilis*, *B. attenuata*, *B. prionotes*), *Hakea* spp., Marri (*Corymbia calophylla*), insect larvae, market vegetation and fallen seed, orchard fruit or nut (species undetermined), and several unknown food sources on the ground (Finn *et al.* 2009; Valentine and Stock 2008). Pine trees and the pine plantations are an important food source for Carnaby's Black Cockatoo (Kendrick 2011), and flocks of up to several hundred birds have been commonly sighted within pine plantations (Stock *et al.* 2013).

The long-term survival of a robust population of Carnaby's Black Cockatoos depends on the availability of suitable woodland breeding habitat and tree hollows, and foraging habitat capable of providing enough food to sustain the population. More recently, night roost sites have been recognised as important components of the non-breeding habitat (DEC 2012a).

3.1.3 Other Black Cockatoo species

There are two other species of Black Cockatoo which occur on the Swan Coastal Plain, which have been included in this assessment.

- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*), which is listed as Vulnerable under the EPBC Act and Schedule 1 under the *Wildlife Conservation Act 1950*.
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*), which is listed as Vulnerable under the EPBC Act and Schedule 1 under the *Wildlife Conservation Act* 1950.

These two species of Black Cockatoo have similar ecology, habitat requirements and threatening processes to Carnaby's Black Cockatoo (DEC 2008).

3.1.4 Local extent

The Project Area is located within the modelled distribution of Carnaby's Black Cockatoo and is located at the northern edge of the modelled distribution of both the Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo (DEC 2008; DSEWPaC 2012). The Project Area is situated within the non-breeding range of Carnaby's Black Cockatoo (DSEWPaC 2012).

A search of the DSEWPaC Protected Matters database (DSEWPaC 2013a) identified all three Black Cockatoo species as potentially occurring within 5 km of the Project Area.

A search of the DEC NatureMap database (DEC 2013) identified:

- 58 records of Carnaby's Black Cockatoo within 5 km and 188 records within 10 km of the Project Area.
- Two records of Baudin's Black Cockatoo within 5 km and four records within 10 km of the Project Area.
- No records of the Forest Red-tailed Black Cockatoo within 10 km of the Project Area.

Likelihood of occurrence

It's very likely that Carnaby's Black Cockatoo occurs within the Project Area as there are frequent records of the species in the area and there is suitable habitat within the Project Area.

It is considered unlikely that the Baudin's or Red-tailed Black Cockatoos would regularly occur within the Project Area as the habitat within the Project Area for Baudin's or Red-tailed Black Cockatoos is very limited, and the Project Area is not within the documented breeding range for either species.

Baudin's Black Cockatoo is known to occur north of the Swan River, has been recorded within 10 km (DEC 2013) and there is habitat available for the species within the Project Area. However, there are very few records of Baudin's within the local area, and the Project Area is not within the documented breeding range of the species.

It is unlikely that the Forest Red-tailed Black Cockatoo occurs within the Project Area as this species is not commonly recorded north of the Swan River (Johnstone *et al.* 2011; DEC 2008), has not been recorded within 10 km (DEC 2013) and there is limited suitable habitat for the species within the Project Area. Forest Red-tailed Black Cockatoos have rarely been reported eating the seeds of pine (DEC 2012b) and there is very limited native foraging vegetation within the Project Area.

Based on this likelihood of occurrence assessment, only Carnaby's Black Cockatoo is considered further in this report.

The Gnangara pine (mostly Maritime Pine *Pinus pinaster*) plantations north of Perth are the largest pine plantations in the Perth region, and at their historical maximum in 2002 covered an area of 23, 000 ha (Stock *et al.* 2013). Since 2004, the Gnangara plantations have been harvested without replacement, which will results in the complete removal of all remaining stands of pine by 2031. A regional planning process, known as the Gnangara Sustainability Strategy proposed revegetating portions of the plantation system with native vegetation (Stock *et al.* 2013).

Carnaby's Black Cockatoo

The behavioural ecology of Carnaby's Black Cockatoo in the Gnangara Sustainability Strategy (GSS) Area has been examined in studies by Finn *el al.* (2009) and Valentine and Stock (2008), with a focus on habitat use of pine plantations. A summary of these studies is provided in Appendix D, and relevance to the Project Area is discussed in relation to the Gnangara flock which is known to cross over the Project Area.

These studies confirmed that the pine is the main food source for Carnaby's Cockatoos within the GSS area during the non-breeding season (January-June). Carnaby's Black Cockatoos are also present in the GSS area during the non-breeding period. The resident population during this period would include non-breeding adults, juveniles (immatures), and a small number of pairs breeding in the GSS area (Finn *et al.* 2009).

During March 2009, the Gnangara flock was sampled and the best estimate of flock size was 350 individuals (Finn *el al.* 2009). The defining feature for this flock is its tendency to roost in the pines to the north of Gnangara Road. The flock appears to follow the site-bound flock ecology, exhibiting a reliable association with the site, to which they consistently return to. This site fidelity probably reflects that:

- The pine trees along Gnangara Road are very tall and maintain some cones.
- There are few other areas of very tall pine in the south-west corner of the Gnangara plantation.
- There is freely available water at the Hammersley Centre just south of Gnangara Road.
- There are few alternative roosting sites off-plantation that have tall trees.

During a study conducted by Shah (2006), a known flock of Carnaby's Black Cockatoos was also observed roosting in the same area within the Project Area, north of Gnangara Road just west of Beechboro Road North (Finn *el al.* 2009).

3.1.5 Regional context

The Department of Planning and the DEC have prepared maps that outline potential Carnaby's Black Cockatoo habitat in the Perth, Peel and Greater Bunbury Region Scheme areas (Department of Planning, 2011). For the Perth area these maps provide regional information on potential Carnaby's habitat, including:

- Potential feeding vegetation Swan Coastal Plain IBRA region.
- Known night roost areas.
- Known breeding areas.

Each of these habitats is discussed further below.

Mapping of night roosts and of breeding sites is based on point records of roosting and breeding behaviour which have a buffer applied that aims to reflect the flexible use of these areas by cockatoos and to indicate the important zone for access to potential feeding habitat around each roost or breeding site (Glossop *et al.* 2011). Mapping of feeding habitat is based on

mapping vegetation that Carnaby's cockatoo show a preference for when feeding, and so is not based on observations or point records of feeding.

It is important to note however, that it is difficult to accurately designate and quantify the value of the more 'diffuse' critical habitat such as feeding habitat, as Carnaby's Black Cockatoo is highly mobile and adaptive, and uses resources spread over a relatively large area (DEC 2012a). The application of a 'buffer' around point records of nesting sites and night roost sites may reflect the potential use of these areas by cockatoos (Glossop *et al.* 2011).

Breeding habitat

Throughout south-western Australia, Carnaby's Black Cockatoo breeding occurs mainly from the Three Springs district south to the Stirling Range, west to Cockleshell Gully, Cataby, Regans Ford, Gingin, near mouth of Moore River, Yanchep, Serpentine, Mandurah, Lake Clifton, Bunbury, Nannup and Tone River and east to Manmanning, Kellerberrin, Woolundra, Lake Cronin, Hatters Hill and near Ravensthorpe (Johnstone *et al.* 2011). There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past 10–30 years into the Jarrah-Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain (Johnstone *et al.* 2011). There are now numerous breeding records on the Swan Coastal Plain at Gingin, Boonanarring, Mooliabeenee, near mouth of Moore River, Yanchep, Baldivis, Lake Clifton and near Bunbury (Johnstone *et al.* 2011).

The Project Area does not occur within the documented breeding-range of Carnaby's Black Cockatoo (Department of Planning 2011; DSEWPaC 2012).

Foraging habitat

On the Swan Coastal Plain, there is fragmented foraging habitat available for Carnaby's Black Cockatoo (Department of Planning 2011). This fragmentation has been caused by past clearing of feeding habitat such as *Banksia* woodlands and commercial pine plantations, which has reduced the availability of significant food resources on the Swan Coastal Plain (DEC 2012a; Johnstone *et al.* 2011).

Due to past clearing, fragmentation and degradation of foraging habitat on the Swan Coastal Plain, pine plantations now provide important feeding areas for Carnaby's Black Cockatoo. Pine plantations were not included in the Department of Planning's (2011) mapping of foraging habitat on the Swan Coastal Plain as they are not native and their area will change significantly in the future with the removal without replacement of 23,000 hectares of pines in the Gnangara, Pinjar and Yanchep plantations (DEC 2012a; Kendrick 2011)).

The removal process for pines in these plantations is underway (staged removal between 2004 and 2031) with no stated plan to re-establish the pine plantations (DEC 2012a). This will result in step-down removal of pine from a peak of ~23 000 ha of pine to ~18 000 ha in late 2007 to complete removal by about 2026. Not providing an alternative food resource following removal of pines is likely to have a significant impact on the food resources available to Carnaby's Black Cockatoo in the Perth region (DEC 2012a; Kendrick 2011)).

Roosting habitat

There is one Carnaby's Black Cockatoo known roosting site located within the Project Area as mapped by Department of Planning (2011). This site is located approximately 1 km west of Drumpellier Drive. There are also a number of known roosting sites within 5 km of the Project Area, particularly within the suburb of Gnangara, approximately 4 km north-west (Department of Planning 2011).

Burnham *et al.* (2010) provides details of 222 roost locations and counts from the Great Cocky Count carried out at 190 roost sites by 350 volunteers on 7 April 2010. The count supported an estimated population of 8,000–10,000 birds for the northern Swan Coastal Plain and highlighted the importance of the Gnangara area compared with the Perth metropolitan area (Johnstone *et al.* 2011).

3.1.6 Summary of habitat available within the greater locality

The discreet block of pine plantation located north of Gnangara Road is estimated at 254 ha². The area of remaining pine plantation within the Gnangara-Moore River State Forest is estimated to exceed 10,000 ha based on a conservative estimate of the removal of pines as discussed in the Gnangara Sustainability Strategy (Valentine & Stock 2008). Taking into account the remaining reserves managed by DEC in the greater locality (see Section 3.2.3) it is estimated that the potential area of habitat available to Carnaby's Black Cockatoo, including foraging and night roosting in the greater Gnangara-Moore River State Forest locality, exceeds 10,000 ha.

3.1.7 Review of potential impacts

A review of key published information (i.e. DSEWPaC 2012, and DSEWPaC 2013b) was completed to understand the known and perceived threats to the three species of Black Cockatoo within Western Australia. The review focussed on the published threats to the Carnaby's Black Cockatoo, however also included literature for the other two species of Black Cockatoo. The purpose of the review was to list the known and perceived threats causing the decline of the Black Cockatoo populations and determine which of these may be created (e.g. habitat loss) and/or exacerbated (e.g. fragmentation) by the proposed Project. Table 2 provides a summary of the review. The relevance of each threat and its potential impact as a result of the proposed Project is also discussed.

	•	
Threat	Potential Impact	Relevant to project
Habitat loss, land clearing, habitat fragmentation and/or	Loss and isolation of mature, hollow- bearing trees necessary for breeding.	Possible
habitat degradation °	Lack of or loss of younger age class trees required to replace old trees which die or are destroyed, leading to a shortage of hollows in the future.	Possible
	Loss, degradation and fragmentation of foraging habitat. This is particularly important in breeding areas: removal of vegetation around breeding sites, and the removal of native vegetation corridors that connect breeding and foraging sites, reduces the amount of food available to breeding birds. Breaks of more than 4 km have been shown to prevent breeding birds reaching resources.	Possible
	Removal of native vegetation corridors, restricting the birds' ability to migrate across the landscape.	Unlikely - The Project would not involve the removal of native vegetation

Table 2Known and perceived threats to the three species of BlackCockatoo within Western Australia (DSEWPaC 2013b).

² Area calculation taken from 2012 aerial photography of the Project area and locality

³ Degradation may occur through a variety of sources, including changes to the hydrology or fire regimes, and chemical application (causing death or dieback) to known roosting or nesting trees (DSEWPaC 2012).

		corridors.
	Loss, degradation and isolation of night roost sites and surrounding feeding or watering habitat.	Possible
	Loss and degradation of habitat by secondary impacts such as introduction of dieback caused by <i>Phytophthora</i> <i>cinnamomi</i> (and other plant diseases), weed invasion which can affect seed set, and hydrological changes (such as flooding, drainage or salinity).	Possible
Interactions with humans	Death or injury when hit by cars or trucks, particularly at road constructions which concentrate birds at roadsides to feed on roadside vegetation and spilt grain, or drink from rainwater retained as puddles on roadsides.	Possible
	Death or injury from crop protection measures which may trap, injure or prohibit birds from accessing nearby native vegetation.	Unlikely - There are no crops within the Project Area.
	vibrations and fumes.	Possible
	Shooting of birds (for example where they are coming into conflict with humans over fruit or nut crops).	Unlikely
	Poaching of birds and eggs.	Unlikely - The Project Area is outside the breeding range for the three Black Cockatoo species.
Competition for nest hollows	Competition for nest hollows from native fauna including galah and western corella.	Unlikely - The Project Area is unlikely to provide nest hollows.
Invasive species	Competition for nest hollows with European honeybees and invading bird species (rainbow lorikeet).	Unlikely - The Project Area is unlikely to provide nest hollows.
	Injury and death from European honeybees.	Unlikely - The Project Area is unlikely to provide nest hollows, it is therefore unlikely that Black Cockatoos would be exposed to a situation which may cause injury or death from European honeybees.

3.2 Field survey

3.2.1 Black Cockatoo survey

No Black Cockatoo species were sighted during the field survey, however evidence was recorded that the Project Area is utilised by Black Cockatoos. This evidence included:

- Foraging evidence (e.g. chewed marri nuts) was recorded throughout the Project Area and is mapped in Figure 2.
- Foraging habitat was recorded throughout the Project Area, including pine plantation and *Banksia* species (Figure 2).
- Potential breeding habitat was recorded within the Project Area (Figure 2), however this habitat is limited given the level of existing disturbance. The Project Area is also located outside of the documented breeding range of all three species of Black Cockatoo.

3.2.2 Type and extent of Black Cockatoo habitat within the Project Area

Black Cockatoo habitat on the northern side of Gnangara Road consisted of degraded strips of road reserve and pine plantation, with scattered native vegetation including Marri and Banksia. The extent of the pine plantation within the Project Area is approximately 1-3 rows deep (approximately 10-30 m from the edge), and approximately 4 km long.

The pine plantation would provide foraging habitat and potential roosting habitat for Black Cockatoo species. The pine plantation consists of Maritime Pine (*Pinus pinaster*) and the Radiata Pine (*Pinus radiata*), both of which are known foraging and roosting habitat for Carnaby's Black Cockatoo (Groom, 2011).

On the southern side of Gnangara Road, the Black Cockatoo habitat consists of completely degraded strips of road reserve with scattered Marri and Jarrah trees, over mostly weed species. In some sections, there are small scattered patches of *Banksia menziesii* and *Adenanthos sericeus*.

Foraging habitat

Approximately 5.63 ha of foraging habitat was recorded within the Project Area. This includes 4.72 ha of pine plantation and 0.91 ha of native foraging vegetation and is mapped in Figure 2. The 0.91 ha of native foraging vegetation is scattered throughout the Project Area in the form of single trees and small clumps of trees, and mainly occurs south of Gnangara Road. These degraded areas would provide low quality foraging habitat for Carnaby's Black Cockatoo.

A summary of the extent and type of foraging habitat is provided in Table 3. The extent and type of foraging habitat was confirmed by the presence of foraging evidence (e.g. chewed pine cones). The majority of the foraging habitat is pine plantation, solely made up of the Maritime Pine (*Pinus pinaster*). An example of a Carnaby's Black Cockatoo feeding on a Maritime pine cone is shown in Plate 1.



Plate 1 Carnaby's feeding on seeds of pine cone (Groom 2013)

Roosting habitat

Approximately 4.72 ha of pine plantation roosting habitat was recorded within the Project Area. This pine plantation provides potential night roosting habitat for Carnaby's Black Cockatoo. Carnaby's Black Cockatoos are known to roost in pines north of Gnangara road, including within the Project Area (Finn *et al.* 2009).

A summary of the extent and type of habitat is provided in Table 3.

Breeding habitat

The habitat assessment identified a total of 26 trees of suitable DBH (>500 mm) across the Project Areas including:

- 22 Marri (Corymbia calophylla)
- Three Jarrah (*Eucalyptus marginata*)
- One Tuart (Eucalyptus gomphocephala)

These trees are mapped in Figure 2 and the details of each tree are shown in Appendix E.

Trees of this size are considered to have nesting potential now, or will develop hollows within 100 years. Of these 26 trees, two were identified with potentially suitable hollows for Black Cockatoo nesting. Both of these trees were Jarrah which had previously been burnt, were partly dead and showed signs of regrowth. The first Jarrah (Tree ID 3 Appendix E, see Figure 2) had two medium sized hollows (between 50-cent piece–size to fist-size) and is located approximately 380 m east of the western end of the Project Area. The second Jarrah (Tree ID 13, see Figure 2) had one medium-sized hollow and is located approximately 645 m west of Beechboro Road North.

A summary of the breeding observations for the Project Area is provided in Table 3.

Area	Number of trees of suitable DBH			Number of trees potentially suitable for nesting		Instances of evidence of foraging (chewed marri nuts, pine cones)	Area of foraging habitat recorded (ha)	Area of roosting habitat recorded (ha)
	Marri	Jarrah	Tuart	No hollows	Hollows			
Project Area 35.89 ha	22	3	1	24	2	3	 4.72 ha pine plantation 0.91 ha native vegetation Known foraging habitat supported by observations of chewed pine cones and Marri nuts. 	4.72 ha pine plantation

Table 3 Evidence of Black Cockatoo foraging and potential breeding habitat present within the Project Area

3.2.3 Connectivity and linkages

The pine plantation north of Gnangara Road is part of and is well connected to the Gnangara-Moore River State Forest. This habitat is on the southernmost area of pine plantation and DEC managed land. To the south, the limited habitat within the road reserve is connected to areas of the Whiteman Park Bush Forever Site (Site 304, 1,547.9 ha). In the surrounding area (10 km), there are eight reserves managed by the DEC including:

- Gnangara-Moore River State Forest (65,984 ha)
- Jandabup Nature Reserve (R 7349, 277.5 ha)
- Ellen Brook Nature Reserve (R 27620, 67.15 ha)
- Twin Swamps Nature Reserve (R 27621, 155.27 ha)
- Un-named Nature Reserve (46920, 20.52 ha)
- Un-named Nature Reserve (46919, 126.41 ha)
- Un-named Nature Reserve (46875, 158.68 ha)
- Un-named Nature Reserve (44853, 2.42 ha)

The pine plantation within the Gnangara-Moore River State Forest is linked to the Banksia woodland throughout Whiteman Park, and studies undertaken by Finn *et al.* (2009) have found there to be a known Carnaby's Black Cockatoo flight path between these two areas, and crossing over the Project Area. Therefore, the movement between these two areas is known and Gnangara road does not currently provide a barrier to this movement pattern.

3.2.4 Disturbance

Various forms of historical disturbance were evident throughout the Project Area, including clearing (e.g. road reserve, access tracks) and the existing road. The entire Project Area is completely disturbed, and there are no substantial areas of native vegetation remaining within the road reserve. The areas of pine plantation represent highly modified habitat which has previously been disturbed, and there are some scattered areas of native vegetation. Despite the history and types of disturbance, the pine plantation offers moderate to high foraging and potential night roosting habitat value for Carnaby's Black Cockatoo.

4. Potential Impacts

The Project could potentially result in a range of adverse impacts upon Carnaby's Black Cockatoo and its habitats within the Project Area. Some of the identified impacts that could occur as a result of the Project are likely to be new (e.g. habitat removal for the construction of the road), while other existing detrimental processes within the Project Area and surrounds may be exacerbated (e.g. road mortality).

For the purposes of this assessment all Black Cockatoo habitat located within the construction area footprint are presumed permanently lost. At this stage of the Project, a full survey of the land features and detailed design of the Project has not been provided and the construction area identified is considered somewhat conservative. It is possible that the width of the construction area may need to be increased in some areas, which may result in an increase in habitat losses. Conversely a reduction in losses may be possible through detailed design.

The potential impacts predicted to result from the Project to the Carnaby's Black Cockatoo and its habitat values are presented below for the construction and operational phases of the proposed Project. The purpose of providing the potential impacts in context of the project timeframe may assist with the development of phase specific mitigation measures. Furthermore, it may allow for appropriate design to reduce, then minimise the potential impacts to this species. The potential impacts discussed below do not consider mitigation measures.

Table 4 provides the potential impacts for the construction and operational phases of the proposed Project. The extent and importance of each impact to Carnaby's Black Cockatoo is discussed when relevant.

4.1 Summary of key potential impacts

The proposed Project will result in the loss of an estimated 5.63 ha of known and potential Black Cockatoo habitat including:

- 26 potential breeding trees (two with hollows).
- 5.63 ha of foraging habitat, including 4.72 ha of pine plantation.
- 4.72 ha of potential roosting habitat in the form of pine plantation.

Phase of Project	Potential Impact	Project impact discussion
Construction	Loss and isolation of mature, hollow-bearing trees necessary for breeding.	Two hollow-bearing trees deemed suitable for Carnaby's Black Cockatoo breeding (see Section 3.2.2) were identified during the field survey. Both trees were located within the southern road reserve approximately 5 -10 m from the edge of the road. The road is subject to constant vehicle traffic, which may deter breeding attempts. Also, the trees are located outside of the documented breeding range for this species. Considering this information, and that there are no known breeding records within the locality there is a low likelihood that Carnaby's Black Cockatoo would utilise these hollows for breeding. The Project is unlikely to result in the isolation of any mature hollow-bearing trees necessary for the breeding for Carnaby's Black Cockatoo.
Construction	Lack of or loss of younger age class trees required to replace old trees which die or are destroyed, leading to a shortage of hollows in the future.	 The Project could result in the removal of up to 26 younger age class trees including: 9 scattered trees or small clumps of trees (DBH > 50 cm) located north of the existing road within the Project Area. 17 scattered trees or small clumps of trees (DBH > 50 cm) located south of the existing road within the Project Area. The loss of these trees from the Project Area would result in a shortage of hollows in the future from the local area. However, the loss of these hollows is not considered a substantial loss for the Carnaby's Black Cockatoo.
Construction	Loss, degradation and fragmentation of foraging habitat. This is particularly important in breeding areas: Removal of vegetation around breeding sites, and the removal of native vegetation corridors that connect breeding and foraging sites, reduces the amount of food available to breeding birds. Breaks of more than 4 km have been shown to prevent breeding birds reaching resources.	 The Project could result in approximately 5.63 ha of foraging habitat to be removed comprising two areas of habitat separated by the existing road including: Approximately 4.72 ha of pine located north of the existing road and scattered Mari and Banksia located on the northern side of the existing road. The extent of the pine plantation to be removed is approximately 1-3 rows deep (approx. 10-30 m from the edge), and approximately 4 km long. Scattered Marri and Banksia located in the southern road reserve (approximately 0.91 ha). The removal of this foraging habitat would result in the overall reduction of foraging habitat available to Carnaby's Black Cockatoo, however this loss is not considered substantial as the foraging habitat within the Project Area represents less than 2.5%⁴ of the overall area of pines within the immediate vicinity of the Project Area, and less than 0.1%⁵ of the overall foraging

Potential impacts for each phase of the proposed Project. Table 4

 ⁴ Area of pines within the immediate vicinity of the Project area / north of Gnangara Road is estimated at 254 ha. Area calculation taken from 2012 aerial photography of the Project area and locality.
 ⁵ Area calculation taken from 2012 aerial photography of the Project area and locality

		 habitat available to this species in the greater Gnangara-Moore River locality (see Section 3.1.6). The Project is unlikely to fragment the habitat within the Project Area, or create a barrier (e.g. break of more than 4 km) to the movement of Carnaby's Black Cockatoo between the habitat within the Project Area and surrounding habitat areas. The Project is unlikely reduce the amount of food available to breeding birds given the lack of local breeding records and considering the Project Area is outside the documented breeding range for the Carnaby's Black Cockatoo.
Construction	Removal of native vegetation corridors, restricting the birds' ability to migrate across the landscape.	No native vegetation which may be considered as a corridor used to facilitate the movement of Carnaby's Black Cockatoo across the landscape was identified during the survey within the Project Area. The Project is unlikely to result in the loss of habitat that connects breeding and foraging sites, nor would the Project create a barrier or break greater than 4 km wide.
Construction and Operation	Loss, degradation and isolation of night roost sites and surrounding feeding or watering habitat.	The Project could result in the loss of 4.72 ha of pine plantation north of the existing road, and scattered Marri and Banksia in the northern and southern road reserve during the construction phase (approximately 0.91 ha). The Project is likely to result in the reduction of and degradation of a known and potential night roosting site. A portion of the roosting site (approximately 4.72 ha or 2% ⁶ See Section 3.1.5 and 3.1.6) would be lost as a result of the proposed Project, however the majority of the site would remain intact (249 ha or 98% of the original plantation area). The habitat being removed is also considered foraging habitat, thus the Project would result in the reduction of foraging habitat in the local area, near a roost site, however the loss of this foraging habitat is not considered substantial. No watering habitat would be removed or modified as a result of developing the proposed Project.
Construction and Operational	Loss and degradation of habitat by secondary impacts such as introduction of dieback caused by <i>Phytophthora</i> <i>cinnamomi</i> (and other plant diseases), weed invasion which can affect seed set, and hydrological changes (such as flooding, drainage or salinity).	The Project is unlikely to trigger secondary impacts such as dieback caused by <i>Phytophthora</i> <i>cinnamomi,</i> weed invasion, or hydrological changes that would result in the substantial loss or degradation of habitat within or surrounding the Project Area. <i>Phytophthora cinnamomi</i> is known to occur in many parts of the Swan Coastal plain. It is likely that <i>Phytophthora cinnamomi</i> occurs either within, or in proximity to, the Project Area and given the level of development and disturbance around the Project Area. It is unlikely that this project will increase/exacerbate the prevalence of <i>Phytophthora cinnamomi</i> within, or in proximity to, the Project Area.

⁶ Area of pines within the immediate vicinity of the Project area / north of Gnangara Road is estimated at 254 ha. Area calculation taken from 2012 aerial photography of the Project area and locality.

		A secondary impact during the construction phase is the need to undertake construction activities at night. The potential additional noise, light and visual disturbance, particularly at night during the construction period may deter the Carnaby's Black Cockatoo from night roosting within the adjacent pine plantation, however this is considered to be a temporary disturbance for the period of construction, and is no considered to be a substantial ongoing impact to the species.
Construction and Operational	Death or injury when hit by cars or trucks, particularly road constructions that concentrate birds at roadsides to feed on roadside vegetation and spilt grain, or drink from rainwater retained as puddles on	The Black Cockatoos are susceptible to injury and/or death during two stages of the Project: 1) the construction phase; and 2) the operation phase of the upgraded road. The proposed Project is unlikely to cause injury or death to Carnaby's Black Cockatoo that could occur in the Project Area during the construction period. The species is highly mobile and capable of moving from harm during the removal of habitat.
	roadsides.	The ongoing operation phase of the project is unlikely to substantially inhibit (e.g. reduce the number of movements across the road) or reduce the functionality of the habitat in the surrounding area, including foraging and night roosting habitat. Furthermore, there is little relevant habitat within the road reserves (e.g. Banksia or other foraging species), that would concentrate birds at the roadside, thus causing vehicle – bird collisions.

5. Significance of Potential Impacts

5.1 Commonwealth – *Environment Protection and Biodiversity Conservation Act 1999*

DEWHA's Policy Statement 1.1 (DEWHA, 2009) defines the significant impact criteria for vulnerable and endangered species. The criteria are intended to assist in determining whether the impacts of the proposed action on any matters of national environmental significance (MNES) are likely to be significant impacts.

An action is considered likely to have a significant impact on a species if there is a real chance or possibility that it will trigger one or more of these criteria. When deciding whether or not a proposed action is likely to have a significant impact on a MNES (i.e., the listed Carnaby's Black Cockatoo) the precautionary principle is relevant. Accordingly, where there is a risk of serious or irreversible damage, a lack of scientific certainty about the potential impacts of an action will not itself justify a decision that the action is not likely to have a significant impact on a matter of national environmental significance (DEWHA 2009).

An assessment of the likely impacts on Carnaby's Black Cockatoo against the significant impact criteria is summarised in Table 5.

The assessment determined that the proposed Project as described in Section 1.3 is **unlikely to have a significant impact** on the Carnaby's Black Cockatoo.

Table 5 Assessment of the Potential Impacts According to Significant Impact Criteria Guidelines for a Listed Endangered Species (Carnaby's Black Cockatoo)

Significant Impact Criteria	Impact Outcome		
An action is likely to have possibility that it will:	a significant impact on an endangered species if there is a real chance or		
Lead to a long-term decrease in the size of a population of a species	Unlikely - For the purpose of this assessment 'population of a species' in this case for the Carnaby's Black Cockatoo is defined as the population that occurs within the greater Gnangara Moore River State Forest locality including Whiteman Park and, includes the Gnangara location flock described by Finn <i>et al.</i> (2009 - See Appendix D). The proposed Project, without the implementation of species specific mitigation measures, is unlikely to result in a long term decrease in the size of a population of this species as it is unlikely to substantially:		
	 Reduce the overall area of available habitat to the population. 		
	• Reduce the overall area of occupancy of the population.		
	• Exacerbate existing barrier effects and create new barrier effects.		
	• Reduce the number of individuals because of construction or road kill.		
	• Disrupt the breeding cycle of part of the population.		
	Therefore the proposed Project is unlikely to lead to a long term decrease in the size of an important population of the Carnaby's Black Cockatoo.		
Reduce the area of occupancy of the	Unlikely - The Project is unlikely to substantially reduce the area of occupancy of the population of Carnaby's Black Cockatoo within the		

species	local area or region.
	The species is known to occur throughout greater Gnangara-Moore State Forest locality, and the Swan Coastal Plain Bioregion. The Project may reduce the overall area of habitat by less than 0.1% ha within the Gnangara-Moore State Forest locality as a result of direct loss of habitat from construction. The estimated area of habitat available (including foraging and roosting habitat) within the greater Gnangara-Moore State Forest locality is 10,000 + ha (see Section 3.1.6).
Fragment an existing important population into two or more populations	Unlikely – The Project is unlikely to fragment the population into two or more populations.
	The Project proposes the widening of 5.1 km of bitumen road, which intersects known and potential Carnaby's Black Cockatoo habitat within the Project Area. The upgraded road is unlikely to impose a physical barrier to the movement of Carnaby's Black Cockatoo from one side of the road to the other. The species is highly mobile and capable of traversing the gap (< 100 m) between the pine plantations and surrounding habitats.
Adversely affect habitat critical to the survival of a species	Unlikely – The Project is unlikely to affect habitat critical to the survival of a species
	Up to 5.63 ha of Carnaby's Black Cockatoo habitat in the Project Area would be cleared for this Project. Given that this habitat type is well represented adjacent to the Project Area, and the greater locality the impacts of this clearing are not considered significant. Furthermore, the habitat located within the Project Area does not consist of habitat described by a recovery plan critical for the survival of the Carnaby's Black Cockatoo, nor is it habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DEWHA 2009 pp10).
Disrupt the breeding cycle of a population	Unlikely – The works associated with the Project, are unlikely to disrupt the breeding cycle of the population of the Carnaby's Black Cockatoo. Two hollow-bearing trees deemed suitable for Carnaby's Black Cockatoo breeding (see Section 3.2.2) were identified during the field survey. Both trees were located within the southern road reserve approximately 5 -10 m from the edge of the road. The road is subject to constant vehicle traffic, which may deter breeding attempts. Also, the trees are located outside of the documented breeding range for this species.
	Considering this information, and that there are no known breeding records within the locality there is a low likelihood that Carnaby's Black Cockatoo would utilise these hollows or the Project Area for breeding.
Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	Unlikely – The works associated with the Project, may modify and destroy a small proportion (< 0.1% within the Gnangara-Moore State Forest locality) of known and potential habitat for this species, but unlikely to the point that this species would decline. Given that this habitat type is well represented adjacent to the Project Area, and the greater locality the impacts of this clearing are not considered significant.
	The construction and operational phases of the Project may also reduce the functionality of the retained habitat alongside the road. Although difficult to estimate, the area of occupancy alongside the new road is likely to reduce, however the affected area is unlikely to be substantial reduced or modified. Despite these impacts the proposed Project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
Result in invasive species that are harmful to an endangered species becoming	Unlikely – The Project is unlikely to exacerbate existing invasive species (such as weeds and introduced predators) that already occur within the Project Area, and is unlikely to increase the area of suitable habitat for such species. The Project is unlikely to result in the exterior species that is hereful to Correct in the
endangered species'	Cockatoo and its habitats within the Project Area.

habitat	
Introduce disease that may cause the species to decline, or	Unlikely – The Project is unlikely to introduce a disease that may cause this species to decline. There are no known diseases that may be introduced to the area that may cause the Carnaby's Black Cockatoo population to decline, and it is unlikely that any diseases already exist in the Project Area that may be spread by the activities of the Project.
Interfere with the recovery of the species.	Unlikely – The Project is unlikely to interfere substantially with the recovery of this species. The Project and its actions are unlikely to interfere substantially with or prevent the recovery of the Carnaby's Black Cockatoo.

Legend for Table 3

Significant impact guidelines

DEWHA 2009 - Determination of significance of impact according to page 9-10, Endangered species Matters of National Environmental Significance 'Significant Impact Guidelines 1.1' Commonwealth of Australia For the purpose of this assessment,

'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to an endangered species, occurrences include but are not limited to:

• a geographically distinct regional population, or collection of local populations, or

• a population, or collection of local populations, that occurs within a particular bioregion ((DEWHA 2009 pp10)

'invasive species; is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed threatened species or ecological communities by direct competition, modification of habitat or predation (DEWHA 2009 pp10).

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

• for activities such as foraging, breeding, roosting, or dispersal

• for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)

• to maintain genetic diversity and long term evolutionary development, or

• for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DEWHA 2009 pp10).

6. Management and Mitigation

This section outlines the management measures for reducing the potential impacts to the Carnaby's Black Cockatoo and its habitats within the Project Area, and surrounding areas. It is recommended that the following management and mitigation measures are included in the environmental or construction management plan for the Project.

Where possible road design should minimise impacts to the Black Cockatoo habitat as documented in this report. The Project could include fauna sensitive road design elements (e.g. signage – to alert drivers to the presence of flying Black Cockatoos) incorporated into the planning phase of the Project prior to commencement of construction.

The following measures may need to be reassessed after additional information has been provided including additional infrastructure needed to complete the proposed works not discussed to date or that may occur outside the current preferred alignment footprint.

GHD understands that the City of Swan is discussing offsets for the loss of Carnaby's Black Cockatoo habitat within the Project Area with DSEWPaC. Consequently GHD have not discussed offsets within this report.

6.1.1 Planning (pre-construction) phase measures

- Design principles that would demonstrate avoidance of, the minimisation of impacts to the Carnaby's Black Cockatoo and its habitat (e.g. micro-alignment of the road to avoid as many habitat trees as possible during the detailed design phase).
- Fauna sensitive road design (e.g. signage)
- Develop and include erosion, drainage, pest animal, weed and fire control protocols to be implemented during construction.

6.1.2 Construction phase measures

- Clearing of habitat would best be completed during the breeding season (i.e. when breeding birds are within their breeding range, away from the Project Area).
- Demarcate all native vegetation and Black Cockatoo habitat to be retained via erection of orange para-webbing fencing, so that "No Go" zones are clearly delineated and noted by construction workers and any accidental loss of native vegetation and habitat is avoided.
- Induct all staff and contractors working within the Project Area regarding the Black Cockatoo constraints (e.g. areas that can be cleared and areas that are to be retained) and required actions regarding these values.
- Implement erosion, drainage, pest animal, weed, and fire management protocols.

7. Conclusion and Recommendations

GHD have completed a desktop and targeted field assessment for Black Cockatoo within the Project Area. Foraging, roosting and potential breeding habitat for the Carnaby's Black Cockatoo was identified during the field assessment. It is considered unlikely that the Baudin's or Red-tailed Black Cockatoos would regularly occur within the Project Area as the habitat within the Project Area for Baudin's or Red-tailed Black Cockatoos is very limited, and the Project Area is not within the documented breeding range for either species.

It was determined that the proposed Project may result in the loss of an estimated 5.63 ha of known and potential Carnaby's Black Cockatoo habitat including:

- 26 potential breeding trees (two with hollows deemed suitable for nesting).
- 5.63 ha of foraging habitat, including 4.72 ha of pine plantation and 0.91 ha of native vegetation.
- 4.72 ha of potential roosting habitat in the form of pine plantation on the northern side of Gnangara Road.

An assessment of the likely impacts on Carnaby's Black Cockatoo against the significant impact criteria (Policy Statement 1.1; DEWHA, 2009) was undertaken to determine whether the impacts of the proposed action on Carnaby's Black Cockatoo are likely to be significant impacts.

The assessment determined that the proposed Project is *unlikely to have a significant impact* on the Carnaby's Black Cockatoo or its habitats within the Project Area.

Although not related to this Project, the ongoing harvesting of the Gnangara pine plantations is a much greater risk to the population of Carnaby's Black Cockatoo that inhabits the Project area and greater locality than the potential Project impacts. The pine harvesting will results in the complete removal of all remaining stands of pine by 2031. The harvesting involves a step-down removal of pine from a peak of ~23 000 ha of pine to ~18 000 ha (late 2007) to complete removal by about 2026. Not providing an alternative food resource following removal of pines is likely to have a significant impact on the food resources available to Carnaby's Black Cockatoo in the Perth region (DEC 2012a; Kendrick 2011)).

GHD have recommended management measures (Section 6) to reduce the potential impacts to the Carnaby's Black Cockatoo and its habitats within the Project Area, and surrounding areas. It is recommended that these management and mitigation measures are included in the environmental or construction management plan for the Project.

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