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Stockland Developments Pty Ltd

Vincentia Master Plan

Glossy Black-cockatoo Nest Surveys

Report

January 2006

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1. Introduction

1.1 Background

GHD Pty Ltd was commissioned by Stockland Developments Pty Ltd to undertake targeted surveys to identify nest sites of the Glossy Black-cockatoo (*Calyptorhynchus lathami lathami*) across the proposed Vincentia development site which is located at the corner of The Wool Road and Jervis Bay Road, Vincentia NSW. Stockland is seeking approval for a residential subdivision and concept approval for a district town centre across the 127 hectare (ha) site (see Figure 1). This document will form part of the supporting documentation for the Stockland proposal.


The Glossy Black-cockatoo (GBC) has been widely reported within the locality with around 150 records on the NPWS Wildlife Atlas (2003). Forest She-oak (*Allocasuarina littoralis*) is a preferred feed tree for the GBC and this species is known to forage across the subject site in stands of *A. littoralis* of medium to high density (refer Figure 4.8 of the SIS (ERM 2006)).

Whilst there is some detailed information on the foraging behaviour of GBC within the locality (Robinson 2004) there have been no records of nest sites for this species. The occurrence of large numbers of hollow-bearing trees across the subject site and adjoining Jervis Bay National Park suggested that this species may be nesting within the vicinity.

1.2 Purpose

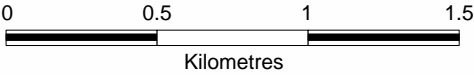
The aim of the targeted field surveys were to search for evidence of GBC breeding activity across the subject site and adjoining areas (hereafter referred to as “study area”) in order to assess the potential impact of the proposed development on the GBC at a local and regional scale.



 Study Area

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Figure 1 Site Location

2. Methodology

2.1 Glossy Black-cockatoo Breeding Biology

A literature review of available information on the breeding biology of the GBC was undertaken to provide an indication of the probable breeding biology of the GBC occurring within the subject site.

2.2 Field Investigations

Field investigations were undertaken by four ecologists over seven days from 9 to 15 May 2005.

The weather was mild with daytime temperatures around 20 °C. Wind speed was nil to slight with cloud cover less than 5 % during the majority of the week. Rain had fallen over the days preceding the surveys resulting in a large number of ephemeral waterbodies along unsealed tracks.

A methodology was developed through discussions with the Department of Environment and Conservation (DEC) (Matt Cameron, pers. comm.) and Environment SA (Trish Mooney, pers. comm.) and through a review of existing literature on the behaviour of the species during the breeding period. The following survey techniques were adopted:

- ▶ Before commencing the field investigation, potential watering points used for drinking by the GBC within the site and surrounds were identified from satellite imagery and aerial photography. The suitability of identified watering points was confirmed and the potential presence of other smaller temporary watering points that may have formed in the study area and surrounds during recent rainfall events were also noted;
- ▶ At least one hour before sunset, the observers would move to a number of locations throughout the study area. At first, observers would preferentially move to a location within sight of suitable waterbodies. If GBC were observed using these waterbodies, the direction that the birds subsequently flew after drinking or feeding was noted by taking a compass bearing. Other relevant information was also documented (e.g. behaviour, direction of arrival, time). Other GBC seen or heard in the vicinity, but not using the monitored waterbody were also recorded. Either immediately after the departure of the GBC, or the next day, observers would then follow this bearing to search for potential nesting sites or other GBC activity. Over the following evenings, observers would also be placed along the compass bearing of flight departure to ascertain if the birds would be seen again in the vicinity and if a closer location for the potential nesting or roosting site could be obtained;
- ▶ During the day, searches were also conducted at both on-site and off-site *Allocasuarina* patches to determine the locations of foraging birds; and
- ▶ Surveys were also conducted at dawn, commencing before sunrise. Once there was some knowledge of the roosting location of some of the birds, their first activity

at dawn within this area was monitored and relevant information was documented. Male roosting sites are usually in close proximity to their partners' nesting site, often within 30 metres.

A summary of the total survey effort is provided below in Table 1 and Figure 2 shows the survey locations.

Table 1 Summary of survey effort within the study area at Vincentia, NSW

Timing of survey	Number of occasions	Total survey effort (person-hours)
Dawn	3 mornings with four observers 1 morning with three observers	11.8
Middle period of day	Occurring on six days with one to four observers	38.6
Dusk	Five evenings with four observers One evening with three observers	44.5
TOTAL		94.9

2.3 Limitations

Unlike other species of cockatoo, the GBC is a secretive and quiet bird making detailed breeding observations challenging. As such, it was not possible to obtain a detailed understanding of breeding activity of the GBC and indeed this was not the aim of this study. The record of the four nest sites during this survey period does not preclude the presence of additional nesting sites within the subject site at present, or that nesting sites do not also occur in greater numbers and / or at other locations during other seasons.

A summary of the limitations of the present study is provided below.

- ▶ *The study was conducted over a limited timeframe.* This limitation was partially offset by conducting the study during the time period usually considered to be the core breeding season (February to May) and by using four ecologists focussed specifically on this task;
- ▶ *A species whose breeding behaviour is known to be cryptic and difficult to study.* Nesting sites are difficult to find and may be overlooked. This limitation was partially offset by consulting relevant literature sources and talking with specialists to design a methodology most likely to find nesting sites if they existed; and

- *Weather Conditions.* Weather conditions during the field work were generally suitable for surveying for the GBC. However, rainfall in the week leading up to the field work created a large number of small ephemeral waterbodies throughout the subject land and surrounds. This increased the difficulty in determining which waterholes were being used for drinking by the GBC.



◆ Survey point
— Survey transect

VERSION: 24/5/05

PROJECT NO: 21-13727

0 200 400 600
Metres



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Project: **Glossy Black-Cockatoo Nesting Surveys**

Figure 2 Glossy Black-Cockatoo Survey Locations

3. Results

3.1 Glossy Black-cockatoo general information

The GBC *Calyptorhynchus lathami* is restricted to eastern Australia and within its range there are three identified subspecies (Higgins 1999). One subspecies, *C. l. halmaturinus*, is confined to Kangaroo Island, off the South Australian coast, and this is the subspecies for which most published studies have been undertaken. Another subspecies, *C. l. erebus* is confined to central coastal Queensland, and appears to be common and secure within its relatively restricted area. The third subspecies, *C. l. lathami*, occurs from southern Queensland to far-eastern Victoria. It is this latter subspecies that occurs within the study area. The morphological differences between the subspecies are in the size and shape of the bill (Higgins 1999). It has been suggested that these bill differences relate to differences in the principal food sources across the range of the species (i.e. the local species of *Allocasuarina* seed cones consumed).

The GBC is considered to be a vulnerable species, as is the subspecies occurring within the study area (Table 2). An Eight Part Test Report and Species Impact Statement have been prepared for this species in relation to the study area, as part of the requirements under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act) and *Threatened Species Conservation Act 1995* (ERM 2006). The species is also considered to be threatened under the legislation of Victoria, Queensland and South Australia.

Table 2 Status of the Glossy Black-cockatoo (in relation to the birds using the study area)

Source	Threat Status
National	
Action Plan for Australian Birds (Garnett and Crawley 2000)	Subspecies occurring within study area is Near Threatened. Species as a whole is listed as Least Concern.
<i>Environment Protection and Conservation Act 1999</i>	Neither species nor subspecies is listed as threatened.
IUCN Red List (Birdlife International 2004)	Species as a whole is listed as Least Concern.
New South Wales	
<i>Threatened Species Conservation Act 1995</i>	Species is listed as vulnerable in NSW.

There have been a number of identified and suggested threats for the species as a whole, and for the various subspecies. These threats include the loss of nesting habitat, loss of foraging habitat, impeded regeneration of food trees through inappropriate fire regimes or overgrazing by stock and rabbits, habitat fragmentation, illegal collection for aviculture, nest predation by possums and feral cats, nest hollow competition and inbreeding and loss of genetic diversity (Higgins 1999, Garnett *et al.* 1999, NSW NPWS 1999, Garnett and Crawley 2000, DEC 2004).

3.2 Glossy Black-cockatoo Breeding Biology

A literature review of available information on the breeding biology of the GBC was undertaken to provide an indication of the probable breeding biology of the GBC occurring within the study area.

There are three subspecies of the GBC. The subspecies which occurs within NSW is the eastern Australian subspecies, *Calyptorhynchus lathami lathami*. Although a number of the breeding locations for this subspecies have been documented (e.g. Blakers *et al.* 1984; Barrett *et al.* 2004), the breeding biology of this subspecies has not been studied in detail (Higgins 1999). There are no documented breeding records from the Jervis Bay area and only one nest site known between Wollongong and the Victorian border and this is located within the Currowan State Forest approximately 20 km north of Batemans Bay. Most published information on the breeding biology of the GBC as a species comes from the Kangaroo Island subspecies *Calyptorhynchus lathami halmaturinus* (Garnett *et al.* 1999), from anecdotal observations and from captive birds (Higgins 1999). Perhaps surprisingly for such a large bird, they are relatively cryptic and difficult to study.

A summary of the available information is provided below (Table 3). An indication of the probable breeding biology of the GBC subspecies occurring within the study area can be inferred from this information.

Table 3 Summary of Glossy Black-cockatoo breeding biology literature review

Breeding Activity	Description	Source
Egg Laying	April to June.	Higgins 1999
	Late January to early June, mostly February to May.	Garnett <i>et al.</i> 1999
	Will attempt to nest up to three times in a season following repeated nest failure.	Higgins 1999 Garnett <i>et al.</i> 1999
Clutch-size	One egg, rarely two.	Higgins 1999
	One egg.	Garnett <i>et al.</i> 1999
Incubation	28.5 to 33 days in captivity. By female only. Female remains on nest during day, leaves nest in evening and is fed by male.	Higgins 1999
	29.3 to 32.2 days (n = 4). By female only. Female usually leaves nest only in evening as the male returns from daytime feeding. Female remains off nest usually between 30 to 60 minutes, during which time she was fed by male and then she drank. Occasionally female fed in she-oak if present near nest.	Garnett <i>et al.</i> 1999
Nestling Period (between hatching and first leaving nest)	60 to 105 days, average 90 days, and is then fed for another 3-4 months after fledging. Fledging has occurred as late as mid-Oct.	Higgins 1999
	84 to 96 days (n=4). After hatching the egg, the adult female increasingly spends more time away from nest, and roosts outside but near nest. Female exclusively regurgitates food for the nestling.	Garnett <i>et al.</i> 1999

Breeding Activity	Description	Source
Nesting Site	Nesting activity occurs in a hollow occurring in a trunk, stump, spout or limb of eucalypt tree, living or dead. In nth NSW, all nine nests observed were in dead vertical spouts above foliage, in trees in small clearings, surrounded by low she-oak forest and near water. Nesting often occurs in loose colonies, but sometimes solitary.	Higgins 1999
	Nesting occurs in eucalypt hollows. There were statistically significant preferences for many of the hollow characteristics assessed (e.g. distance to feeding areas, vegetation type, eucalypt species, height and condition, geology, position in tree, hollow origin). However, for none of the hollow characteristics assessed were the GBC hollow preferences exclusive.	Garnett <i>et al.</i> 1999.
	Of 64 nests analysed, approximately three-quarters were within 1 km of another nest active in the same season. Approx. half had four nests within 2 km. All nests were within 1.5 km of freshwater. Most were within 100 m of suitable foraging habitat (she-oak woodland), but some were up to 12 km away from their main feeding site.	Garnett <i>et al.</i> 1999
Pair-bonding	Monogamous, appear to mate for life with low rate of divorce.	Higgins 1999
	Pair fidelity confirmed for four pairs over two seasons.	Garnett <i>et al.</i> 1999
Nesting site Fidelity	Previously used nests are often used again in subsequent seasons, sometimes by the same pair, sometimes by a different pair. Between seasons (or within the same season following nesting failure), some pairs will re-use the same hollow, some will use a different hollow.	Garnett <i>et al.</i> 1999, Higgins 1999
	Of four females observed moving to use new hollows, they were all less than 1 km from the previous hollow.	Garnett <i>et al.</i> 1999

Breeding Activity	Description	Source
Other Characteristics of Breeding Behaviour	Male escorts female to and from nest hollow during late afternoon / evening for feeding and drink.	Higgins 1999, Garnett <i>et al.</i> 1999
	Courtship Feeding (see Appendix B for description).	Higgins 1999
	Male roosting near nesting site (see Appendix B).	Higgins 1999, Garnett <i>et al.</i> 1999
	Copulation behaviour (see Appendix B).	Higgins 1999
	Birds seen singularly or in pairs rather than in flocks.	Higgins 1999

Previous survey attempts were conducted on the study area to observe potential GBC breeding activity as part of broader bird survey effort (pp. 52 in ERM (2006)). However, these broader bird surveys were conducted at a time of the year (early-mid September) when GBC nesting activity is likely to have been near completion (ERM 2006). Although numerous GBC were recorded on site during these studies, no birds were seen in pairs and no breeding activity was recorded. Potential nesting habitat was recorded during hollow-bearing tree surveys on the study area (ERM 2006).

The Species Impact Statement (SIS) for the study area indicated that large old trees with hollows “represent important habitat for this species within the study area” and that “[t]ree hollows found on the subject site represent potential breeding habitat for this species” (ERM 2006). The SIS noted that no GBC were recorded in pairs and no activity was recorded around tree hollows (ERM 2006). However, the SIS also noted that “this does not preclude the possibility that the species breeds on the study area, as due to their cryptic nature, observations of breeding birds are extremely difficult to obtain, and very few observations of breeding exist” (ERM 2006). For the area from Wollongong to the Victorian border there are a total of 1,989 documented records of GBC, 20 of these include juvenile birds and only one documented nest site (D. Oliver, pers. comm.) and this is located 20 km north of Batemans Bay in the Currowan State Forest.

3.3 Field Investigations

GBC were recorded within the study area on all but the last day of the field investigation (however, on the final day of survey, there were no targeted searches for the GBC undertaken). A summary of the key findings is provided below.

3.4 Site Use

GBC were recorded using the site during the late afternoon and early morning. There was little observed foraging activity by GBC within the study area during the present survey although previous surveys have found birds using the subject site for foraging (ERM 2006).

The following table summarises the number of GBC observations recorded during the present assessment (Table 4). It should be noted that this does not necessarily equate to an exact number of individuals using the study area, as some observations may be of the same birds recorded at separate locations or at different times of the particular survey period (e.g. if the birds had departed from an area and later returned, or if GBC had been heard in the distance and then later observed). However, this table does give an indication of the level of GBC activity during each survey period (Table 4).

Table 4 Summary of Glossy Black-cockatoo activity recorded across the Vincentia development site during the study period

Date	Dawn	Day	Dusk
9 May 2005	Not applicable	None	Heard – 2 Single – 1 Pair – 1 possible
10 May 2005	Not applicable	CSC - 1	Heard – 1 Single – 4 Pair – 2 + 1 possible Three – 1 Cop – 1
11 May 2005	Not applicable	CSC - 1	Heard – 6 Single – 5 Pair – 1 Three - 2
12 May 2005	Single -3 Pair - 2	None	Heard – 9 Single – 3 Pair – 3 CF – 1 Feed – 1 Nest – 1
13 May 2005	Single - 3 Heard – 4 Pair – 1 Nest - 1	None	Heard – 6 Single – 3 Pair – 1 CF – 1 Nest – 1
14 May 2005	Single - 1 Heard - 1 Pair – 1	None	Heard – 5 Single – 3 Pair – 2 CF – 1 Nest – 1
15 May 2005	Not Applicable	None	Not Applicable

Key to table

Single = single GBC seen

Pair = pair of GBC seen

Three = group of three GBC seen

Heard = GBC calls heard none seen

Feed = feeding on she-oak observed

1,2,3 = number of records during this time period

Cop = copulation between GBC observed

CSC = chewed she-oak cones located

Nest = nest site located

CF = Courtship feeding observed

3.5 Breeding Activity

Four confirmed GBC nest sites were recorded and details of these are presented below and their locations are shown in Figure 3. The more detailed findings of the characteristics of these nesting trees and the surrounding habitat along with photographs is provided in Appendix A.

- ▶ Two nests occur in the centre of the study area, near the Central creekline (Nest Sites 1 and 2);
- ▶ One nest occurs less than 100 m beyond the north-western boundary of the study site in Jervis Bay National Park (Nest Site 3); and
- ▶ One nest occurs less than 300 m beyond the north-western boundary of the study site in Jervis Bay National Park (Nest Site 4).

In addition to the four nesting sites, other behaviour characteristic of breeding activity was also recorded, including:

- ▶ A pair of GBC was observed to copulate on a nearby tree after drinking at the Bay & Basin Leisure Centre track waterhole. These GBC were then observed to fly on a bearing into the middle of the study area. It is not known whether these individuals are using one of the known nesting sites or another nesting site within the study area or surrounds;
- ▶ During the breeding season male GBC usually perch near their partners' nest tree. Males were recorded roosting on a number of occasions within the study area and near its boundaries. Some of these roost sites are attached to known nests. But others may be associated with other potential nesting sites nearby;
- ▶ Courtship feeding behaviour, as described in Appendix B, was observed on a number of occasions. On at least one occasion, the nesting site of the GBC pair was not confirmed;
- ▶ At the base of Nest Site 2 a broken eggshell was located. Key attributes of this egg were measured, photographs were taken, and it was compared against field guides and other literature sources (Slater 1989, Higgins 1999, Garnett *et al.* 1999, Morcombe 2000). There is a high likelihood that this is a GBC egg. It is not clear whether the egg was broken by the hatching chick, discarded by the adult or whether it may have been left by a predator; and
- ▶ Birds seen within the study area were primarily single or pairs of birds. Flocks of birds greater than two are more common outside of the breeding period.

In general, there was little consistency between the characteristics of the four nesting trees and their surrounding habitats:

- ▶ Three nests occurred in living trees, one occurred in a dead tree (Nest Site 3);
- ▶ One nest occurred in living Scribbly Gum (*Eucalyptus sclerophylla*) (Nest Site 4), two nests occurred in living Spotted Gum (*Corymbia maculata*) (Nest Sites 1 and 2), and the dead tree with a nest was considered most probably the remains of a Red Bloodwood (*Corymbia gummifera*);

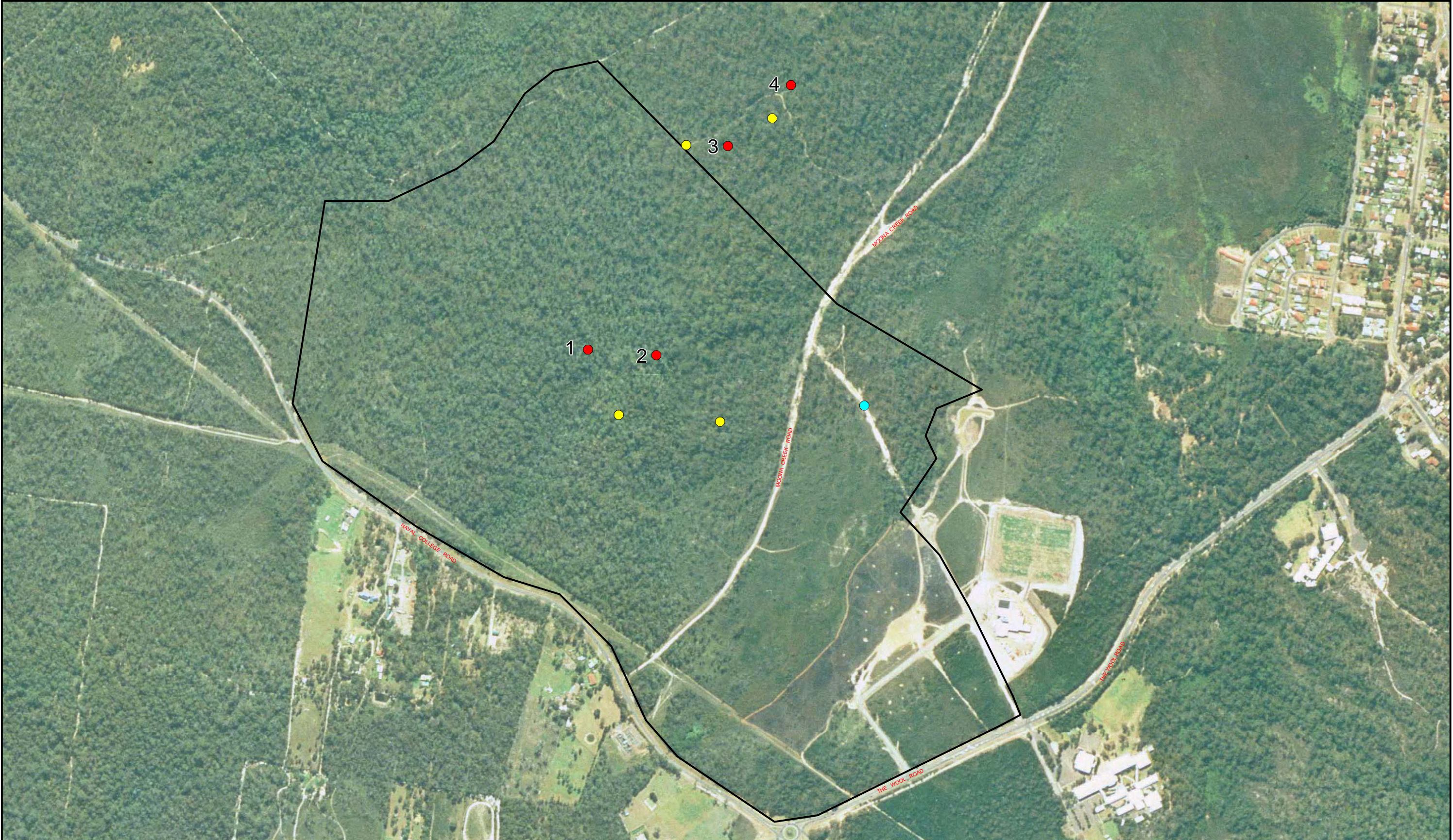
- ▶ Two nests occurred on the slopes leading down to the creekline in closed forested habitat, two nests occurred on the ridgeline in more open habitat;
- ▶ In the living trees, two nests occurred in dead limbs, and one nest occurred in the hollow fork of living limbs; and
- ▶ The numbers of hollows within the nest trees ranged from one to eight.

The following features were relatively consistent between the nesting sites:

- ▶ All nests were within hollow-bearing eucalypt tree species;
- ▶ All nests occurred in the hollow spouts of trees, with vertical openings; and
- ▶ All nesting trees were relatively close to known stands of *Allocasuarina littoralis* (all 200 metres or less). Other studies have also noted this correlation, although these studies have also noted that birds will nest more up to 10 km or more from their primary feeding site (Garnett *et al.* 1999, Higgins 1999). Only one of the four nesting pairs identified during the present study was recorded foraging within an *Allocasuarina* patch near their nesting site.

It is possible that not all nesting sites within the study area have been recorded. Based on the numbers and timing of birds seen flying across the site in the late afternoon and early morning, plus male GBC roosting sites, it is possible that other nesting sites may occur nearby.

- ▶ One nesting site is suspected beyond the study area to the north-west;
- ▶ One further nesting site is suspected near the two nests along the Central creekline;
- ▶ Another one or two further nesting sites could possibly occur near the north-eastern boundary of the study area; and
- ▶ One further nesting site could occur near the roosting site located on the final evening of survey between the leisure track waterhole and the known nesting sites along the Central creekline (Nest Sites 1 and 2).



- GBC Nesting Tree
- GBC Roost Tree
- GBC Waterhole

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Figure 3 Glossy Black-Cockatoo Nesting and Roosting Sites

4. Assessment of Likely Impacts

The four nest sites recorded during this study are a significant finding as DEC holds only one previously documented recording of a nest site from the area between Wollongong and the Victorian border (D. Oliver, pers. comm.). The Species Impact Statement notes that if the species is to be found breeding in tree hollows on the study area, then the loss of this breeding habitat would be considered to be significant in the regional context as there are no other known nesting sites in the Jervis Bay area (ERM 2006).

It is likely that additional surveys within the locality and region would successfully locate other nest sites and nesting colonies as this study was temporally and spatially limited in nature and that nest sites were recorded in a variety of situations. This indicates that a range of habitat conditions can be utilised as long as certain criteria are met including a supply of Eucalypt tree hollows with vertical openings and nearby *Allocasuarina littoralis* stands. There are likely to be additional criteria which are currently unknown.

In response to the findings of these targeted surveys, Stockland Developments Pty Ltd has modified the footprint of the proposal to accommodate:

- ▶ All known nest sites across the subject site;
- ▶ An additional 10 ha of potential breeding habitat;
- ▶ Retention of a habitat corridor between the subject site nest trees and those recorded within the Jervis Bay National Park; and
- ▶ Additional foraging habitat.

Consequently, the proposed development will not result in the direct loss of a known nest tree and the buffers between nest trees and proposed development has been increased for the majority of the trees. Current buffers include:

- ▶ Nest Site 1 on the northern side of the Central creek – approximately 100 m from the edge of development to the north and 90 m from the edge of development to the south-west;
- ▶ Nest Site 2 was recorded in the creekline of the Central creek and it is approximately 225 m from the edge of development to the north and 45 m from the edge of development to the south;
- ▶ Nest Site 3 occurs in the Jervis Bay National Park and it is approximately 187 m from the northern boundary of development; and
- ▶ Nest Site 4 occurs in the Jervis Bay National Park and it is approximately 360 m from the boundary of development.

Some of these buffers are less than the required 100 m around nest trees within NSW State Forests (NSW Department of Primary Industries 2004). However, there are reports of GBC using nest sites adjacent to roads and within 100 m of residential areas

on Kangaroo Island although these areas are known to have nearby stands of *Allocasuarina* (S. Garnett, pers. comm.).

GBC tend to nest in loose colonies (Higgins 1999), and there is evidence to indicate that there could be additional active GBC nesting trees in the vicinity of those already located within the subject land and adjacent Jervis Bay National Park. Although there is no conclusive evidence it would seem unlikely that the four nesting sites within the study area are examples of two smaller colonies but rather that they are part of a single larger nesting colony. There is little information from the literature on why loose nesting colonies occur but it may be due to the availability of suitable habitat as the highest density of hollow-bearing trees on the subject site occur in this area.

In other studies, the general location of these loose colonies appears to be relatively consistent between seasons. However, the hollows being used within a colony is not always so consistent. Often, but not always, the same hollows will be re-used. A hollow could be re-used by the same pair of birds, by different pairs of birds or not at all for one or more seasons (Higgins 1999, Garnett *et al.* 1999). Sometimes, a pair of GBC will even use different hollows during subsequent nesting attempts within the same season (Garnett *et al.* 1999). As such, it is plausible that other hollows in the same area as those found during the present assessment, or elsewhere within the study area, may be used by these four known breeding pairs if they were to have other nesting attempts during this season, or in subsequent seasons. The same would be true for any other nesting GBC pairs potentially using the study area now or in the future.

The proposed development footprint will not result in the loss of a known nesting tree and the development footprint has been modified to include an additional 10 ha of potential breeding sites in the potentially important corridor between the subject site nests and those located within the Jervis Bay National Park. However, it will result in the loss of additional hollow-bearing trees across the remainder of the subject site that could potentially be used for nesting at present (but were not located or confirmed during the present study) and hollow-bearing trees that could be used for nesting at other times during this season or during other breeding seasons.

Retention of an additional 10 ha increases the buffers around the current known nest sites and provides additional breeding and foraging habitat. However, breeding habitat retained within the subject site and Jervis Bay National Park will be at risk from indirect impacts associated with the proposed development and resultant urbanisation including:

- ▶ Loss of foraging habitat;
- ▶ Habitat fragmentation;
- ▶ Nest predation by fauna associated with urbanised areas, e.g. Brushtail Possums; and
- ▶ Competition for nest hollows, both between GBC pairs and between GBC pairs and other hollow-dependent species, as fewer hollows will be available.

These indirect impacts could cause instability within the local population through a decrease in breeding success either through a reduction in potential nesting areas, loss of nestlings through predation, disturbance as a consequence of neighbouring urbanisation and a decrease in food sources. GBC are known to fly up to 14 km between feeding and nesting areas although the majority of nests are known to occur within 1 km of feeding habitat and 200 m of permanent water (Crowley *et al.* 1997 cited in Mooney & Pedler 2004). The major stands of *Allocasuarina* will be removed from the subject site in a staged approach over approximately eight years including those identified by Robinson (2004) as having medium significance to GBC as foraging habitat in the locality outside the Jervis Bay National Park. It is noted that regeneration is proceeding within the locality and immature *A. littoralis* trees are evident within neighbouring areas of Jervis Bay National Park.

Overall a response to further urbanisation in the region may be a reduction in the distribution of this species and reduced reproductive opportunities as local populations retract into remaining suitable habitat outside of the subject land. However, if recommendations outlined in Section 5 are implemented impacts will be reduced.

5. Recommendations

The modification of the proposal by Stockland Developments Pty Ltd has incorporated the two major recommendations included in an earlier draft of this report (GHD 2005 Draft Report) which stated:

...modify the proposed footprint to retain Nest Site 1 within the development. It is also recommended that the conserved riparian area of the Central creek be widened along its northern section to allow the retention of a habitat corridor between the on-site nest trees (Nest Sites 1 and 2) and the off-site nest trees (Nest Sites 3 and 4) in the Jervis Bay National Park. Such a modification would provide benefits for the GBC in the form of:

- ▶ *Retention of hollow-bearing trees for current and future nest sites;*
- ▶ *Retention of trees for male roost sites;*
- ▶ *Retention of some areas of Allocasuarina as on-site foraging resources;*
- ▶ *Maintenance of probable flight paths between these two areas; and*
- ▶ *Set back of development would provide buffers to potential habitat.*

It is considered that widening of the riparian corridor into neighbouring open-woodland areas would have benefits not only for the GBC but would also potentially benefit a number of other species, such as the Giant Dragonfly (Petalura gigantea) and Yellow-bellied Glider (Petaurus australis).

As stated above, the incorporation of these major recommendations will be of benefit not only to the GBC but to a range of threatened species, general biodiversity and indirect impacts on Jervis Bay National Park.

6. Mitigation Measures

Direct impacts on the nest sites of the GBC have been avoided through modification of the Stockland proposal. However, there is the potential for a number of indirect impacts and this section outlines the ameliorative measures that should be implemented to reduce the extent of impacts on this species within the subject site, locality and region.

A GBC Management Plan should be developed for the conserved areas and should potentially include a number of measures which have been developed to protect the Kangaroo Island subspecies (Garnett *et al.* 1999). An important component of such a plan should be ongoing monitoring of the known breeding habitat and usage by the GBC especially during construction and for a number of years post construction. The management plan should clearly identify potential hazards and solutions and the ongoing monitoring provide clear actions to be undertaken in response to changes in usage of the subject site.

Additional foraging habitat should be provided through planting of *Allocasuarina littoralis* in areas to be rehabilitated, e.g. along the existing power easement to compensate for loss of foraging habitat from the site. Revegetation with *Allocasuarina littoralis* should be undertaken with seed collected from preferred feed trees as those trees with large amounts of seed per cone are favoured by GBC (Garnett *et al.* 1999, Robinson 2004).

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Appendix A

Description of Glossy Black-cockatoo Nesting Sites

DESCRIPTION OF GLOSSY BLACK-COCKATOO NEST SITES

NEST SITE 1

Location	Within the subject site, near the Central creekline. Located on slope above creekline, with a south-easterly aspect.
Tree Species	Spotted Gum (<i>Corymbia maculata</i>). Tree height estimated at 25 m. In a moderately healthy condition. Epicormic growth along top half of trunk. Trunk diameter at breast height is 74 cm.
Hollow	Hollow is estimated at 20 m height. At top of main trunk, split into two branches. One branch approximately five metres above this height, other branch less than 80 cm in length. Hollow occurs in the split between these two branches. Nest hollow partially hidden by epicormic growth. No other hollows were observed within this tree.
Description of Surrounding Habitat	<p>Overstorey a mixture of mature and intermediate eucalypts, Spotted Gum, White Stringybark (<i>E. globoidea</i>), Red Bloodwood (<i>C. gummifera</i>). Scattered <i>Allocasuarina littoralis</i>, although no cone-bearing trees in the immediate vicinity. Moderately dense canopy.</p> <p>Understorey vegetation includes <i>Lomandra longifolia</i>, Bracken (<i>Pteridium esculentum</i>), Tall Rice flower (<i>Pimelia linifolia</i>), Tick Bush (<i>Kunzea capitata</i>), Lemon-scented Tea-tree (<i>Leptospermum polygalifolium</i>), <i>Pultenea</i> sp..</p> <p>Moderately dense canopy. Ground layer contains a relatively high proportion (50%) of leaf litter with no vegetation. Other ground layer vegetation includes bracken, <i>Lomandra</i>, <i>Pimelia</i>, <i>Kunzea</i>.</p>
Nearest She-oak stand	Approximately 150 m to the south-east of the nest tree.
Nearest waterway	Approximately 80 m to the south-east of the nest tree.

NEST SITE 2

Location	Within the subject site. Located on slope above Central creekline, with a north-north-westerly aspect.
Tree Species	Spotted Gum (<i>Corymbia maculata</i>). Tree height approximately 26 m. Diameter at breast height of 75 cm. Lightning strike scar wrapping around trunk from northern side to southern side (possibly along the spiral grain). Top of tree is dead. Live branches below this top height, and epicormic shoots on trunk.
Hollow	<p>Height of the hollow is estimated at 17 m. Trunk is forked at height of approximately 12 m. Northern fork is dead, and the nest hollow is at the terminus of this fork. Length of the fork is approximately 5 m. No other hollows were observed within this tree.</p> <p>A broken egg was found at the base of this tree, below the hollow. The egg was white, with a width of approximately 32 mm. It was broken, missing approximately one third of its length.</p>
Description of Surrounding Habitat	<p><i>Corymbia maculata</i> / <i>Eucalyptus globoidea</i> Open-forest.</p> <p>Overstorey a mixture of mature and intermediate eucalypts, Spotted Gum, White Stringybark (<i>E. globoidea</i>), Red Bloodwood (<i>C. gummifera</i>). Scattered <i>Allocasuarina littoralis</i>, although no cone-bearing trees in the immediate vicinity. Moderately dense canopy.</p> <p>Understorey vegetation includes <i>Lomandra longifolia</i>, Bracken (<i>Pteridium esculentum</i>), Tall Rice flower (<i>Pimelia linifolia</i>), Tick Bush (<i>Kunzea capitata</i>), Lemon-scented Tea-tree (<i>Leptospermum polygalifolium</i>), <i>Pultenea</i> sp..</p>
Nearest She-oak stand	Approximately 45 m to the east of the nest tree.
Nearest waterway	Approximately 100 m to the west of the nest tree.

NEST SITE 3

Location	In Jervis Bay National Park less than 100 m to the north-east of the boundary. Located on the ridgeline.
Tree Species	Probable Red Bloodwood <i>Corymbia gummifera</i> , ca. 13 m tall, diameter at breast height of 102 cm. Dead tree, but still retaining sufficient features to allow probable identification. Tree is little more than a trunk with a spilt at its top. Each split is about 0.5 metres in length and each has a hollow openings at their top.
Hollow	Hollow opening is 12.5 m high. The diameter of the spout opening used by the GBC for nesting is estimated at ca. 40 cm. The diameter of the other spout opening is estimated at ca. 60 cm.
Description of Surrounding Habitat	<i>Eucalyptus sclerophylla</i> / <i>Corymbia gummifera</i> Open-woodland. Moderately open canopy unlike that of Nest Sites 1 and 2. Understorey comprised of low shrub layer of Lemon-scented Tea-tree (<i>Leptospermum polygalifolium</i>), Hair-pin Banksia (<i>Banksia spinulosa</i>), Mat Rush (<i>Lomandra longifolia</i>), Black She-oak (<i>Allocasuarina littoralis</i>).
Nearest She-oak stand	Less than 100 m to the south-east of the nest tree.
Nearest waterway	Approximately 300 m to Western creek and Wetland No. 325 and approximately 300 m to Central creek.

NEST SITE 4

Location	In Jervis Bay National Park less than 300m to the north-east of the boundary with the subject site.
Tree Species	Scribbly Gum (<i>Eucalyptus sclerophylla</i>), 15 m in height, diameter at breast height of 100 cm. Tree appears moderately healthy, but has evidence of a lightning scar. Epicormic growth occurs on many of the limbs.
Hollow	12 m high. Hollow on northern side of tree. Nesting hollow has an almost vertical spout in a dead limb. One of an estimated eight hollows in this tree.
Description of Surrounding Habitat	Scribbly Gum – Stringybark Open Woodland. On ridgeline. Sparse and open canopy, unlike that of Nest Sites 1 and 2. Canopy dominated by Scribbly Gum and White Stringybark. Understorey open and dominated by Hair-pin Banksia (<i>Banksia spinulosa</i>), Mountain Devil (<i>Lambertia formosa</i>), Finger Hakea (<i>Hakea dactyloides</i>), Rapier Sedge (<i>Lepidosperma filiformis</i>), Broad-leaved Geebung (<i>Persoonia levis</i>).
Nearest She-oak stand	Approximately 105 metres to the south of the nest tree.
Nearest waterway	Approximately 400 metres to both south and west of the nest tree.

Appendix B

Summary of Selected Glossy Black-cockatoo Behaviour

SUMMARY OF SELECTED GLOSSY BLACK-COCKATOO BEHAVIOUR

Courtship Feeding (Higgins 1999)

Male usually feeding female. Pair stands on sloping branch, usually with male higher than female. Female has head thrown back and has bill tilted up. The bill of the male is then thrust forward, and downward, interlocking with the female, with food passing from the male to female. During feeding, female sometimes gives calls similar to those of a begging juvenile, but not while actually receiving the food. During incubation and brooding, male feeds the female in the late afternoon. However, although this provides evidence of a pair-bond and probable nesting activity, studies on the Kangaroo Island subspecies indicate that on rare occasions outside of the breeding period, some female may beg for food year-round.

Courtship feeding was recorded on three occasions during the present study by different pairs. The nesting sites of two of these pairs was recorded in nearby hollow-bearing trees.

Copulation (Higgins 1999)

Male flies in beside female and lands on her back; female raises tail and lifts to one side. Male tucks tail beneath that of female and moves it up and down rhythmically while holding wings up behind body and sometimes flapping. Copulation can occur year round, but is mostly commonly recorded in the breeding season and mostly in the evening.

Copulation was recorded on one occasion during the present study, and followed behaviour very similar to that described above. It occurred on the limb of a eucalypt, soon after the birds had perched there after drinking at the nearby leisure track waterhole in the late afternoon.

Nesting (Higgins 1999)

During nesting, a breeding pair will leave the nest area in the mid to late afternoon and travel to a water body to drink. The female will be seen begging for food from the male. The male is likely to feed the female and then they will both fly from the waterbody back to the nest. The pair may stop along the way and the male may feed the female again (or for the first time). The female may be recorded entering the nest site in a hollow-bearing tree, particularly during incubation. After the egg hatches, and the chick develops, the female spends an increasing amount of time away from the nesting while she feeds, returning to the nest to feed the chick. After hatching, the adult female increasingly begins to roost outside of the nest at night as the chick grows larger and older.

Using this previously described nesting behaviour, four nesting sites were located within the study area and immediate surrounds. For all four of the nesting sites located, the adult male was observed to escort the adult female back to the nesting tree then the female entered the hollow. The male moved off a short time later, presumably to a nearby roost site. The female was never observed to roost outside of the hollow at night.

Foraging Behaviour

Across the range of the species, the main (and almost exclusive) food source of the GBC is the seeds of the she-oak *Allocasuarina* spp (Higgins 1999). The particular *Allocasuarina* species used for feeding depends on the availability in the local area. Three species of *Allocasuarina* are known to occur within the study area; *A. distyla*, *A. littoralis* and *A. paludosa* (ERM 2006). Of these, *A. littoralis* is considered widespread and relatively abundant across the site, while the occurrence of the other two *Allocasuarina* species is more scattered (ERM 2006). Suitable stands of *Allocasuarina littoralis* also occur in other reserves in the local area (Gaia Research 1999).

Direct evidence (observations) and indirect evidence (chewed seed cones on the ground in stands of she-oak) of foraging have been recorded on a number of occasions within the site (ERM 2006). Stands of she-oak considered suitable for GBC foraging have been mapped across the subject site (ERM 2006).

During the present study, searches for the GBC in suitable food trees were conducted in previously mapped stands of *A. littoralis*, plus some additional off-site locations. No foraging GBC were recorded during these searches. Only one pair were observed foraging during the present study, in the late afternoon just before they flew off to a nearby nesting hollow. Elsewhere on site, chewed seed cones were recorded. Many of the birds that were observed flying through the site in late afternoon, entered the subject site from the south.

Although not recorded during the present study, GBC would be expected to regularly forage in *A. littoralis* stands within the study area, as has been recorded in previous investigations (ERM 2006).

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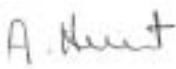
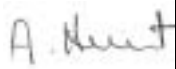
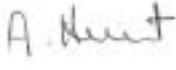
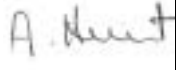
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