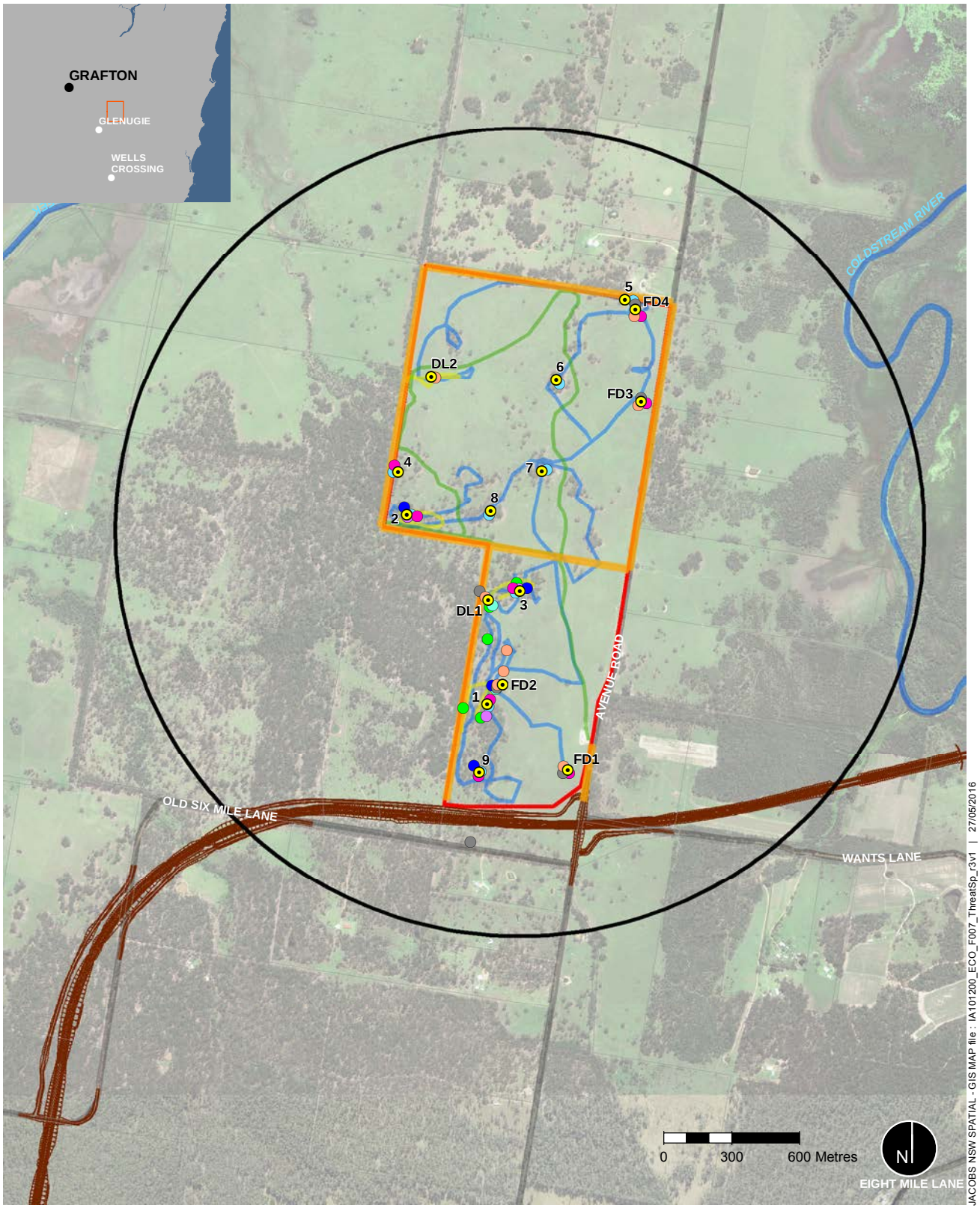
Table 5-11 Summary of fauna survey methods, targeted species, survey effort and timing

| Survey method | Target species | Habitat strata (area) | | |
|---|---|---|---|---|
| | | Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (14.6 hectares) | Spotted Gum - Grey Box - Grey Ironbark dry open forest (16.2 hectares) | Coastal freshwater meadows and forblands of lagoons and wetlands (0.8 hectares) |
| | | Sites: 1, 3, 9 & DL1 | Sites: 2, 4, 5, 6, 7 & 8 | Sites: FD1, FD2, FD3, FD4 & DL2 |
| Tree-based Elliot traps | Brush-tailed Phascogale, Squirrel Glider | 24 trap nights (Site 1)<br>18 trap nights (Site 3) | 24 trap nights (Site 2) | - |
| Ground-based Elliot traps | Common Planigale | 100 trap nights (Site 1) | 100 trap nights (Site 2) | - |
| Harp traps | Eastern Bentwing Bat, Little Bentwing-bat, Southern Myotis, | Four trap nights (Sites 1 & DL1) | - | - |
| Bat call recording | Eastern Bentwing Bat, Little Bentwing-bat, Southern Myotis | 48 hours (Site DL1) | - | 48 hours (Site FD1)<br>48 hours (Site FD2)<br>24 hours (Site FD3)<br>24 hours (Site FD4) |
| Time and area based bird surveys | Red-tailed Black-cockatoo, Red Goshawk, Black-necked Stork<br>Emu, Regent Honeyeater, Red-backed Button-quail | 90 person minutes (Site 1) over two consecutive days<br>120 person minutes (Site 3) over two consecutive days<br>60 person minutes (Site 9) over one day | 120 person minutes (Site 2) over two consecutive days<br>60 person minutes (Site 4) over one day | 20 person minutes (Site FD4) over one day<br>20 person minutes (Site FD3) over one day |
| Walked spotlighting transects | Koala, Brush-tailed Phascogale, Squirrel Glider, Rufous Bettong | Four person hours (Site 1)\<br>Two person hours (Site 3) | Two person hours (Site 2) | |
| Vehicle spotlighting | Rufous Bettong | One person hour (Site 3) | Two person hours (Sites 2, 4, 6, 7, 8) | - |

| Survey method | Target species | Habitat strata (area) | | |
|---|---|---|---|---|
| | | Spotted Gum - Grey Ironbark - Pink Bloodwood open forest (14.6 hectares) | Spotted Gum - Grey Box - Grey Ironbark dry open forest (16.2 hectares) | Coastal freshwater meadows and forblands of lagoons and wetlands (0.8 hectares) |
| | | Sites: 1, 3, 9 & DL1 | Sites: 2, 4, 5, 6, 7 & 8 | Sites: FD1, FD2, FD3, FD4 & DL2 |
| Area-based frog searches / spotlighting | Wallum Froglet | Two person hours (Site DL1) | - | Two person hours (Site DL2)<br>Two person hours (Site FD2)<br>One person hours (Site FD1)<br>One person hours (Site FD3)<br>One person hours (Site FD4) |
| Koala SAT & habitat assessment | Koala | Three sites (1, 3 & 9) | Four sites (2, 6, 7 & 8) | - |
| Camera traps | Brush-tailed Phascogale<br>Rufous Bettong | Three camera trap days (Site 9) | Three camera trap days (Site 2)<br>Three camera trap days (Site 3) | Three camera trap days (FD2 - near Site 1) |
| Sign search | Emu | 1,103 metres of fence length (near Site 3)<br>380 metres of fence length (near Site 1)<br>380 metres of fence length (near Site 9) | 973 metres of fence length (near Site 2)<br>1,105 metres of fence length (near Site 5) | 260 metres fence length (near FD1)<br>597 metres fence length (near FD3)<br>597 metres fence length (near FD4)<br>586 metres of fence length (near DL2) |




## Legend

- The Project
- Grafton Bypass (proposed)
- Inner assessment circle
- Random flora meanders
- Walked spotlight tracks
- Spotlighting transect
- Emu fence surveys
- Threatened species survey locations
- Amphibian survey sites and call playback
- Anabat locations
- Bird survey sites
- Camera trap sites
- Fauna survey sites
- Harp trap locations
- Mammal trapping sites
- Reptile and Koala SAT survey sites
- Spotlighting and call playback sites

**Figure 5-3** | Threatened species survey locations

### 5.2.3 Limitations

The fauna survey effort and timing is adequate when considering past land use history and disturbances such as grazing, under-scrubbing and widespread land clearing across the Project Site.

The survey timing for all threatened fauna candidates was suitable during the summer site survey. However the conditions were dry and the lack of rainfall during and preceding the survey would have limited the chance of recording the Green-thighed Frog and Black-necked Stork.

A period of several seasons or years is often needed to identify all the species present in an area, especially as some species are only apparent at certain times of the year (e.g. migratory birds) and require specific weather conditions for optimum detection (e.g. frogs). The conclusions of this report are therefore based upon available data and a short field survey in one summer and are therefore indicative of the environmental condition of the Project Site at the time of the survey. It should be recognised that site conditions, including the presence of threatened species, can change with time. To address this limitation, the assessment has also aimed to identify the presence and suitability of the habitat for threatened species as discussed in the following sections.

One session of walked and vehicle spotlighting on Thursday (4 February) was cancelled due to uncontrollable externalities occurring adjacent the Project Site.

Searching for Coastal Emu evidence / sightings along fences increases the likelihood of detecting the species, particularly along fences with barbs. Birds will pass through fences and usually snag feathers on barbs of which feathers can remain for around three months. However, Coastal Emu are considered nomadic with very large home ranges and can move across the landscape undetected, this can result in false absences.

The probability of detecting microchiropteran bats using harp traps was reduced due to a lack of obvious flyways in the Project Site. Harp traps were setup near waterbodies which are generally in open area. Bats were observed flying over waterbodies during spotlighting, however no captures were made in harp traps in the same location.

At the time of the survey, peak flowering of Pink Bloodwood (*Corymbia intermedia*) was producing large quantities of nectar attracting a diversity of honeyeaters at day and large numbers of Grey-headed Flying-fox at night, particularly at Sites 1 and 3. This was considered a major factor for detecting nocturnal mammals such as Squirrel Glider where high nectar resource availability may have caused bait avoidance and reduced tree trap capture rates.

Pitfall traps are a generally accepted method for capture of the small Common Planigale. Pitfall trapping requires soft soils or sandy substrate in order the establish trap into the ground. The dense and hard clay soils on the site precluded the use of pitfall traps and live mammal traps (Elliott scientific) were used to target this species, however it is noted that these may not be an effective trapping method for Common Planigale.

## 5.3 Threatened species survey results

### 5.3.1 Flora

**Weeping Paperbark (*Melaleuca irbyana* – endangered, TSC Act**

The species was observed on an adjacent property to the east of the Project Site along Avenue Road. No threatened flora species were recorded on the Project Site.

### 5.3.2 Fauna

The Project Site is considered to have high fauna species richness despite the small area of forested habitat with a total of 83 fauna species recorded. This comprised 55 birds, nine terrestrial mammals, four bats, nine frogs, six reptiles and one fish species. An additional nine bats were detected but not positively identified. All recorded species are listed in **Table B-1**. The high diversity of fauna is a result of the size and condition of

contiguous habitats off the site. A total of eight threatened fauna species were recorded on the site. Details of threatened candidate species recorded on the site are described below with locations shown on **Figure 5-4**.

**Glossy Black-Cockatoo (*Calyptorhynchus lathami*) – vulnerable TSC Act**

A high density of chewed cones from *Allocasuarina littoralis* trees was observed on western fence line near site 2 (outside of Project Site). This is strongly indicative of foraging Glossy Black Cockatoos which soley rely on *Allocasurina* plant species as a food source.

**Little Lorikeet (*Glossopsitta pusilla*) – vulnerable TSC Act**

The Little Lorikeet was identified at sites 1 and 3 in the study area on multiple occasions. This species was observed in groups of 2 to 4 individuals flying through the canopy and feeding on flowering Pink Bloodwood (*C. intermedia*). Vegetation in the study area provides both foraging and nesting habitat for the Little Lorikeet. Foraging habitat includes all nectar producing trees and many of the hollow-bearing trees and stags provide suitable nesting habitat.

**Grey-crowned Babbler (*Pomatostomus temporalis temporalis*) – vulnerable TSC Act**

Grey-crowned Babblers were observed on the Project Site on multiple occasions in small groups of 4 to 6 individuals. Grey-crowned Babblers occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs where they forage in leaf litter and on bark of trees for insects. Vegetation within the study area represents suitable foraging and nesting habitat for this species. The Grey-crowned Babbler is a sedentary and the individuals identified on the Project Site are likely to local family group.

**Brolga (*Grus rubicunda*) – vulnerable TSC Act**

Male and female observed in cleared grassland around the water body FD4 in the north east of the Project Site. This species is dependent on wetlands for both foraging and nesting. No nest was observed; therefore the two individuals of this species were likely foraging and may have travelled over from large floodplain areas to the east around Coldstream River. Due to the disturbed nature of aquatic habitat in the Project Site, it likely only represents foraging value to the Brolga.

**Brown Treecreeper (*Climacteris picumnus victoriae*) – vulnerable TSC Act**

Observed gleaning on rough-barked tree species in sites 1 and 9 in the Project Site. This species mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species, where it forages for insects amongst the litter, tussocks and fallen timber, and along trunks and lateral branches. The Project Site represents good quality habitat for this species due to the high abundance of rough-barked eucalypts and amount of fallen logs and woody debris. Many of the hollow-bearing trees and stags represent suitable nesting habitat for the Brown Treecreeper.

**Rufous Bettong (*Aepyprymnus rufescens*) – vulnerable species TSC Act**

Rufous Bettong was observed during spotlighting near Site 3 in open grassland dominated by Blady Grass. Most of the Project Site is preferred habitat for the Rufous Bettong, particularly areas of open grassy understorey and open forest. The high diversity of understorey plant species provide plentiful food resources where it feeds on roots, tubers and fungi. No nest site(s) was discovered on the Project Site.

**Grey-headed Flying Fox (*Pteropus poliocephalus*) – vulnerable species under the TSC Act and EPBC Act.**

The species was observed on three consecutive nights in large numbers feeding on nectar from flowering Pink Bloodwood, particularly at Sites 1 and 3. There is no known roost camps on the Project Site, although there are known roost camps located near the town of Grafton and potentially Glenugie State Forest. Native vegetation

on the Project Site is likely to have productive flowering periods year round where a diversity of *Eucalyptus* and *Corymbia* tree species are present. According to Eby (2008), Pink Bloodwood, Forest Red Gum, Grey Box, Northern Grey Ironbark and Narrow-leaved Red Gum are recognised as significant food tree species in the blossom diet for the Grey-headed Flying Fox.

**Little Bentwing-bat (*Miniopterus australis*) - vulnerable TSC Act**

The Little Bentwing-bat was positively recorded from echolocation calls at Sites DL1 and FD1 near a drainage line and wetland habitat. These wet areas provide foraging habitat and it may roost and potentially breed in tree hollows found on the Project Site.

**Wallum Froglet (*Crinia tinnula*) – vulnerable TSC Act**

Wallum Froglet was heard calling discretely at Site DL2 and outside the Project Site near FD4. There was little to no water at each location. Although this species prefers Wallum sandy swamps and wet heath, it is not uncommon for this species to occur in disturbed environments away from water sources.

**Other threatened fauna and their habitat**

The Project Site provides suitable foraging and / or breeding and sheltering habitat for additional threatened fauna species as described in **Appendix A**. A number of Eucalypt tree species on the site are important nectar food resources for threatened fauna such as Little Lorikeet, Swift Parrot (*Lathamus discolo*r), Black-chinned Honeyeater (*Melithreptus gularis gularis*) and Yellow-bellied Glider (*Petaurus australis*). The nectar production and flowering reliability score values of all nectar producing trees on the Project Site is summarised in **Table 5-12**.

Table 5-12 Flowering time, reliability and nectar production of trees in the Project Site (Eby 2008)

| Nectar producing trees | Flowering time / Individual flowering length | Nectar production | Flowering reliability | Proportion of trees within the Project Site |
|---|---|---|---|---|
| Thin-leaved stringbark (*E. eugenioides*) | October to December / variable | N/A | N/A | 29.9% |
| Northern Grey ironbark (*E. siderophloia*) | August – January / 2 months | **0.91** | **0.60** | 21.8% |
| Small-fruited grey gum (*E. propinqua*) | December to March / 2 months | 0.47 | 0.15 | 19.6% |
| Pink Bloodwood (*C. intermedia*) | December to March / 2 months | **1** | **0.60** | 16% |
| Grey Box (*E. moluccana*) | February March / 2 months | 0.37-0.59 | 0.30-0.80 | 5.1 |
| Broad-leaved Ironbark (*E. fibrosa*) | October to July / 2 months | 0.70 | 0.30 | 4.4% |
| Narrow-leaved Red Gum (*E. seeana*) | August – November / 2 months | **0.77** | **0.80** | 1.1% |
| Spotted Gum (*C. henryi*) | October to January / 3 months | 0.70 | 0.30 | 1.1% |
| Forest Red Gum (*E. tereticornis*) | June – March / 2 months | **0.54-0.91** | **0.15-0.60** | 1% |
| *Scores in bold represent important nectar producing trees.* | | | | |

The wet meadow habitats consist of ephemeral freshwater and offer foraging, shelter, roosting and breeding habitat for a range of fauna, including amphibians, reptiles and waterfowl as well as micro- and macro-invertebrates. In the Project Site, these are represented as farm dams, ephemeral drainage lines and soaks. These are generally important refuge for threatened waterbirds such as Magpie Goose (*Anseranas semipalmata*), Black-neck Stork (*Ephippiorhynchus asiaticus*) and Brolga (recorded using the site). These also provide habitat for Wallum Froglet, also recorded using the site. Waterbodies are also important foraging areas for insectivorous micro-bats, where possible call recordings were made of Hoary Wattled Bat (*Chalinolobus nigrogriseus*), Eastern False Pipistrelle (*Falsistrellus tasmaniensis*), Greater Broad-nosed Bat (*Scoteanax rueppellii*) and Eastern Bentwing-bat (*Miniopterus schreibersii oceanensis*). Only a small portion (0.8 hectares) of this habitat with a low to moderate abundance of macrophytes is present in the Project Site.

Dry open forest habitats are widespread in scattered patches and larger contiguous patches on the western border of the Project Site. These habitats have succumbed to a high level of under-scrubbing where a mid-storey is absent. However, representations display important foraging and potential breeding habitat for a large number of threatened fauna. Dry forest consists of two PCTs (NR244 and NR246) comprising approximately 30.8 hectares. As presented in **Table 5-12**, these habitats produce important nectar resources for nectar feeding birds, mammals and invertebrates. This includes threatened fauna such as Little Lorikeet (identified on site), Swift Parrot, Yellow-bellied Glider and Black-chinned Honeyeater. There is also a wide range of microhabitats such as woody debris, a diversity of bark types, leaf litter, some rocks and bare soil which attract a variety of invertebrates as prey for many insectivorous fauna, including vulnerable (TSC Act) species Scarlet Robin, Varied Sittella and Hooded Robin. The grassy understorey provides a multitude of different native grass species which may also attract seed feeders such as the vulnerable (TSC Act) Diamond Firetails.

The Project Site provides a large number of hollow-bearing trees and dead standing trees (many appearing as a result of tree ring-barking). On average there are 5.3 hollow trees per hectare, this equates to approximately 164 hollow trees across the dry open forest on the Project Site. In total there is an estimated 204 hollow bearing trees (includes dead trees) throughtout the Project Site, which includes isolated paddock trees in cleared / modified habitat. All hollow trees have been mapped throughout the Project Site and are shown in **Figure 5-4**. In NSW, terrestrial vertebrate species that are reliant on tree hollows for shelter and nests include at least 46 mammals, 81 birds, 31 reptiles and 16 frogs (Gibbons and Lindenmayer 1997, Gibbons and Lindenmayer 2002). Of these, 19 are listed as threatened species (TSC Act or EPBC Act) which have either been identified in the Project Site or are considered likely to occur in the dry open forest or paddock trees and are shown in **Table 5-13**.

Table 5-13 Identified or potentially occurring threatened fauna dependent on hollow-bearing trees

| Common name | Scientific name | TSC Act | EPBC Act |
|---|---|---|---|
| Glossy Black-cockatoo | *Calyptorhynchus lathami* | V | |
| Brown Treecreeper (eastern subsp.) | *Climacteris picumnus picumnus* | V | |
| Little Lorikeet | *Glossopsitta pusilla* | V | |
| Powerful Owl | *Ninox strenua* | V | |
| Masked Owl | *Tyto novaehollandiae* | V | |
| Hoary Wattled Bat | *Chalinolobus nigrogriseus* | V | |
| Little Pied Bat | *Chalinolobus picatus* | V | |
| Spotted-tailed Quoll | *Dasyurus maculatus* | V | E |
| Eastern False Pipistrelle | *Falsistrellus tasmaniensis* | V | |
| Beccari's Freetail-bat | *Mormopterus beccarii* | V | |
| Eastern Freetail-bat | *Mormopterus norfolkensis* | V | |
| Southern Myotis | *Myotis macropus* | V | |
| Eastern Long-eared Bat | *Nyctophilus bifax* | V | |

| Common name | Scientific name | TSC Act | EPBC Act |
|---|---|---|---|
| Yellow-bellied Glider | *Petaurus australis* | V | |
| Squirrel Glider | *Petaurus norfolcensis* | V | |
| Brush-tailed Phascogale | *Phascogale tapoatafa* | V | |
| Yellow-bellied Sheathtail-bat | *Saccolaimus flaviventris* | V | |
| Greater Broad-nosed Bat | *Scoteanax rueppellii* | V | |

Open grassland habitats are dominant across the site and include isolated paddock trees. Although these areas have been modified with introduced pasture grasses and land clearing, they provide important habitat for nesting and foraging Rufous Bettong and are highly likely to be used by Coastal Emu.

There were no Koalas reported on the site and no evidence of Koalas using the habitats in the Project Site; however there are several records within the locality and Koala habitat assessments identified potential habitat based on present food tree proportions in the Project Site (refer to **Table 5-14**).

Table 5-14 Koala food tree species confirmed in the Project Site

| Species | Koala recovery plan (DEC 2009) | SEPP44 Koala Habitat Protection | Koala food tree proportions (%) at SAT survey sites | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Forest Red Gum (*E. tereticornis*) | Primary species | Yes | 0 | 0 | 0 | 5 | 0 | 25 | 10 |
| Small-fruited grey gum (*E. propinqua*) | Secondary species | No | 37 | 0 | 61 | 0 | 0 | 0 | 20 |
| Narrow-leaved Red Gum (*E. seeana*) | Secondary species | No | 0 | 0 | 6 | 0 | 0 | 0 | 0 |
| Grey Box (*E. moluccana*) | Secondary species | No | 0 | 0 | 6 | 10 | 10 | 70 | 63 |
| Thin-leaved stringbark (*E. eugenioides*) | Supplementary | No | 0 | 64 | 0 | 85 | 0 | 0 | 0 |

The Project Site contains four artificial waterbodies (i.e. man-made dams) with limited macrophyte cover and moderate to high levels of stock pugging. Although in low quality, the largest waterbody at the northern extent of the Project Site is known to provide foraging habitat for Brolga (listed vulnerable under TSC Act) and other common water birds, frogs and turtles.

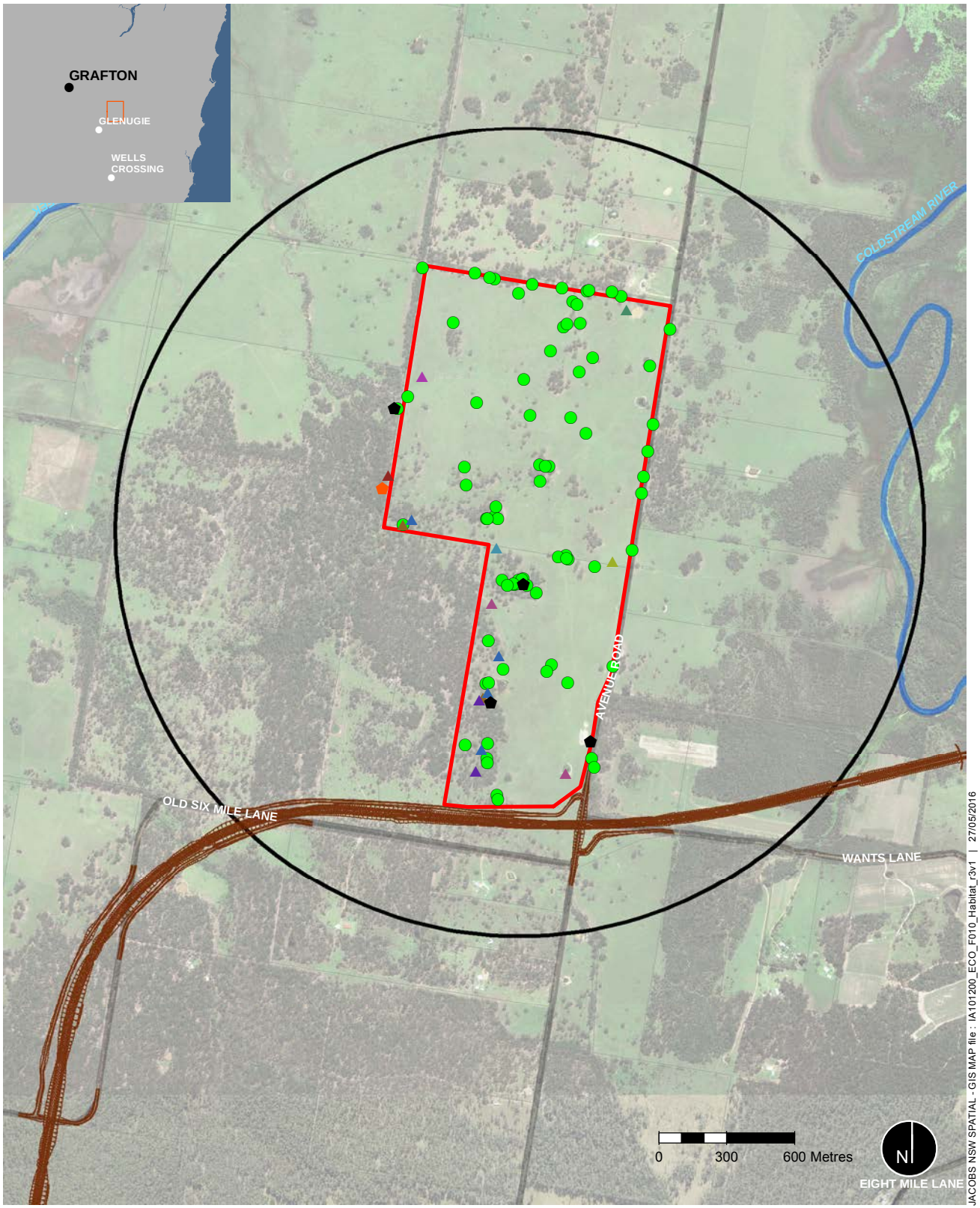
Two minor tributaries (1st and 2nd order streams) of the Coldstream River also occur on the Project Site and are in poor condition with low water quality as a result of cattle grazing, compaction and bank erosion. The introduced Plague Minnow (*Gambusia holbrooki*) was observed in shallow isolated pools.

### 5.3.3 Summary

A summary of the outcomes of the threatened species survey are described in **Table 5-15**.

Table 5-15 Summary of survey results

| Name | Credit class | Status | | Can the species withstand further loss? | Identification method details (survey, assumed to be present or expert report) | Details of sightings on Project Site / habitat features / associated PCT | Habitat area / ha present in Project Site |
|---|---|---|---|---|---|---|---|
| | | TSC Act | EPBC Act | | | | |
| Rufous Bettong (*Aepyprymnus rufescens*) | Species credit | V | - | Yes | Survey - confirmed | Recorded in open grassland near site 3 | 195 |
| Wallum Froglet (*Crinia tinnula*) | Species credit | V | - | Yes | Survey - confirmed | Calling in moist open grassland at site DL2 and recorded outside Project Site near site FD4. | 0.8 |
| Little Bentwing-bat (*Miniopterus australis*) | Species credit & Ecosystem credit | V | - | Yes | Survey - confirmed | Positively recorded on call echolocation analysis at Sites DL1 and FD1 near a drainage line and wetland habitat. | 31.6 |
| Brolga (*Grus rubicunda*) | Ecosystem credit | V | - | Yes | Survey - confirmed | A pair of birds recorded at site FD4 on fringes of wetland and foraging in open grassland | 0.8 |
| Glossy Black-Cockatoo (*Calyptorhynchus lathami*) | Ecosystem credit | V | - | Yes | Survey - confirmed | High density of chewed cones observed from *Allocasuarina* spp. trees on western fence line near site 2. | 30.8 |
| Little Lorikeet (*Glossopsitta pusilla*) | Ecosystem credit | V | - | Yes | Survey - confirmed | Recorded feeding on flowering *Eucalyptus* / *Corymbia* trees at sites 1 and 2. | 30.8 |
| Brown Treecreeper (*Climacteris picumnus*) | Ecosystem credit | V | - | Yes | Survey - confirmed | Recorded foraging on branches and trunks of *Eucalyptus* / *Corymbia* trees at sites 1 and 9. | 30.8 |
| Grey-crowned Babbler (eastern subspecies) (*Pomatostomus temporalis temporalis*) | Ecosystem credit | V | - | Yes | Survey - confirmed | Two family groups recorded in open areas and open forest. One group of nine at site 1 and second group of five near Plot 3. | 30.8 |
| Grey-headed Flying-fox (*Pteropus poliocephalus*) | Ecosystem credit | V | V | Yes | Survey - confirmed | Recorded in high abundance in all nocturnal surveys in all vegetation patches feeding on nectar from *C. intermedia* trees. | 30.8 |




## Legend

- The Project
- Grafton Bypass (proposed)
- Inner assessment circle
- Hollow trees and stags

**Migratory Species**

- Rainbow Bee-eater
- Satin Flycatcher

**Threatened Species**

- Brolga
- Brown Tree-creeper
- Glossy Black-cockatoo (chewed cones)
- Grey-crowned Babbler
- Grey-headed Flying Fox
- Little Bent-wing Bat
- Little Lorikeet
- Rufous Bettong
- Wallum Froglet

**Figure 5-4** | Threatened species records and habitat values on the development site

# 6. Matters of National Environmental Significance

## 6.1 Threatened species

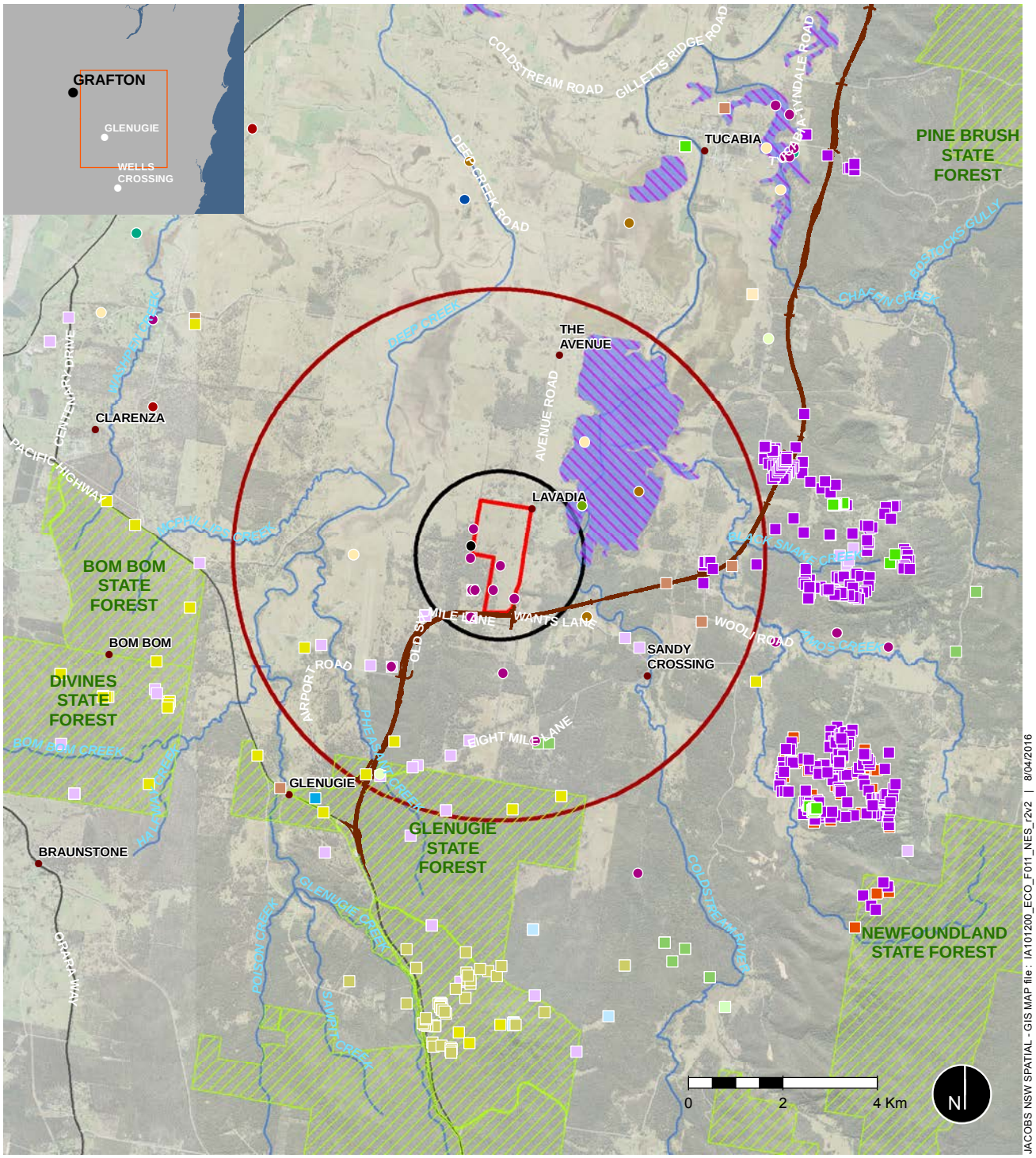
There are four MNES that are known or have potential to occur within the Project Site. This includes:

- Grey-headed Flying Fox listed as vulnerable under the EPBC Act and was commonly observed at night foraging in PCTs of the Project Site which are known from a roost camp near Grafton and potentially in Glenugie State Forest.
- Swift Parrot and Regent Honeyeater (*Anthochaera phrygia*) listed as endangered under the EPBC Act has potential foraging habitat in PCTs of the Project Site but not identified on site.
- Koala (*Phascolarctos cinereus*) listed as vulnerable under the EPBC Act has potential foraging habitat in PCTs of the Project Site but was not identified (see section 5.3.2).

## 6.2 Migratory species

Nineteen migratory species listed under the EPBC Act may potentially occur within the study area. Of these, 11 have a high to moderate potential of occurring in the Project Site. Many of these species are migratory birds which would likely utilise the open forest habitat to forage and breed. The full list of migratory species considered in this assessment is provided in **Table A-3** of **Appendix A** and the distribution of records in the study area are provided **Figure 6-1**.

The field surveys positively identified two migratory species in the Project Site. This includes numerous sightings of Rainbow Bee-eater (*Merops ornatus*) throughout forested areas and a pair of Satin Flycatchers (*Myiagra cyanoleuca*) on the western border near Site 2.




## Legend

- The Project
- Grafton Bypass (proposed)

Threatened species

- Australasian Bittern
- Four-tailed Grevillea
- Giant Barred Frog
- Glenugie Karaka
- Grey-headed Flying-fox
- Hairy Melichrus
- Koala
- Moonee Quassia
- Red Goshawk
- Sandstone Rough-barked Apple
- Spotted-tailed Quoll
- Square-fruited Ironbark
- Swift Parrot

Migratory species

- Cattle Egret
- Glossy Ibis
- Gull-billed Tern
- Latham's Snipe
- Marsh Sandpiper
- Rainbow Bee-eater
- Sharp-tailed Sandpiper
- White-bellied Sea-Eagle
- White-throated Needletail
- Satin Flycatcher

**Figure 6-1** | Records of threatened and migratory species (EPBC Act) - MNES

# 7. Avoidance and impact assessment

## 7.1 Avoidance and minimisation of impacts

The site surveys have identified that the Project Site exhibits PCTs that contain a threatened ecological community and habitat for threatened fauna species. Impacts on these biodiversity values have been avoided as much as practicable through the site selection phase by selecting a Project Site which is primarily cleared of native vegetation (i.e. approximately 84 per cent of the site is cleared and modified grazing land). Further details of the site selection process are explained below. The project planning objective of avoiding impacts to biodiversity as much as practicable are in keeping with the *Clarence Valley Biodiversity Strategy* objectives of intergenerational equity, the precautionary approach and biodiversity conservation (Clarence Valley Council (2010).

**Site selection**

One of the most important criteria was that the site needed to be easily accessible to the Grafton town centre within a 40 kilometre radius, of a sufficient size to accommodate the scale of development that is proposed and present minimal risks such as being prone to floods and bushfires or potentially containing Aboriginal or European heritage items or endangered species.

A number of government and privately owned sites were considered but were unsuitable for a range of reasons, as they were not of a sufficient size to accommodate the scale of the new facility and were located further away from the Grafton town centre. The sites also had a higher probability of containing heritage items relating to Aboriginal settlement, were bush fire prone and contained significant trees and other vegetation that required clearing as well as displacing potential endangered species from their habitats.

The Project Site was identified as the most suitable site as it best meets all of the criteria including:

- Ease of access to the Grafton town centre, particularly for suppliers during the construction phase and future employees and visitors.
- The size of the property, which is large enough to accommodate the scale of development that is proposed.
- The topography of the site, which is a relatively level.
- The site is not prone to floods and does not present a high risk of bushfires.
- It contains relatively few trees and other vegetation that would otherwise need to be cleared.
- There is little to no known potential Aboriginal or European heritage items.
- It is in single ownership.
- There is road access including frontage to a sealed road or close to a sealed access road.
- The zoning of the site would permit its future use as a correctional centre.

The site is zoned RU2 Rural Landscape, under the Clarence Valley Local Environmental Plan (LEP) 2011

**Minimising impacts**

The Project would involve clearing the majority of the Project Site, of which 30.3 hectares is native vegetation. Reasonable measures to avoid and minimise further impacts are proposed and include:

- Minimise vegetation / habitat clearing where possible to minimise impacts to threatened fauna species which utilise these habitats.
- Selecting a fire trail and break buffer to avoid removing vegetation and habitat.
- Selecting appropriate locations for the main construction access and placement of ancillary facilities that avoid tree removal where possible.

## 7.2 Assessment of direct impacts

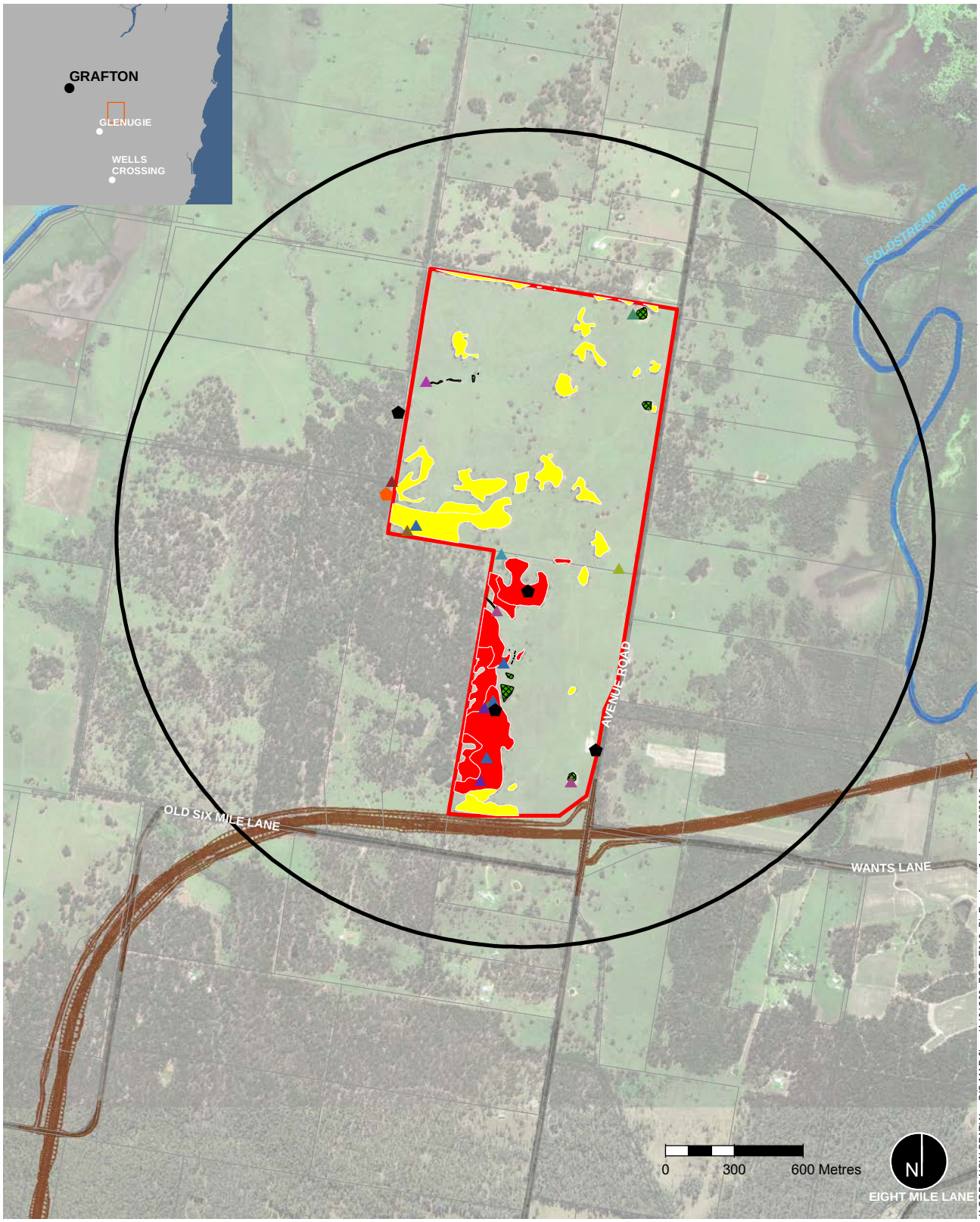
The assessment of direct and indirect impacts of the Project on biodiversity are summarised in this chapter. The potential for indirect impacts on biodiversity values are considered to be minimal given that much of the Project Site boundary is already largely cleared and edge effects would remain unchanged.

The Project would have direct and indirect impacts on a range of biodiversity values during construction of the Stage 1 works and operation of the Project. The area of direct impact includes the whole site, and includes the development zone and the asset protection zone, shown in **Figure 1-3**. The assessment has identified all biodiversity values for the entire Project Site; however the majority of vegetation clearing to be assessed for impacts occurs in the south west (i.e. Lot 1 DP 1190399) and centre of the site within the footprint as identified in **Figure 7-1**.

Although the Project Site is largely cleared, these cleared areas are a mix of derived native and exotic open grassland which provide habitat values for occasional visitors such as the threatened Brolga, Black-necked Stork and Coastal Emu and important habitat for Rufous Bettong. Remnant paddock trees are also important for potential roosting habitat for threatened bird and bat species. Due to the poor condition of these areas offsets would generally not be required but should be considered as part of the landscaping of the facility, particularly in association with farm dams / ponds.

### 7.2.1 Removal of native vegetation

Direct impacts to PCTs are assessed for vegetation and habitat removal. Under the current Proposal, clearing on the Project Site would encompass all portions of the site, including the PCTs, open grassland and small isolated patches and paddock trees. The total area of PCT removal is estimated to be approximately 30 hectares and is detailed in **Table 7-1**. Clearing of native vegetation constitutes a key threatening process listed under the TSC Act and EPBC Act.




## Legend

- The Project
- Grafton Bypass (proposed)
- Inner assessment circle

Migratory Species

- Rainbow Bee-eater
- Satin Flycatcher

Threatened Species

- Brolga
- Brown Tree-creeper
- Glossy Black-cockatoo (chewed cones)
- Grey-crowned Babbler
- Grey-headed Flying Fox
- Little Bent-wing Bat
- Little Lorikeet
- Rufous Bettong
- Wallum Froglet
- Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions

Vegetation

- Coastal freshwater meadows and forblands of lagoons and wetlands
- Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the North Coast
- Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the North Coast

**Figure 7-1** | Biodiversity values requiring assessment

Table 7-1 Impacts to native vegetation

| Zone | Plant Community Type | BVT code | Site value (refer Section 4.2) | Status | | Percent cleared in CMA | Area impacted (ha) |
|---|---|---|---|---|---|---|---|
| | | | | TSC Act | EPBC Act | | |
| 1 | Coastal freshwater meadows and forblands of lagoons and wetlands (PCT 782) | NR150 | 76.09 | EEC | - | 40 % | 0.7 |
| 2 | Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1209) | NR244 | 64.06 | - | - | 45 % | 8.0 |
| 3 | Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1209) | NR244 | 63.02 | - | - | 45 % | 7.0 |
| 4 | Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1211) | NR246 | 70.83 | - | - | 50 % | 10.6 |
| 5 | Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (PCT 1211) | NR246 | 47.40 | - | - | 50 % | 4.0 |
| | | **Sub-total PCT impacted** | | | | | **30.3 hectares** |
| | | **Sub-total PCT not impacted** | | | | | **1.3 hectares** |
| | | **Open grassland (exotic) and paddock trees** | | | | | 163.4 **hectares** |
| | | **Total Project Site Footprint** | | | | | 195 **hectares** |

### 7.2.2 Removal of Endangered Ecological Communities

The coastal freshwater meadows and forblands of lagoons and wetlands PCT on the Project Site is consistent with the *Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions* Endangered Ecological Community listing under the TSC Act. Approximately 0.7 hectares would be removed to accommodate the Project. The wet meadow habitat is restricted in area and distribution on the site, and is part of a much broader complex of ephemeral and permanent wetland habitats found commonly throughout the vast Coldstream River floodplain in this locality. This small loss is considered minor, particularly as the wetland habitat on site is in poor condition being impacted from a long history of grazing.

### 7.2.3 Removal of habitat for threatened fauna species

The potential impacts to threatened fauna and their habitat would occur during clearing of habitat in the short-term and over the long-term through reduction in availability of habitat for sedentary and transient local populations and possibly movements of species through the landscape. As presented in **Table 7-1**, the Project would result in the clearing 30.3 hectares of three PCTs, thereby resulting in an equivalent loss of habitat for fauna. The loss of habitat is relatively minor on a regional scale and confined to clearing vegetation patches on

edges of very large contiguous habitats. A number of threatened fauna species would also utilise the cleared and modified habitat including species such as Coastal Emu, Rufous Bettong, Black-necked Stork and Brolga.

**Loss of food resources**

The loss of Eucalypt forest habitat would reduce the availability of nectar resources in the locality and is likely to affect threatened nectar feeding birds such as Little Lorikeet, Black-chinned Honeyeater, the migratory Swift Parrot as well as mammals such as Squirrel Glider, and the Grey-headed Flying-fox. Further discussion on impacts to Grey-headed Flying-fox is discussed in **Section 7.5**. The dry sclerophyll forest habitats on the site support a range of *Eucalyptus* and *Corymbia* trees with different bark types and canopy structures of which are a source of multiple food resources such as seeds, lerps and gum / resin and attract a diversity of invertebrates. Impacts to this habitat would reduce foraging habitat for Brown Treecreeper, Grey-crowned Babbler, Varied Sittella, Squirrel Glider, Brush-tailed Phascogale and microchiropteran bats. Loss of forest habitat would also reduce prey (ground-dwelling, arboreal mammals, birds and reptiles) important for threatened raptor species such as Masked Owl, Powerful Owl, Little Eagle and Square-tailed Kite.

Foraging habitat for Glossy-Black Cockatoo would not be directly impacted as important food resources (i.e. *Allocasuarina* spp) are absent from the site.

**Loss of tree hollows and woody debris (sheltering and breeding habitat)**

There is an abundance of hollow-bearing trees and standing dead trees with a range of large and small hollows across the site. An estimated 184 hollow bearing trees and dead trees with hollows would be directly removed during construction. This is likely to impact on hollow dependent threatened fauna particularly Brush-tailed Phascogale, Squirrel Glider and possibly Forest Owls and Little Lorikeet. Loss of tree hollows is KTP listed under the TSC Act. A similar density of tree hollows was observed across the adjacent contiguous forest off the site, which is of similar age and structure. The loss of hollows would represent only a small portion of the hollows available for these threatened species through the adjoining landscape.

Open grassland habitats provide cover and shelter for Rufous Bettong. Such habitats are very common and widespread in this location and the local population is also considered widespread as a result.

An abundance of dead wood and logs is present in discrete areas on the Project Site and this is the result of ring-barking and felling trees. These provide excellent shelter for a range of ground-dwelling mammals and reptiles, particularly for providing cover where shrubs are absent. Loss of this habitat material is KTP listed under the TSC Act. As with hollow-bearing trees, logs and woody debris appear to be a common feature of the forest habitats in this location and were observed widely throughout the forest on adjoining land.

**Loss of ephemeral wet meadow (breeding and foraging habitat for wetland dependent species)**

The wet meadow habitat is restricted in area and distribution on the site, and is part of a complex of ephemeral and permanent wetland habitats found commonly throughout the vast Coldstream River floodplain in this locality. These wet meadow habitats support sedges and reeds which provide shelter and food resources for wide-ranging and transient wetland and migratory bird species, and for sedentary wetland dependent fauna species as frogs. They may be used as important refuge or dispersal habitat for frogs. The Project is likely to remove these habitats from the site and therefore may impact on small populations of the threatened Wallum Froglet. Similar and indeed better quality habitats for this species are widespread through the locality and the small loss is considered negligible. Similarly, the loss of habitat is expected to have minimal longer-term impacts on local populations of wetland birds and migratory birds due to the abundance of these habitats throughout the landscape and transient movements of the species.

There is no ‘critical habitat’ as listed under the TSC Act identified in the Project Site for threatened biota.

### 7.2.4 Removal of threatened plants

The targeted surveys confirmed that no threatened plant species are present on the Project Site. Several endangered Weeping Paperbark individuals occur in close proximity to existing cleared areas on the eastern border of the site, along Avenue Road, but are unlikely to be affected by the Project.

## 7.3 Assessment of indirect impacts

### 7.3.1 Aquatic impacts

There are no Class 3 or 4 waterways on the site. Impacts to aquatic biodiversity values are considered to be minor given that farm dams and drainage lines are already in poor condition and are likely to remain at their current state or re-used. No impacts to important waterways, wetlands and / or key fish habitats are expected. There is a small potential for construction works to increase sedimentation and erosion along drainage lines and has been considered for mitigation in **Chapter 9**.

### 7.3.2 Groundwater dependent ecosystems

The desktop review found no identified groundwater dependent ecosystems on the Project Site. The Project is not expected to impact or change groundwater flows providing that impacts to possible groundwater interactions at or near drainage lines is kept to a minimal. Further on site investigations may be required to confirm any interaction with groundwater.

### 7.3.3 Changes to hydrology

The Project is unlikely to impact on present surface or groundwater hydrology, given the lack of major rivers or streams on the Project Site. Minor tributaries of the Coldstream River are present as drainage lines located at the western boundary and are in poor condition with a low potential for impacts from the Project.

### 7.3.4 Fragmentation of identified biodiversity links and habitat corridors

One connecting link was identified from native vegetation within the Project Site traversing south west-north east direction into a large area biodiversity link (i.e. 2 923 hectares). Native vegetation on the Project Site is proposed for clearing and the linkage would not be crossed.

The Clarence Valley Biodiversity Strategy (Clarence Valley Council 2010) identifies the Coldstream wetlands as regionally important habitat, these occur around 0.5 km to the east of the Project Site. Existing vegetated corridors and links which occur in lands surrounding the wetlands are therefore important regional habitat corridors.

The construction of the new Pacific Highway to the south of the Project Site is likely to have cumulative impacts on the connecting link by reducing ground movement of fauna heading north-south and restricting fauna passage to the south west-north east.

On site fragmentation is considered to be minimal across the Project Site, given that existing vegetation patches are currently isolated. However, the operation stage of the project is likely to create a barrier with the installation of tall security fencing and maintained lawns which may inhibit or reduce movement of Coastal Emu and Rufous Bettong.

### 7.3.5 Edge effects on adjacent native vegetation and habitat

While the clearing limits of the Project Site already contain edge effects adjacent to different land use regimes from neighbouring properties, removal of native vegetation along the western boundary may increase edge effects. Impacts would affect native vegetation on adjacent properties, including alteration of light penetration from loss of canopy and increase edge to area ratio improving conditions for weed invasion.

### 7.3.6 Injury and mortality of fauna

Clearing of native vegetation, including open grasslands and wetland habitat would result in fauna injury and /or mortality during construction and operation. Macropods would have a chance to evade vegetation clearing and would likely seek refuge in adjacent habitats. The threatened Rufous Bettong would need to re-locate from site depending on the location of nesting sites and home range. There are potential vehicle collisions with

macropods, including the Rufous Bettong as well as Coastal Emu as a result of increased construction and operational traffic, particularly at dawn and dusk.

Birds are generally mobile and can move quickly to avoid habitat removal. Other species such as frogs, reptiles and some ground dwelling mammals are less mobile and may not be able to re-locate resulting in injury or mortality.

### 7.3.7 Noxious weeds and weeds of national significance

There were 39 exotic flora species recorded, with four being noxious weeds identified by the DPI for the Clarence Valley LGA and two are Weeds of National Significance. These are shown in **Table 7-2** with their control class and control requirement. These species were observed in low to moderate abundance. Lantana is listed as a KTP under the TSC Act for its ability to invade, establish and spread easily, particularly on disturbed sites associated with edge adjoining native habitats.

Table 7-2 Noxious weeds recorded in the study area

| Species | Class | Control requirement | Weed of National Significance |
|---|---|---|---|
| Annual ragweed (*Ambrosia artemisiifolia*) | 5 | Restricted Plant<br>The requirements in the NW Act for a notifiable weed must be complied with. Low abundance. | No |
| Groundsel bush (*Baccharis halimifolia*) | 3 | Regionally Controlled Weed<br>The plant must be fully and continuously suppressed and destroyed. Low abundance. | No |
| Lantana (*Lantana camara*) | 4 | Locally Controlled Weed<br>The growth of the plant must be managed in a manner that continuously inhibits the ability of the plant to spread. Low abundance in the west of the site. | Yes |
| Fireweed (*Senecio madagascariensis*) | 4 | Locally Controlled Weed<br>The plant must not be sold, propagated or knowingly distributed. Moderate abundance and widespread. | Yes |

### 7.3.8 Invasion and spread of pests

There is a high potential for animal pests on the Project Site, given its proximity to rural houses and disturbed landscapes. A domestic cat (*Felis catus*) was recorded in the Project Site and the increase in human activity has potential to increase cat presence. Predation by feral cats has a high potential on site and is listed a KTP under both the EPBC Act and the TSC Act.

Plague Minnow (*Gambusia holbrooki*) was observed and is expected to occur in most waterbodies on the Project Site. This species is a significant predator on native fish and tadpoles and can proliferate in disturbed aquatic habitats. Plague Minnow is listed a KTP under the TSC Act.

Other pest species with a high potential to occur on the Project Site post-construction include:

- European Red Fox (*Vulpes vulpes*) - KTP under both the EPBC Act and the TSC Act.
- European Rabbit (*Oryctolagus cuniculus*) - KTP under both the EPBC Act and the TSC Act.
- Feral dogs.

### 7.3.9 Invasion and spread of pathogens and disease

In NSW there are infectious pathogens that have the potential to impact on biodiversity. Any activities involving the movement of soil and equipment over large areas are a potential risk for spread and infection. Three pathogens are considered a risk to the project and are listed as a key threatening process under either the EPBC Act and/or TSC Act including:

- Dieback caused by Phytophthora (EPBC Act and TSC Act).
- Infection of frogs by amphibian chytrid fungus causing the disease chytridiomycosis (EPBC Act and TSC Act).
- Introduction and establishment of exotic Rust Fungi of the order Pucciniales on plants of the family Myrtaceae (TSC Act).

There is a moderate likelihood for the potential risk of pathogens on the Project Site during construction given the requirements to excavate and transport soil. There is a particular risk for site access routes near waterways or floodplain habitats where the risk of transmission is higher. Pathogen management should therefore be implemented throughout all stages of construction as a precaution. The construction environmental management plan will need to address the following potential disease pathogens.

**Phytophthora (*Phytophthora cinnamomi*)**

Phytophthora is soil-borne fungus that causes tree death (dieback). It attacks the roots of a wide range of native plant species. Spores can be dispersed over relatively large distances by surface and sub-surface water flows. Infected soil/root material may be dispersed by vehicles (e.g. earth moving equipment).

**Myrtle rust (*Uredo rangelli*)**

Myrtle rust is an introduced fungus that attacks the young leaves, short tips and stems of Myrtaceous plants eventually killing the plant. Myrtle rust is an air-borne fungus that may be spread by moving infected plant material, contaminated clothing, equipment and vehicles.

**Chytrid fungus (*Batrachocytrium dendrobatidis*)**

Chytrid fungus is an infectious disease that affects amphibians worldwide causing death. It is a water-borne fungus that may be spread as a result of handling frogs or through cross contamination of water bodies by vehicles and workers.

### 7.3.10 Noise, light, dust and vibration

During the construction and operation of the new correctional facility, effects of noise, light, dust and vibration may potentially result in indirect impacts to biodiversity values. Construction work, including increased traffic and operation of heavy machinery would increase these effects over the 6 to 12 months construction period of Stage 1, but would be temporary in nature. Increased operational lighting along the perimeter of the facility and access roads and car parks is unlikely to have substantial effects on nocturnal bird and mammal activity or movement, given the 100 metre APZ buffer around the new facility from surrounding habitat and the presence of the new highway adjacent to the site.

### 7.3.11 Cumulative impacts

The construction of the new Pacific Highway to the south of the Project Site is likely to have cumulative impacts on the connecting link by reducing ground movement of fauna heading north-south and only restricting fauna passage to the south west-north east. This will also significantly reduce the level of native vegetation cover in the region. Construction and operation of the Project will have minor cumulative contribution to the impacts on biodiversity in the locality.

## 7.4 Areas not requiring assessment

The Project Site largely cleared of forest habitat and consists of cleared and modified grazing areas (representing around 84 percent of the Project Site) that comprise of a mix of derived native and exotic grasses. These dominant habitat types are known to be utilised on an occasional basis for foraging and movement by wide ranging species such as Coastal Emu, Brolga and Black-necked Stork. These species utilise large parts of the floodplain. This cleared and modified habitat is also preferred habitat for Rufous Bettong and this species is widespread is the locality utilising grazed grasslands and adjacent forest habitats. The loss of habitat for these species is expected to have minimal long-term impact, while a small number of Rufous Bettong may become displaced during clearing for construction.

Large remnant paddock trees are potentially important in providing roosting / breeding microhabitats for hollow-dependent threatened species, particularly breeding birds and bats and may also provide important source of nectar due to their size and nesting opportunities for large raptors.

As a result of the generally poor condition of the cleared and modified habitat and the lack of important resources for threatened species, these areas would generally not require offsets. However there is scope to retain a portion of this habitat as part of the landscaping at the facility, particularly in association with farm dams / ponds and this should be considered.

## 7.5 Matters for further consideration

The SEARs for the Proposal and the biodiversity assessment has not identified any matters for further considerations for impacts to landscape features, native vegetation and / or species and populations.

## 7.6 Matters of National Environmental Significance (EPBC Act)

Expected impacts of the project on MNES are summarised below (refer to **Table 7-3**, **Table 7-4** and **Table 7-5**). This information provides an overview of the impacts for further assessment of significance for MNES which is provided in Appendix E. There were no nationally listed Threatened Ecological Communities identified on the site.

### 7.6.1 Grey-headed Flying Fox (*Pteropus poliocephalus*)

Table 7-3 Summary of potential impacts to Grey-headed Flying-fox

| Impact considerations | Grey-headed Flying-fox (Vulnerable) |
|---|---|
| *Type of impact* | Loss of habitat |
| *Nature of impact* | Direct |
| *Scale of impact* | Removal of 29.6 ha of two PCTs (NR244 and NR246) which comprises known foraging habitat. There are no roosting camps currently on the Project Site.<br>The Project will not affect the movements of this wide-ranging species. |
| *Intensity of impact* | Minor. Similar foraging habitat for this species is widespread throughout the locality including around 3,000 ha contiguous with the site identified from within the 1,000 hectare assessment circle.<br>The Project Site does not contain roosting habitat critical to survival of the species as defined in the species recovery plan (DEC 2009). The nearest known roost camps are at Glenugie State Forest approximately 3.5 km from the site, Suzan Island near Grafton < 17 km and Wooli approximately 19 km from the site.<br>The site does contain foraging habitat critical to survival as defined in the species recovery plan (DEC 2009) due to the fact that it supports a number of criteria under the definition:<br>· Productive during winter and spring when food bottlenecks have been |

| Impact considerations | Grey-headed Flying-fox (Vulnerable) |
|---|---|
| | identified.<br>· Known to support populations of >30,000 individuals within an area of 50 km radius of a roost (the maximum foraging distance of an adult)<br>· Productive during the final weeks of gestation and during the weeks of birth, lactation and conception (September to May)<br>· Known to support a continually occupied camp. |
| *Duration of impact* | Short-term for construction, long-term for permanent facility |
| *Likely significance of impact* | Not significant |
| *Confidence in assessment* | High, impacts are predictable |

### 7.6.2 Swift Parrot (*Lathamus discolour*) and Regent Honeyeater (*Anthochaera phrygia*)

Table 7-4 Summary of potential impacts to Swift Parrot and Regent Honeyeater

| Impact considerations | Swift Parrot (Endangered), Regent Honeyeater (Critically Endangered) |
|---|---|
| *Type of impact* | Loss of habitat |
| *Nature of impact* | Direct |
| *Scale of impact* | Removal of 29.6 ha of two PCTs (NR244 and NR246) which comprises low potential foraging habitat for these wide-ranging species. Not all areas of the forest habitat would be accessed as species are mainly dependent on winter flowering eucalypts and there are no breeding populations in this location. The small area habitat on the site is very minor compared to the overall contiguous areas of forest surrounding the site to the west and south.<br>The proposal will not affect the movement of these species |
| *Intensity of impact* | Minor. Similar habitat for these species is very widespread throughout the locality and region including around 3,000 ha contiguous with the site identified from within the 1,000 hectare assessment circle. The species is only a rare vagrant to the area. |
| *Duration of impact* | Short-term for construction, long-term for permanent facility |
| *Likely significance of impact* | Not significant |
| *Confidence in assessment* | High, impacts are predictable |

### 7.6.3 Koala (*Phascolarctos cinereus*)

Table 7-5 Summary of potential impacts to Koala

| Impact considerations | Koala (*Phascolarctos cinereus*) (Vulnerable) |
|---|---|
| *Type of impact* | Loss of habitat and injury and mortality |
| *Nature of impact* | Direct and Indirect |
| *Scale of impact* | Loss of habitat associated with around 29.6 ha of two PCTs (NR244 and NR246). There are five reported koala food tree species known from the site including one primary species, three secondary species and one supplementary species. The actual loss of habitat is minor on a local and regional scale based on the size and availability of similar habitats. A large-scale study of koala presence and activity in |

| Impact considerations | Koala (*Phascolarctos cinereus*) (Vulnerable) |
|---|---|
| | the study area as part of the W2B Pacific Highway upgrade (RMS 2014) did not identify any significant activity or populations in this location.<br>Given the proposed increased traffic associated with the facility this would increase the risk of vehicle strike with Koalas if they are indeed present. A detailed mitigation and connectivity strategy has been developed for the W2B Pacific Highway upgrade that addresses road strike and connectivity for this species; it is likely that the project would have minor additional impact as most users would be accessing the site from the Pacific Highway to be constructed.<br>The proposal will not impact on an important movement corridor or affect the movements of the species. |
| *Intensity of impact* | Minor. Similar habitat for this species is very widespread throughout the locality and region including 3000 ha contiguous with the site. |
| *Duration of impact* | Short-term for construction, long-term for permanent facility |
| *Likely significance of impact* | Not significant |
| *Confidence in assessment* | High, impacts are predictable |

Consideration was given to the Koala habitat assessment tool from the *Draft Koala Referral Guidelines* (Commonwealth Department of the Environment 2013). The document guides issues for consideration in assessing the impacts of an action on Koala and the need to refer the action. This includes determining whether the Project Site contains critical Koala habitat, whether the proposal would threaten the viability of such habitat and whether the proposal is consistent with the interim recovery objectives of the species.

In summary, the assessment used the following approach:

- Reviewing the Atlas of Living Australia, NSW BioNet, the Australian Koala Foundation Koala map, Commonwealth Protected Matters Search Database, and previous reports prepared for the W2B Pacific Highway Upgrade, to establish the occurrence of a Koala population in the study area.
- Collation of information on the vegetation composition in the Project Site and analysis in relation to Koala habitat. This involved a review of CRAFTI vegetation mapping (Resource and Conservation Division, 2001) followed by a Koala survey and habitat assessment, including an assessment of vegetation condition and structure.
- SAT surveying for Koala to provide an indication of the extent and frequency of habitat use and identify the relative importance of the habitat on the site for Koala. This was supported by walked and vehicle transect spotlighting.
- Determining the landscape context of the Koala habitat in the study area in terms of habitat connectivity.
- Identifying existing and future threats to survival of Koalas in the Project Site.
- Identifying the recovery value of the habitat in the study area in accordance with the interim recovery objectives for genetically diverse, disease-free, breeding Koala populations on the coast.

The habitat assessment tool has reported a moderate score of 6 (refer to **Table 7-6**) which confirms the presence of habitat critical to the survival of Koalas within the Project Site and contiguous forest habitats, although the population is considered a low-density population based on surveys conducted for the broader W2B Pacific Highway Upgrade (RMS 2014).

Table 7-6 Koala habitat assessment tool (DotE 2013)

| Attribute | Score | Habitat assessment | |
|---|---|---|---|
| Koala occurrence | 0 | Desktop | EPBC PMST report identified the Koala as 'known to occur' in the study locality.<br>The Atlas of NSW Wildlife identifies 5 records from the last 17 years within 5 km of the Project Site.<br>There are no records within 2 km of the Project Site within the last 5 years. |
| | | On-ground | Surveys undertook a total of 7 scat search plots (SAT), 1.4 km of walked spotlighting and 5 km of vehicle spotlighting.<br>No Koala evidence was observed survey surveys.<br>More extensive surveys were conducted for the W2B Pacific Highway Upgrade and identified low Koala activity to the north east of this location near Tucabia over 5 km from the site. The species is also known from Glenugie SF in low numbers around 15 km south |
| Vegetation structure and composition | +2 | Desktop | A review of CRAFTI vegetation mapping (Resource and Conservation Division, 2001) indicates that there is potentially Koala food trees surrounding the Project Site, including Forest Red Gum (*E. tereticornis*).<br>Aerial imagery of the Project Site and surrounding lands indicates a vegetation structure with an open forest canopy. |
| | | On-ground | Field surveys undertook a total of 7 Koala habitat assessments in dry forest habitat. The Koala habitat in the Project Site comprises four koala food trees relevant to the North Coast (DECC, 2008) and include:<br>One primary food tree (*E. tereticornis*) species (5.7% total mean tree proportion).<br>Three secondary food tree (*E. propinqua*, *E. seeana* & *E. moluccana*) species (13.7% total mean tree proportion).<br>One supplementary food tree (*E. eugenioides*) species (21.3 % total mean tree proportion).<br>All forest habitats lack a mid-storey structure. |
| Habitat connectivity | +2 | The Koala habitat is part of a contiguous vegetation landscape > 1000 ha extending into Glenugie State Forest to the south of the Project Site. There is a narrow (100 m) corridor (as a result of agricultural development) linking Koala habitat to larger vegetation patches. This excludes current biodiversity links intersecting the approved Pacific Highway alignment directly south of the Project Site. | |
| Key existing threats | +1 | Desktop | No accessible information sources available on Koala road kill or level of wild dog activity. The Atlas of Living Atlas identifies 7 records of wild dog or dingo within 5 km of the Project Site. In-house data suggests notable dog activity in the region. |
| | | On-ground | No evidence of Koala mortality from vehicle strike or dog attack. |
| Recovery value | +1 | Given the large size of contiguous landscape, vegetation composition and level of threats present in the study locality, the habitat is considered likely to be important for the recovery of the Koala. However, the cumulative impacts associated with the existing dual carriageway (to the south west) and approved construction of the Pacific Highway Upgrade (to the south and east) would eventually reduce Koala movement to large contiguous vegetation patches. This result also considers the loss of biodiversity values on the Project Site.<br>The status of Koala disease in the region is unknown. | |
| Total score | 6/10 | Habitat in the impact area is critical to the survival of Koalas | |

### 7.6.4 Migratory species

Two migratory bird species were identified on the site from the field survey. A number of other species have been reported from the Project Site and there potential presence in the habitat on the site is assessed in **Table 7-7.**

Table 7-7 Assessment of migratory bird species likelihood of occurrence

| Species | Preferred habitat | Likely presence |
|---|---|---|
| Osprey (*Pandion haliaetus*) | Occur in littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. They are mostly found in coastal areas but occasionally travel inland along major rivers | Has potential to nest on the site |
| Great Egret (*Egretta alba*) | Prefer shallow water, particularly when flowing, but may be seen on any watered area, including damp grasslands. | Commonly reported in the Clarence Valley wetlands (Smith 2011). Has potential to use the wet meadow habitat |
| Cattle Egret (*Ardea ibis*) | Is found in grasslands, woodlands and wetlands particularly in coastal areas. It also uses pastures and croplands, especially where drainage is poor. Is often seen with cattle and other stock. | Commonly reported in the Clarence valley wetlands (Smith 2011). Has potential to use the wet meadow habitat |
| White-bellied Sea-Eagle (*Haliaeetus leucogaster*) | Forages over large open fresh or saline waterbodies, coastal seas and open terrestrial areas (Higgins 1999; Simpson & Day 1999). Breeding habitat consists of tall trees, mangroves, cliffs, rocky outcrops, silts, caves and crevices and is located along the coast or major rivers. Breeding habitat is usually in or close to water, but may occur up to a kilometre away (Marchant & Higgins 1999). | Has potential for transient use of the site |
| Satin Flycatcher (*Myiagra cyanoleuca*) | Associated with drier eucalypt forests, absent from rainforests (Blakers et al. 1984), open forests, often at height (Simpson & Day 1999). | Recorded on the Project Site |
| White Throated Needletail (*Hirundapus caudacutus*) | Forages aerially over a variety of habitats usually over coastal and mountain areas, most likely with a preference for wooded areas (Higgins 1999; Simpson & Day 1999). Has been observed roosting in dense foliage of canopy trees, and may seek refuge in tree hollows in inclement weather (Higgins 1999). | May occur in all forested habitats |
| Rainbow Bee-eater (*Merops ornatus*) | Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). Usually occurs in open, cleared or lightly-timbered areas, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages (Woinarski et al. 1988). | Recorded on the Project Site |
| Black-faced Monarch (*Monarcha melanopsis*) | Occurs in rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984). | May occur and utilise the forest habitat |

| Species | Preferred habitat | Likely presence |
|---|---|---|
| Rufous Fantail (*Rhipidura rufifrons*) | Frequents wet forests, less often open forests and woodlands (Simpson & Day 1999). May occur in open woodland and forest habitats throughout the north coast region. | May occur and utilise the forest habitat |
| Lathams Snipe (*Gallinago hardwickii*) | Occurs in permanent and ephemeral wetlands, usually inhabiting open, freshwater wetlands with low, dense vegetation (eg swamps, flooded grasslands or heathlands, around bogs and other water bodies) (Frith et. al. 1977). However, they can also occur in habitats with saline or brackish water, in modified or artificial habitats, and in habitats located close to humans or human activity (Frith et al. 1977) | May occur and utilise the wet meadow habitat |
| Australian Painted Snipe (*Rostratula australis*) | Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage treatment plants and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum Muehlenbeckia or canegrass or sometimes tea-tree (Melaleuca). | May occur and utilise the wet meadow habitat |
| Spectacled Monarch (*Monarcha trivirgatus*) | Occurs in rainforest and eucalypt forests, feeding in tangled understorey (Blakers et al. 1984). | May occur and utilise the forest habitats |

**Assessment of impacts on migratory species**

The Commonwealth Significant Impact guidelines under the EPBC Act (DotE 2013) define an area of 'important habitat' for a migratory species has:

- Habitat used by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, and/or
- Habitat that is of critical importance to the species at particular life-cycle stages, and/or
- Habitat used by a migratory species which is at the limit of the species range, and/or
- Habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species. Some factors that should be considered include the species' population status, genetic distinctiveness and species specific behavioural patterns (for example, site fidelity and dispersal rates). These factors have been considered in assessing the potential impacts on the species identified in **Table 7-7**.

*Substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species*

As discussed above potential habitat for these migratory species may occur widely throughout the study area particularly in floodplain areas of the Coldstream River and Coldstream wetlands. However, there is limited data on the size and distribution of local populations. Records from the Atlas of NSW Wildlife show that sightings are very widespread across the region in particular along the eastern foothills of the Great Dividing Range and low flat coastal regions. Many records are associated Nationally Important Wetlands which are not within the project

boundary. There is no evidence to suggest that an ecologically significant proportion of the population of any identified migratory species exists within the project boundary.

*Result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species*

The potential for weed invasion has been considered within the project impacts and mitigation strategy. The management of invasive species would be managed under the construction environmental management plan and during operation of the facility.

*Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.*

As discussed there is no evidence to suggest that an ecologically significant proportion of the population of a migratory species exists within the project boundary.

### 7.6.5 Assessment of Significance MNES

An assessment of significance was conducted for MNES considered species and communities that have a moderate to high likelihood of occurring on the Project Site (**Appendix E**). This includes four threatened species. No threatened flora or ecological communities were identified on the site. The assessment has concluded that the project is unlikely to have a significant impact on a MNES.

## 7.7 Impact summary

This section summarises all anticipated impacts requiring assessment under the FBA and other impacts not covered in FBA (refer **Table 7-8**). A summary of proposed mitigation is also included to demonstrate how impacts intend to be mitigated, with further details on mitigation provided in **Chapter 8**.

Table 7-8 Summary of impacts and proposed mitigation

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Removal of native vegetation | Plant Community Types (30.3 ha) | Direct | Site based | Long term, permanent | · Clearing of native vegetation (TSC Act)<br>· Land clearance (EPBC Act) | · Remove in stages and retain vegetation buffer around facility | Yes |
| | Isolated paddock trees and derived and exotic grasslands | Direct | Site based | Long term | · Loss of hollow-bearing trees (TSC Act) | · Retain if in buffer around facility.<br>· include nest boxes in buffer area | No |
| Removal of TECs | Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions | Direct / Indirect | Site based | Short / pre and during construction | · Clearing of native vegetation (TSC Act)<br>· Land clearance (EPBC Act) | · Retain if in buffer around facility.<br>· Sediment control during construction | Yes |
| Removal of threatened fauna species habitat and habitat features | Grassy forests and open grassland:<br>· Rufous Bettong<br>· Coastal Emu population<br>· Brolga<br>· Woodland birds | Direct | Site based | Long term | · Clearing of native vegetation (TSC Act)<br>· Land clearance (EPBC Act)<br>· Loss of hollow-bearing trees (TSC Act)<br>· Removal of dead wood and dead trees (TSC Act) | · Remove in stages and retain vegetation buffer around facility where possible.<br>· Include nest boxes in retained habitat in buffer area<br>· Revegetation / landscaping in buffer areas using native species | Yes |

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Removal of threatened fauna species habitat and habitat features | Hollow bearing trees and dead standing trees:<br>· Barking Owl<br>· Masked Owl<br>· Powerful Owl<br>· Glossy Black-Cockatoo<br>· Yellow-bellied Glider<br>· Squirrel Glider<br>· Little Bentwing-Bat<br>· Eastern Bentwing-bat<br>· Eastern Freetail-bat<br>· Greater Broad-nosed Bat<br>· Hoary Wattled Bat<br>· Yellow-bellied Sheathtail-bat<br>· Beccaris Freetail-bat<br>· Brush-tailed Phascogale<br>· Woodland birds | Direct | Site based | Long term | · Clearing of native vegetation (TSC Act)<br>· Land clearance (EPBC Act)<br>· Loss of hollow-bearing trees (TSC Act)<br>· Removal of dead wood and dead trees (TSC Act) | · Remove in stages and retain vegetation buffer around facility where possible.<br>· Include next boxes in retained habitat in buffer area<br>· Revegetation / landscaping in buffer areas using native species | Yes |
| Removal of threatened fauna species habitat and habitat features | Farm dams, soaks and drainage lines<br>· Wallum Froglet<br>· Brolga<br>· Black-necked Stork | Direct | Site based | Short / pre and during construction | · Infection of frogs be amphibian chytrid cause the disease chytridomycosis (TSC Act)<br>· infection of amphibians with chytrid fungus resulting in chytridomycosis (EPBC Act) | · Retain habitat in buffer area where possible<br>· Sediment control during construction<br>· Hygiene protocol during construction | Yes |

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Removal of threatened fauna species habitat and habitat features | Nectar and gum producing trees and plants:<br>· Grey-Headed Flying Fox<br>· Little Lorikeet<br>· Black-chinned Honeyeater<br>· Swift Parrot<br>· Yellow-bellied Glider | Direct | Site based | Long term | · Clearing of native vegetation (TSC Act)<br>· Land clearance (EPBC Act)<br>· Loss of hollow-bearing trees (TSC Act)<br>· Removal of dead wood and dead trees (TSC Act) | · Remove in stages and retain vegetation buffer around facility where possible.<br>· Include next boxes in retained habitat in buffer area<br>· Revegetation / landscaping in buffer areas using native species | Yes |
| Removal of threatened fauna species habitat and habitat features | Open forest with dead wood and logs:<br>· Brush-tailed Phascogale<br>· Bush Stone-curlew | Direct | Site based | Long term | · Clearing of native vegetation (TSC Act)<br>· Land clearance (EPBC Act)<br>· Loss of hollow-bearing trees (TSC Act)<br>· Removal of dead wood and dead trees (TSC Act) | · Retain logs and move into buffer area during clearing works | Yes |

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Removal of threatened fauna species habitat and habitat features | PCTs:<br>· Grey-crowned Babbler<br>· Spotted-tailed Quoll<br>· Square-tailed Kite<br>· Little Eagle<br>· Varied Sittella<br>· Scarlet Robin<br>· Speckled Warbler<br>· Hooded Robin<br>· Brown Treecreeper<br>· Barred Cuckoo-shrike | Direct | Site based | Long term | · Clearing of native vegetation (TSC Act)<br>· Land clearance (EPBC Act)<br>· Loss of hollow-bearing trees (TSC Act)<br>· Removal of dead wood and dead trees (TSC Act) | · Remove in stages and retain vegetation buffer around facility where possible.<br>· Revegetation / landscaping in buffer areas using native species | Yes |
| Removal of threatened plants | None | N/A | N/A | N/A | N/A | N/A | No |
| Aquatic impacts | Farm dams, soaks and drainage lines | Direct / Indirect | Local | Short / pre and during construction | · Alteration to the natural flow regime of rivers and streams and their floodplains and wetlands (TSC Act) | · Retain habitat in buffer area where possible<br>· Sediment control during construction | Yes |
| Groundwater dependent ecosystems | None | N/A | N/A | N/A | N/A | N/A | No |

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Changes to hydrology | Farm dams, soaks and drainage lines | Direct / Indirect | Local | Short / pre and during construction | Alteration to the natural flow regime of rivers and streams and their floodplains and wetlands | · Retain habitat in buffer area where possible<br>· Sediment control during construction<br>. | Not accounted for in loss of habitat |
| Fragmentation of identified biodiversity links and habitat corridors | All native vegetation affecting wide-ranging species such as Rufous Bettong and Coastal Emu population. | Direct | Site | Long term | N/A | · Remove in stages and retain vegetation buffer around facility where possible.<br>· Revegetation / landscaping in buffer areas using native species | Not accounted for in loss of habitat |
| Edge effects on adjacent native vegetation and habitat | Plant Community Types | Indirect | Local | Short term | N/A | Revegetation / landscaping in buffer areas using native species | Not accounted for in loss of PCTs |
| Injury and mortality of fauna | Macropods, frogs, reptiles | Direct / Indirect | Local | Short term / pre, during or post construction | N/A | Pre-clearing and clearing process to minimise impacts to fauna from tree removal | No |

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Invasion and spread of weeds | PCTs and fauna habitat | Indirect | Site | Short term / pre, during or post construction | · Invasion, establishment and spread of *Lantana camara (*TSC Act)<br>· Invasion of native plant communities by exotic perennial grasses (TSC Act) | Weed control during construction and operation | No |
| Invasion and spread of pests | PCTs and native fauna | Indirect | Site | Short term / pre, during or post construction | · Competition and grazing by the feral European rabbit (Oryctolagus cuniculus) (TSC Act)<br>· Predation and hybridisation of feral dogs (*Canis lupus familiaris*) (TSC Act)<br>· Predation by the European red fox (*Vulpes vulpes*) (TSC Act)<br>· Predation by the feral cat (*Felis catus*) (TSC Act)<br>· Predation by Plague Minnow or Mosquito Fish *(Gambusia holbrooki* ) (TSC Act)<br>· Predation, habitat degradation, competition and disease transmission by feral pigs (*Sus scrofa*) (TSC Act) | Pest control during operation, liaison with other property owners and pest control authorities where required | No |

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Invasion and spread of pathogens and disease | PCTs and native fauna | Indirect | Site | Short term / pre, during or post construction | · Infection of native plants by *Phytophthora cinnamomi* (TSC Act)<br>· Dieback caused by root-rot fungus *Phytophora cinnamomi* (EPBC Act)<br>· Introduction and Establishment of Exotic Rust Fungi of the order Pucciniales pathogenic on plants of the family Myrtaceae (TSC Act)<br>· Infection by psittacine circoviral (beak and feather) disease affecting endangered psittacine species and populations<br>· Infection of frogs be amphibian chytrid cause the disease chytridomycosis (TSC Act)<br>infection of amphibians with chytrid fungus resulting in chytridomycosis (EPBC Act) | Hygiene protocol during construction | No |

| Impact | Biodiversity values | Nature of impact Direct / indirect | Extent of impact Site based / local / regional / state / national | Duration Short or long term / pre, during or post construction | Relevant key threatening process | Proposed mitigation (refer detail in Chapter 8) | Requires offset? |
|---|---|---|---|---|---|---|---|
| Noise, light and vibration | PCTs and native fauna | Direct/indirect | Site | Short term / pre, during or post construction | N/A | Construction during daylight hours only | No |

# 8. Mitigation measures

Mitigation measures are required to further avoid and minimise impacts to biodiversity. These measures have been designed to address the potential impacts identified in **Chapter 7** being:

- Loss of vegetation and habitat for threatened species.
- Potential fauna mortality during construction.
- Edge effects and weed invasion.
- Impacts on aquatic habitats including indirect changes to surface hydrology.

A list of recommended mitigation measures is summarised in **Table 8-1**. These are designed to provide guidance on recommended measures to further avoid and mitigate impacts on biodiversity. These measures are to be outlined in the construction environmental management (CEMP) plan or flora and fauna management plan if prepared.

Table 8-1 Recommended mitigation measures

| Item | Timing | Recommended mitigation measures |
|---|---|---|
| Site personnel induction | Pre-construction | Ensure that all construction staff working on the project is aware of the ecological sensitivity of the bushland by educating staff at the induction phase on items such as:<br>· Proposed site environmental procedures (vegetation management, sediment and erosion control, protective fencing, noxious weeds, hygiene protocols, ethical procedures for handling fauna displaced on the site).<br>· What to do in case of environmental emergency (chemical spills, fire, injured fauna).<br>· Key contacts in case of environmental emergency.<br>· Potential imapcts to threatened nocturnal fauna when travelling to or working at the Project Site during dusk to dawn hours (particularly during winter) and where possible to minimise light and noise impacts to fauna. . |
| Site planning | Pre-construction | Locate temporary infrastructure (plant sites and construction offices, access tracks etc.) in cleared areas away from vegetation to minimise vegetation removal.<br>Locate and upgrade any access tracks in a manner which minimises the removal of mature trees, hollow-bearing trees and dead trees. |
| Identification of clearing limits | Pre-construction | Accurately and clearly mark out the limits of clearing (where appropriate) and the trees/vegetation to be retained outside of the construction footprint and / or used for post landscaping.<br>Regular inspections should be undertaken to ensure all retained vegetation/fauna habitat is clearly marked and that fencing is in place, where appropriate.<br>Only clear each stage of the project as required so that vegetation will be retained in the buffer area until future stages commence. |

| Item | Timing | Recommended mitigation measures |
|---|---|---|
| Protection of fauna during clearing of vegetation | Pre-construction and during clearing works | Once final clearing areas have been marked, a suitably qualified fauna ecologist should undertake a pre-clearing inspection to identify and physically mark hollow-bearing trees and dead standing trees (stags), and any large bird nests within the clearing areas. The pre-clearing survey should also conduct a search for any koalas which may be present on the site<br>An experienced and licensed wildlife carer and/or ecologist would be present on site during all habitat removal activities to capture and relocate fauna that may be encountered.<br>Any identified hollow bearing trees to be removed would need to be nudged and/or knocked before felling to allow any fauna to escape.<br>Remove habitat as carefully as possible to avoid injury to any fauna still remaining in trees. Use equipment that would allow the habitat trees to be lowered to the ground with minimal impact (e.g. claw extension on an excavator).<br>Large logs encountered within the works should be retained and scattered throughout the remaining forest habitats adjacent to the site rather than mulched. This should be conducted using the most sensitive manner possible (i.e. not piled up in a heap at the edge of the property or pushed into the forest with a bulldozer).<br>Any dewatering of artificial farm dams if necessary has potential to impact on the breeding cycle of several frog species, including the threatened Wallum Froglet. As a precautionary measure dewatering of the structure should avoid the period late spring and summer to avoid the breeding period for most frog species.<br>WIRES should be consulted if any injured fauna are encountered. |
| Management of erosion and sediment control | Pre and during construction | Provide sediment and erosion controls to manage exposed soil surfaces and stockpiles to prevent sediment discharge into waterways, vegetation and fauna habitat.<br>Clearly identify stockpile and storage locations and provide erosion and sediment controls around stockpiles. |
| Wetland areas | Pre and during construction | Minimise the area of disturbance in and near drainage lines, clearly mark out work zones in wetland and wet meadow areas, where appropriate.<br>Ensure all works within close proximity to aquatic habitats have adequate sediment and erosion control.<br>Further on site investigations may be required to confirm any interaction with groundwater. |
| Weed management | Pre and during construction | Ensure that any machinery arriving on site be inspected for any foreign soil or plant matter/weed material and be washed down before entering the site.<br>Weeds should be controlled within the work area according to the requirements of the *Noxious Weeds Act 1993*.<br>All noxious weeds which are cleared as part of the project must be disposed of appropriately. |
| Impacts from introduction and spread of pathogen and diseases | Construction | All vehicles driving to and from site should follow a protocol to prevent the spread or introduction of Phytophthora, Myrtle Rust or Chytrid Fungus, namely vehicles should be clean, including the tyres and any equipment and disinfectant used. |

| Item | Timing | Recommended mitigation measures |
|---|---|---|
| Revegetation and landscaping | Operation | A Landscape Management Plan is to be developed as part of the CEMP which provides specific details for the re-establishment of native vegetation (shrubs and groundcovers) in areas to be identified in the Stage 2 DA. The Landscape Management Plan will need to consider a range of constraints and opportunities associated with the project including collection and propagation of local seed, salvage and reuse of topsoil and woody debris. The Landscape Management Plan should aim to revegetate buffer lands using the same species composition and structure as currently exists on the site and include a program for monitoring and maintenance of plantings. |
| Monitor and review | All stages | A review of mitigation measures (including a checklist) should be developed to ensure that all measures proposed have been undertaken. |

# 9. Biodiversity offsets

The process of site selection and documented mitigation strategy has aimed at avoiding and minimising impacts to biodiversity in the first instance. Although avoidance and mitigation measures have been applied, impacts on biodiversity, including threatened ecological communities and known threatened species habitat will result from construction and operation of the proposal. In accordance with the FBA these impacts are required to be offset and the quantum of biodiversity credits required have been calculated using the BioBanking Credit Calculator (BBCC).

Cleared grazing land dominated by exotic grasses and exotic vegetation comprise 84 per cent of the Project Site, these areas do not require assessment of site value or offsetting.

The outcomes of the BBCC measure the impact of the project on landscape values and biodiversity values in biodiversity offset credits referred to as ecosystem and species credits. Three PCTs require ecosystem credits (refer to **Table 9-1**) and 10 species require species credits (refer to **Table 9-2**).

The outputs of the biodiversity credit report from the BBCC are provided in Appendix C.

Table 9-1 Ecosystem credits summary

| Plant community type | BVT code | Zone / Loss in site value score | Offset multiplier | Area impacted (ha) | Ecosystem credits required |
|---|---|---|---|---|---|
| Coastal freshwater meadows and forblands of lagoons and wetland (EEC – TSC Act) | NR150 | (1) 76.09 | 3.0 | 0.7 | 42 |
| Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR244 | (2) 64.06<br>(3) 63.02 | 1.0 | 15.0 | 539 |
| Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR246 | (4) 70.83<br>(5) 47.40 | 1.0 | 14.6 | 654 |
| **Total** | | | | 30.3 | 1,235 |

Table 9-2 Species credits summary

| Species | Offset multiplier | Loss of potential habitat (ha) | Species credits required |
|---|---|---|---|
| Black-necked Stork (*Ephippiorhynchus asiaticus*) | 7.7 | 0.7 | 54 |
| Brolga (*Grus rubicunda*) | 1.3 | 0.7 | 9 |
| Brush-tailed Phascogale (*Phascogale tapoatafa*) | 2.0 | 29.6 | 592 |
| Common Planigale (*Planigale maculata*) | 2.6 | 29.6 | 770 |
| Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area (*Dromaius novaehollandiae*) | 2.6 | 30.3 | 788 |

| Species | Offset multiplier | Loss of potential habitat (ha) | Species credits required |
|---|---|---|---|
| Koala (*Phascolarctos cinereus*) | 2.6 | 29.6 | 770 |
| Little Bentwing-bat (*Miniopterus australis*) | 1.3 | 30.3 | 394 |
| Rufous Bettong (*Aepyprymnus rufescens*) | 2.6 | 30.3 | 788 |
| Squirrel Glider (*Petaurus norfolcensis*) | 2.2 | 29.6 | 651 |
| Wallum Froglet (*Crinia tinnula*) | 1.3 | 0.7 | 9 |
| Total | | 211.5 | 4,825 |

# 10. Conclusions

The proposal is located in a landscape that has been modified by past land-uses for rural settlement and agriculture. Much of the native vegetation in the proposed Project Site has been completely cleared or the understorey modified for grazing. However remnant tree cover is present on the site and widely surrounding the site in contiguous properties that were identified as providing habitat for listed threatened fauna species. In addition small areas of wet meadow are present that are consistent with the endangered ecological community freshwater wetlands of the NSW north coast and Sydney basin bioregion (TSC Act).

The Biodiversity Assessment Report (BAR) has been prepared to meet the requirements of the *Framework for Biodiversity Assessment* (OEH 2014a) and the *NSW Offsets Policy for Major Projects* (OEH 2014b). This has involved an assessment of the landscape values on the site and surrounding assessment area, the vegetation communities present and their condition relative to benchmark scores, and the known or potential presence of threatened flora or fauna species.

The Project Site was selected to avoid impacts to remnant vegetation as much as possible. Despite this, the Project would include someloss of remnant vegetation and impacts are described in the BAR along with measures to further avoid and mitigate potential impacts to biodiversity.

The BAR has identified matters which are relevant to the assessment of impacts to threatened species, populations and ecological communities including direct and indirect impacts. The Proposal would require the clearing of around 30.3 hectares from three plant community types (PCT's) ranging in condition from poor to good, this will include habitat for known and potential threatened species.

The direct loss of vegetation required per the Proposal and the condition of this vegetation exceeds the impact threshold identified in the FBA for offsetting, being impacts on PCTs that have a site value score ≥17 that are associated with threatened species habitat. As such biodiversity offsets are required. A Biodiversity Offset Strategy (BOS) has been prepared for the EIS which identifies the biodiversity offset credits required to meet the conditions of the FBA (reter to Appendix D). The BOS presents the first stage of the offset package, and further work is required to identify the availability of relevant offsets to meet the impacts described and in securing an offset and development appropriate protection and management measures. These will be determined during Stage 2 development application process when the detail design for the Project will be finalised.

This report has considered and fulfilled the SEARs No 8 as summarised in **Table 2-1** in which biodiversity impacts related to the Proposal are to be assessed. The assessment has also considered the *Clarence Valley Council's Biodiversity Management Strategy 2010*.

# 11. References

Birdlife Australia (2016) Find a Bird (online). Available: http://www.birdsaustralia.com.au/search/birds

Bureau of Meteorology (BOM) (2016a). Atlas of Groundwater Dependent Ecosystems (online). Available: http://www.bom.gov.au/water/groundwater/gde/

Bureau of Meteorology (BOM) (2016b). Daily Weather Observations from Clarence Valley Regional Airport, Station 058161. Available at: http://www.bom.gov.au/climate/dwo/IDCJDW2050.latest.shtml

Clarence Valley Council (2010) Biodiversity Management Strategy 2010.

Cropper, S. (1993) Management of endangered plants, CSIRO Publications, Melbourne.

Department of Environment (DoE), (2013) Matters of National Environmental Significance Significant Impact Guidelines 1.1, Commonwealth of Australia, Canberra.

Department of Environment, (2016a) Protected Matters Search Tool (online). Available: http://www.environment.gov.au/topics/about-us/legislation/environment-protection-and-biodiversity-conservation-act-1999/protected

Department of Environment, (2016b) Species Profiles and Threats Database (SPRAT), (online). Available: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl

Department of Environment and Climate Change (NSW DECC), (2008) Conservation Assessment of Wetlands in the Clarence Lowlands IBRA Subregion. DECC and the Australian Government.

Department of Environment and Climate Change (NSW DECC), (2009) Threatened species survey and assessment guidelines: field survey methods for fauna – Amphibians.

Department of Environment and Conservation (NSW DEC), (2004), *Threatened Species Survey and Assessment: Guidelines for developments and activities (working draft)*, New South Wales Department of Environment and Conservation, Hurstville, NSW.

Department of Environment, Water, Heritage and the Arts (DEWHA), (2010a), *Survey Guidelines for Australia's Threatened* Bats. Commonwealth Government.

Department of Environment, Water, Heritage and the Arts (DEWHA), (2010b), *Survey Guidelines for Australia's Threatened Birds*. Commonwealth Government.

Department of Environment, Water, Heritage and the Arts (DEWHA), (2010c), *Survey Guidelines for Australia's Threatened Frogs*. Commonwealth Government.

Department of Environment, Water, Heritage and the Arts (DEWHA), (2011a), *Survey Guidelines for Australia's Threatened Reptiles*. Commonwealth Government.

Department of Environment, Water, Heritage and the Arts (DEWHA), (2011b), *Survey Guidelines for Australia's Threatened Mammals*. Commonwealth Government.

Department of Primary Industries (DPI) (2016a), NSW WeedWise (online). Available: http://weeds.dpi.nsw.gov.au/

Department of Primary Industries (2016b), *Listed threatened species, populations and ecological communities* (online). Available: http://www.dpi.nsw.gov.au/fisheries/species-protection/conservation/what-current#Key-threatening-processes

Department of Primary Industries (2016c), *Threatened & protected species - records viewer* (online). Available: http://www.dpi.nsw.gov.au/fisheries/species-protection/records/viewer

Eby, P. and Law, B. (2008) Ranking the feeding habitats of Grey-headed flying foxes for conservation management: a report for The Department of Environment and Climate Change (NSW) & The Department of Environment, Water, Heritage and the Arts.

Environment Australia (2001). A Directory of Important Wetlands in Australia, Third Edition. Environment Australia, Canberra.

Kuginis L., Byrne G., Serov P, Williams J.P.,(2012), *Risk assessment guidelines for groundwater dependent ecosystems, Volume 3 – Identification of high probability groundwater dependent ecosystems on the coastal plains of NSW and their ecological value*, NSW Department of Primary Industries, Office of Water, Sydney.

National Parks and Wildlife Service (2003), The Bioregions of New South Wales: their biodiversity, conservation and history, NSW National Parks and Wildlife Service, Hurstville.

Office of Environment and Heritage, (2014a) Framework for Biodiversity Assessment. NSW Government.

Office of Environment and Heritage, (2014b). Major Projects Offsets Policy. NSW Government.

Office of Environment and Heritage (2016a) *Atlas of NSW Wildlife* (online). Available: http://www.environment.nsw.gov.au/asmslightprofileapp/account/login?ReturnUrl=%2fAtlasApp%2fDefault.aspx

Office of Environment and Heritage, (2016b). *Threatened Species Profile Database* (online). Available: http://www.environment.nsw.gov.au/asmslightprofileapp/account/login?ForceLogin=1

Office of Environment and Heritage, (2016c). *Vegetation Information System* (online). Available: http://www.environment.nsw.gov.au/NSWVCA20PRapp/LoginPR.aspx

Office of Environment and Heritage (OEH) (2011) Freshwater wetlands on coastal floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions - endangered ecological community listing. NSW Scientific Committee – final determination (online). Available: http://www.environment.nsw.gov.au/determinations/FreshwaterWetlandsEndSpListing.htm

PlantNET (The NSW Plant Information Network System), (2016), Royal Botanic Gardens and Domain Trust, Sydney (online). Available: http://plantnet.rbgsyd.nsw.gov.au

Resource and Conservation Division (2001) Comprehensive Regional Assessment Floristic Types Information (CRAFTI)

Roads and Maritime Service (RMS) (2012) Upgrading the Pacific Highway, Woolgoolga to Ballina Upgrade: Working paper Biodiversity Assessment.

Thackway, R. and Cresswell, I.D. (1995), An interim biogeographic regionalisation for Australia: a framework for setting priorities in the National Reserves System Cooperative Program, Version 4.0. Australian Nature Conservation Agency, Canberra.

# Appendix A. Likelihood of occurrence

Table A-1 Likelihood of occurrence includes one or more of the following criteria

| Likelihood of Occurrence | Criteria |
|---|---|
| Unlikely | · Species highly restricted to certain geographical areas not within the Project footprint<br>· Species that have specific habitat requirements are not present in the study area |
| Low | Species that fit into one or more of the following criteria:<br>· Have not been recorded previously in the study area/surrounds and for which the study area is beyond the current distribution range<br>· Use specific habitats or resources not present in the study area<br>· Are a non-cryptic perennial flora species that were specifically targeted by surveys and not recorded |
| Moderate | Species that fit one or more of the following criteria:<br>· Have infrequently been recorded previously in the study area/surrounds<br>· Use specific habitats or resources present in the study area but in a poor or modified condition<br>· Are unlikely to maintain sedentary populations, however may seasonally use resources within the study area opportunistically or during migration<br>· Are cryptic flowering flora species that were not seasonally targeted by surveys and that have not been recorded |
| High | Species that fit one or more of the following criteria:<br>· Have frequently been recorded previously in the study area/surrounds<br>· Use habitat types or resources that are present in the study area that are abundance and/or in good condition within the study area<br>· Are known or likely to maintain resident populations surrounding the study area<br>· Are known or likely to visit the site during regular seasonal movements or migration |

Table A-2 Known or potentially occurring threatened ecological communities

| Name | EPBC Act | TSC Act | Source | Likelihood of occurrence in the Project Site |
|---|---|---|---|---|
| **THREATENED ECOLOGICAL COMMUNITES** | | | | |
| Coastal Cypress Pine Forest in the New South Wales North Coast Bioregion | - | EEC | OEH | Unlikely |
| Coastal Saltmarsh in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions | VEC | EEC | OEH | Unlikely |
| Freshwater Wetlands on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions | - | EEC | OEH | Confirmed |
| Littoral Rainforest in the New South Wales North Coast, Sydney Basin and South East Corner Bioregions | CEEC | EEC | OEH | Unlikely |
| Lowland Rainforest in the NSW North Coast and Sydney Basin Bioregions | CEEC | EEC | OEH, PMST | Unlikely |
| Lowland Rainforest on Floodplain in the New South Wales North Coast Bioregion | CEEC | EEC | OEH, PMST | Unlikely |
| Subtropical Coastal Floodplain Forest of the New South Wales North Coast Bioregion | - | EEC | OEH | High |
| Swamp Oak Floodplain Forest of the NSW North Coast, Sydney Basin and South East Corner bioregions | - | EEC | - | High |
| Swamp Sclerophyll Forest on Coastal Floodplains of the New South Wales North Coast, Sydney Basin and South East Corner Bioregions | - | EEC | OEH | High |
| Themeda grassland on seacliffs and coastal headlands in the NSW North Coast, Sydney Basin and South East Corner Bioregions | - | EEC | OEH | Unlikely |
| White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland | CEEC | EEC | PMST | Unlikely |

Table A-3 Likelihood of occurring threatened and migratory species on Project Site

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| **FLORA** | | | | | | | |
| *Allocasuarina defungens* | Dwarf Heath Casuarina | E | E | Dwarf Heath Casuarina is found only in NSW from the Nabiac area, north-west of Forster, to Byron Bay on the NSW north coast. Grows mainly in tall heath on sand, but can also occur on clay soils and sandstone. The species also extends onto exposed nearby-coastal hills or headlands adjacent to sandplains. | PMST | Low | Species credit |
| *Angophora robur* | Sandstone | V | V | Occurs in a band from around Glenreagh, north-west of Coffs Harbour, to the | 300 OEH, | Low | Species |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | Rough Barked Apple | | | Coaldale area north-west of Grafton, with an isolated occurrence farther west near Nymboida. It can be locally common. Dry open forest in sandy or skeletal soils on sandstone, or occasionally granite, with frequent outcrops of rock. | PMST | | credit |
| *Archidendron hendersonii* | White Lace Flower | - | V | This species occurs from north Queensland south to the Richmond River in north-east NSW. This species is known to occur in lowland, riverine or littoral rainforest, including small remnants in subtropical rainforest north of Coolgardie Road Coolgardie. Archidendron hendersonii is insect/bird pollinated and is found on a variety of soils including coastal sands and those derived from basalt and metasediments. | BBCC | Unlikely | Species credit |
| *Arthraxon hispidus* | Hairy Joint-grass | V | V | Occurs over a wide area in south-east Queensland, and on the northern tablelands and north coast of NSW, but is never common. Also found from Japan to central Eurasia. Moisture and shade-loving grass, found in or on the edges of rainforest and in wet eucalypt forest, often near creeks or swamps. | BBCC, PMST | Moderate | Species credit |
| *Callistemon linearifolius* | Netted Bottlebrush | - | V | Recorded from the Georges River to Hawkesbury River in the Sydney area, and north to the Nelson Bay area of NSW. Was more widespread across its distribution in the past. Some populations are reserved in Ku-ring-gai Chase National Park, Lion Island Nature Reserve, and Spectacle Island Nature Reserve. Further north it has been recorded from Yengo National Park and Werakata National Park. Grows in dry sclerophyll forest on the coast and adjacent ranges. | 1 OEH, PMST | Unlikely | Species credit |
| *Centranthera cochinchinensis* | Swamp Foxglove | - | E | Occurs in northern Australia and south-east Asia and known from NSW north from Wooli. In NSW, it is known from only 6 locations from near Wooli to north of Grafton in swampy areas and other moist sites. Two locations occur within conservation reserves, Yuraygir National Park and Fortis Creek National Park. | BBCC, 1 OEH | Moderate | Species credit |
| *Corynocarpus rupestris* subsp. *rupestris* | Glenugie Karaka | V | V | This tree is known from Glenugie Peak Flora Reserve, south-east of Grafton, north to Wardell. Dry rainforest on steep basalt boulder slopes. Soil is scarce but relatively high in nutrients and very well-drained. Fire is generally excluded by the rocky terrain and absence of ground litter. | 15 OEH, PMST | Unlikely | Species credit |
| *Cyperus aquatilis* | Water Nutgrass | - | E | In NSW, known only from a few sites north from Grafton. Also occurs in Queensland, Northern Territory, Western Australia and New Guinea. Grows | BBCC | Moderate | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | in ephemerally wet sites, such as roadside ditches and seepage areas from small cliffs, in sandstone areas. | | | |
| *Cryptostylis hunteriana* | Leafless Tongue-orchid | V | V | The Leafless Tongue Orchid has been recorded from as far north as Gibraltar Range National Park south into Victoria around the coast as far as Orbost. The larger populations typically occur in woodland dominated by Scribbly Gum (Eucalyptus sclerophylla), Silvertop Ash (E. sieberi), Red Bloodwood (Corymbia gummifera) and Black Sheoak (Allocasuarina littoralis); appears to prefer open areas in the understorey of this community and is often found in association with the Large Tongue Orchid (*C. subulata*) and the Tartan Tongue Orchid (*C. erecta*). | PMST | Low | Species credit |
| *Davidsonia jerseyana* | Davidson's Plum | E | E | Restricted to north-east NSW to as far south as Wardell. Lowland subtropical rainforest and wet eucalypt forest at low altitudes (below 300m). Many trees are isolated in paddocks and on roadsides in former rainforest habitats. | BBCC | Unlikely | Species credit |
| *Dendrobium melaleucaphilum* | Spider orchid | - | E | This orchid occurs in coastal districts and nearby ranges, extending from Queensland to its southern distributional limit in the lower Blue Mountains. It grows frequently on *Melaleuca styphelioides*, less commonly on rainforest trees or on rocks in coastal districts. Flowering period is between July and October. | BBCC | Low | Species credit |
| *Desmodium acanthocladum* | Thorny pea | V | V | Occurs only in north-east NSW. It is found in the Lismore area, and there are also records from near Grafton, Coraki, Casino and the Mount Warning area. Dry rainforest and fringes of riverine subtropical rainforest. On basalt-derived soils at low elevations. Much of its habitat has been cleared for agriculture. | BBCC | Low | Species credit |
| *Diploglottis campbellii* | Small-leaved Tamarind | E | E | Recorded from the coastal lowlands between Richmond River on the Far North Coast of NSW and Mudgeeraba Creek on the Gold Coast hinterland, Queensland. Confined to the warm subtropical rainforests of the NSW-Queensland border lowlands and adjacent low ranges. The forest types in which the species occurs vary from lowland subtropical rainforest to drier subtropical rainforest with a Brush Box open over storey. Occurs on basalt-derived soils and also on poorer soils such as those derived from quartz monzonite. | BBCC | Unlikely | Species credit |
| *Drynaria rigidula* | Basket Fern | - | E | Occurs widely in eastern Queensland as well as islands of the Pacific and parts of south-east Asia. In NSW it is only found north of the Clarence River, | BBCC | Low | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | in a few locations at Maclean, Bogangar, Byron Bay, Mullumbimby, in the Tweed Valley and at Woodenbong. Grows on plants, rocks or on the ground, Usually found in rainforest but also in moist eucalypt and Swamp Oak forest. | | | |
| *Eleocharis tetraquetra* | Square-stemmed Spike-rush | - | E | There is limited information regarding the life cycle of Eleocharis tetraquetra. It is known to spread through vegetative reproduction making counting individuals difficult. It is thought vegetation reproduction may be an essential strategy for the maintenance of local populations following initial establishment from seed (NPWS 1999). The recovery plan for Eleocharis tetraquetra states that the most likely habitat for the species is on tributary creeks with lower water volumes and velocity with low gradient banks and swales that are weakly incised with a constant water flow to maintain swampy conditions (NPWS 1999).<br>The species is known to occur on edges of ponds and in riffle habitats between ponds along two creek lines including Redbank Creek and a tributary of Redbank Creek at Corindi Creek several kilometres south of the Project Site. | BBCC | Moderate | Species credit |
| *Endiandra muelleri* subsp. *bracteata* | Green-leaved Rose Walnut | - | E | Occurs in Queensland and in north-east NSW south to Maclean. It is sparsely distributed within this range. Occurs in subtropical and warm temperate rainforests and Brush Box forests, including regrowth and highly modified forms of these habitats. Records are usually from poorer soils derived from sedimentary, metamorphic or acid volcanic rocks. The species is generally recorded at lower altitudes. | BBCC | Unlikely | Species credit |
| *Elionurus citreus* (syn: *Elyonurus citreus*) | Lemon scented Grass | - | E | Lemon-scented Grass occurs north from Grafton in NSW. It is only known from localities south of Casino, north-west of Grafton, near Cudgen Lake on the Tweed coast and in Yuraygir National Park. It also occurs in Queensland, NT, WA and New Guinea. Lemon-scented Grass grows in sandy soils near rivers or along the coast in wallum areas or sand dunes. At the NSW locations, the species has been found growing in infertile white sands. | BBCC | Low | Species credit |
| *Eucalyptus glaucina* | Slaty Red Gum | V | V | Found only on the north coast of NSW and in separate districts: near Casino where it can be locally common and farther south, from Taree to Broke, west of Maitland. Grows in grassy woodland and dry eucalypt forest. Grows on deep, moderately fertile and well-watered soils. | BBCC | Low | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Eucalyptus tetrapleura* | Square fruited Ironbark | V | V | Restricted to the coastal lowlands and foothills of northern NSW around Casino and Grafton. Dry or moist eucalypt forest on moderately fertile soil, often in low areas with poor drainage. | 56 OEH, PMST | Moderate | Species credit |
| *Geodorum densiflorum* | Pink Nodding Orchid | - | E | This orchid occurs in NSW and Queensland with less than 20 populations thought to be remaining in NSW, all north of Bundjalung National Park and Tweed Shire. Pink Nodding Orchid occurs in dry eucalypt forest and coastal swamp forest at low altitudes on sandy soils. | BBCC | Unlikely | Species credit |
| *Gossia fragrantissima* | Sweet Myrtle | E | E | Occurs in south-east Queensland and in north-east NSW south to the Richmond River. Mostly found on basalt-derived soils. Dry subtropical and riverine rainforest. As it can coppice from roots left in the ground when rainforest is cleared, it is found at several sites as isolated plants in paddocks or regrowth. | BBCC | Unlikely | Species credit |
| *Grevillea masonii* | Mason's Grevillea | E | E | Occurs in only a few locations between Grafton and Casino in north-eastern NSW. Occurs on gravely loam soils and in sand in open eucalypt woodland. Re-sprouts from its lignotuber following disturbance; also regenerates from seed after fire. Flowering usually commences from two to three years of age. | BBCC | Moderate | Species credit |
| *Grevillea quadricauda* | Four-tailed Grevillea | V | V | In NSW it is found to the north-west of Whiporie in Mount Belmore State Forest and Mount Neville Nature Reserve, and at Tucabia east of Grafton. It also occurs near Toowoomba in south-east Queensland. Grows in gravely loam, in the understorey of dry eucalypt forest, usually along or near creeks. | 2 OEH, PMST | Moderate | Species credit |
| *Hibbertia marginata* | Bordered Guinea Flower | V | V | Occurs only in north-east NSW, where it is restricted to the southern Richmond Range between Casino and Grafton. Grassy or shrubby dry open eucalypt forest at low altitudes on sandstone. | BBCC | Low | Species credit |
| *Lindernia alsinoides* | Noah's False Chickweed | - | E | This species has been recorded in coastal areas from Buladelah to Coopernook. Populations are known to occur further north from Halfway Creek to Pillar Valley near Mitchel Road and Mahogany Drive. Grows in swamp forests and wetlands along coastal and hinterland creeks. | 16 OEH | Moderate | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Lindsaea incisa* | Slender Screw Fern | - | E | In NSW it is known only from a few locations between Woombah and just south of Coffs Harbour. Also occurs in north and south-east Queensland. Dry eucalypt forest on sandstone and moist shrubby eucalypt forest on metasediments. It is usually found in waterlogged or poorly drained sites along creeks, where ferns, sedges and shrubs grow thickly. | BBCC | Low | Species credit |
| *Macadamia tetraphylla* | Rough-shelled Bush Nut | V | V | Confined chiefly to the north of the Richmond River in north-east NSW, extending just across the border into Queensland. Many records, particularly those further south, are thought to be propagated. Found in subtropical rainforest, usually near the coast. | BBCC | Unlikely | Species credit |
| *Marsdenia longiloba* | Slender Marsdenia | V | E | Scattered sites on the north coast of NSW north from Barrington Tops. Also occurs in south-east Queensland. Subtropical and warm temperate rainforest, lowland moist or open eucalypt forest adjoining rainforest and, sometimes, in areas with rock outcrops. Associated species include *Eucalyptus crebra, E. microcorys, E. acmenoides, E. saligna, E. propinqua, Corymbia intermedia* and *Lophostemon confertus*. | PMST | Moderate | Species credit |
| *Maundia triglochinoides* | - | - | V | Restricted to coastal NSW and extending into southern Queensland. The current southern limit is Wyong; former sites around Sydney are now extinct. Grows in swamps, lagoons, dams, channels, creeks or shallow freshwater 30 - 60 cm deep on heavy clay, low nutrients. Flowering occurs during warmer months. Associated with wetland species e.g. *Triglochin procerum*. There a number of recent observations recorded 1.7 kilometres to the east of the Project Site in the Coldstream River and tributaries. | BBCC, 26 OEH | High | Species credit |
| *Melaleuca irbyana* | Weeping Paperbark | - | E | Found in only a few places in north-east NSW, including near Coraki, Casino and Coutts Crossing south of Grafton. Also occurs in near Ipswich in south-east Queensland. Only two populations are recorded in conservation reserves in NSW, these are Warragai Creek Nature Reserve and Bungawalbin National Park. Open eucalypt forest in poorly drained, usually clay, sandstone or alluvial soils. There are confirmed observations recorded to the east adjacent to the Project Site, along Avenue Drive. | BBCC, 38 OEH | High | Species credit |
| *Melichrus hirsutus* (syn. *Melichrus* sp. Newfoundland | Hairy Melichrus | E | E | Restricted to a few locations near Grafton in north-east NSW. Dry eucalypt forest with a shrubby understorey with sandstone rock outcrops. Found at low altitudes (20 to 150 m) in sandy soils. There are number of observations | BBCC, 88 OEH | Low | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| State Forest (P.Gilmour 7852) | | | | recorded around Mahogany Drive, Pillar Valley on sandy soils over sandstone. | | | |
| *Melichrus sp. Gibberagee* | Narrow-leaf Melichrus | E | E | This species occurs in one population, restricted to north-east NSW in Gibberagee State Forest about 40 kilometres south of Casino. It prefers low altitude dry grassy eucalypt forest on gentle slopes, usually occurring under tall spotted gum and ironbarks. | BBCC | Unlikely | Species credit |
| *Ochrosia moorei* | Southern Ochrosia | E | E | Southern Ochrosia is found in north-east NSW north from the Richmond River, and in south-east Queensland. It is very sparsely distributed within this range. Southern Ochrosia is found in riverine and lowland subtropical rainforest. | BBCC | Unlikely | Species credit |
| *Oldenlandia galioides* | - | - | E | Found in north-east NSW from Whiporie State Forest south of Casino and one location in the Tweed district. Iso occurs on the north-west plains of NSW and in Queensland, Northern Territory and Western Australia. Grows on margins of seasonally inundated wetlands in paperbacks swamps and Forest Red Gum Woodlands. | BBCC | Unlikely | Species credit |
| *Peristeranthus hillii* | Brown Fairy-chain Orchid | - | V | Found in north-eastern NSW, north from Port Macquarie, extending to north-eastern Queensland as far as the Bloomfield River. Restricted to coastal and near-coastal environments, particularly Littoral Rainforest and the threatened ecological community Lowland Rainforest on Floodplain. The species is an epiphyte, growing in clumps on tree trunks and thick vines. | BBCC | Unlikely | Species credit |
| *Phaius australis* | Southern Swamp Orchid | E | E | Occurs in Queensland and north-east NSW as far south as Coffs Harbour. Historically, it extended farther south, to Port Macquarie. Swampy grassland or swampy forest including rainforest, eucalypt or paperbark forest, mostly in coastal areas. | BBCC. PMST | Unlikely | Species credit |
| *Phyllanthus microcladus* | Brush Sauropus | - | E | Species is confined to a few locations in the Tweed, Brunswick, Richmond and Wilson River Valleys. There is also an outlying population near Grafton. It is found along creek banks and rivers, and streamside of rainforest or dry rainforest. | BBCC | Unlikely | Species credit |
| *Quassia* sp. 'Moonee Creek' | Moonee Quassia | E | E | Scattered distribution from the Moonee Creek area north of Coffs Harbour to north-east of Grafton. Shrubby layer below tall moist eucalypt forest and tall dry eucalypt forest, including forest edges, mostly at lower altitudes. | 84 OEH, PMST | Low | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Rotala tripartita* | - | - | E | In NSW this riparian species is highly restrictive with records in only two locations in Casino and South Grafton. It grows in free-standing water with sedges and may germinate prolifically and establish in large numbers after substantial rain. Individuals disappear above ground in dry periods and only persist in the soil seed bank. | BBCC | Moderate | Species credit |
| *Syzygium hodgkinsoniae* | Red Lilly Pilly | V | V | A restricted range from the Richmond River in north-east NSW to Gympie in Queensland. Locally common in some parts of its range, but otherwise sparsely distributed. Usually found in riverine and subtropical rainforest on rich alluvial or basaltic soils. | BBCC | Unlikely | Species credit |
| *Tephrosia filipes* | - | - | V | Is widespread in Queensland, but is confined from Guy Fawkes River National Park to the Tenterfield district in NSW. It grows in a range of woodland and forest habitats on soils derived from granite, sandstone or metasediments. | BBCC | Unlikely | Species credit |
| *Thesium australe* | Austral Toadflax | V | V | Found in very small populations scattered across eastern NSW, along the coast, and from the Northern to Southern Tablelands. It is also found in Tasmania and Queensland and in eastern Asia. Occurs in grassland on coastal headlands or grassland and grassy woodland away from the coast. Often found in association with Kangaroo Grass (Themeda australis). | PMST | Low | Species credit |
| *Tylophora woollsii* | Cryptic Forest Twiner | E | E | The Cryptic Forest Twiner is found from the NSW north coast and New England Tablelands to southern Queensland, but is very rare within that range. Known on the Tablelands from the Bald Rock and Boonoo Boonoo areas north of Tenterfield. This species grows in moist eucalypt forest, moist sites in dry eucalypt forest and rainforest margins. | PMST | Low | Species credit |
| **BIRDS** | | | | | | | |
| *Amaurornis moluccana* | Pale-vented Bush Hen | - | V | In NSW, Bush-hens are an apparently uncommon resident from the Queensland border south to the Clarence River, though the species appears to be expanding its range southwards with recent records as far south as the Nambucca River. The Pale-vented Bush-hen inhabits tall dense understorey or ground-layer vegetation on the margins of freshwater streams and natural or artificial wetlands, usually within or bordering rainforest, rainforest remnants or forests. Also occur in secondary forest growth, rank grass or reeds, thickets of weeds, such as Lantana (Lantana camara), and pastures, | BBCC | Low | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | crops or other farmland, such as crops of sugar cane, and grassy or weedy fields, or urban gardens where they border forest and streams or wetlands, such as farm dams. Can also occur in and around mangroves, though rarely do so, if at all, in NSW. | | | |
| *Anseranas semipalmata* | Magpie Goose | M | V | Mainly found in shallow wetlands (less than 1 m deep) with dense growth of rushes or sedges. Equally at home in aquatic or terrestrial habitats; often seen walking and grazing on land; feeds on grasses, bulbs and rhizomes. Activities are centred on wetlands, mainly those on floodplains of rivers and large shallow wetlands formed by run-off; breeding can occur in both summer and winter dominated rainfall areas and is strongly influenced by water level; most breeding now occurs in monsoonal areas; nests are formed in trees over deep water; breeding is unlikely in south-eastern NSW. | 14 OEH | Moderate (in areas of inundated floodplain) | Ecosystem credit |
| *Anthochaera Phrygia* (syn: *Xanthomyza phrygia*) | Regent Honeyeater | CE | CE | Temperate woodlands and open forests of the inland slopes of south-east Australia. The species inhabits dry open forest and woodland, particularly Box-Ironbark woodland, and riparian forests of River Sheoak. Regent Honeyeaters usually nest in horizontal branches or forks in tall mature eucalypts and Sheoaks. | BBCC, PMST | Moderate | Species credit |
| *Botaurus poiciloptilus* | Australasian Bittern | E | E | Occurs from south-east Queensland to south-east South Australia, Tasmania and the south-west of Western Australia. Occurs in terrestrial freshwater wetlands and, rarely, estuarine habitats. | BBCC, 1 OEH, PMST | Low | Species credit |
| *Burhinus grallarius* | Bush Stone-curlew | - | E | Open forests and woodlands with a sparse grassy ground layer and fallen timber. Largely nocturnal, being especially active on moonlit nights. Feed on insects and small vertebrates, such as frogs, lizards and snakes. Nest on the ground in a scrape or small bare patch. | BBCC, 18 OEH | High | Ecosystem credit |
| *Calyptorhynchus banksii banksii* | Red-tailed Black-cockatoo (coastal subspecies) | - | CE | The nominate subspecies (banksii) of the Red-tailed Black-Cockatoo is now confined to northern and eastern coastal Queensland and, possibly, far north-eastern NSW. It is thought the most productive habitats for this subspecies were forests and woodlands of fertile riparian flats and floodplains. These areas were heavily cleared for agriculture and settlements, with remaining patches severely fragmented, and also degraded by logging. In north-eastern NSW, the subspecies has been reported from dry open forest and mixed rainforest-eucalypt forest. Australia-wide, the species is known to feed mainly | BBCC | Moderate | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | on seeds, particularly from *Eucalyptus*, *Casuarina*, *Acacia* and *Banksia*, but they also eat fruit, nectar, flowers and, occasionally, insects and their larvae. They tend to feed mainly in trees in forests and woodlands, but also feed on the ground. Nests in tree-hollows, trunks, spouts or stumps, primarily in *Eucalyptus* but also in *Melaleuca*. Although there is no data for NSW, they have been recorded frequently nesting in dead trees, which can have deeper hollows than live trees. | | | |
| *Calyptorhynchus lathami* | Glossy-black Cockatoo | - | V | The species is uncommon although widespread throughout suitable forest and woodland habitats, from the central Queensland coast to East Gippsland in Victoria, and inland to the southern tablelands and central western plains of NSW, with a small population in the Riverina. An isolated population exists on Kangaroo Island, South Australia. Inhabits open forest and woodlands of the coast and the Great Dividing Range where stands of Sheoak occur. Black Sheoak (*Allocasuarina littoralis*) and Forest Sheoak (*A. torulosa*) are important foods. Inland populations feed on a wide range of Sheoaks, including Drooping Sheoak, *A. diminuta*, and *A. gymnanthera*. Belah is also utilised and may be a critical food source for some populations. In the Riverina, birds are associated with hills and rocky rises supporting Drooping Sheoak, but also recorded in open woodlands dominated by Belah (*Casuarina cristata*). | BBCC, 58 OEH | Confirmed (chewed *A. littoralis* cones found on the western border of the Project Site) | Ecosystem credit |
| *Chthonicola sagittata (Pyrrholaemus sagittatus)* | Speckled Warbler | - | V | The Speckled Warbler lives in a wide range of Eucalyptus dominated communities that have a grassy understorey, often on rocky ridges or in gullies. Typical habitat would include scattered native tussock grasses, a sparse shrub layer, some eucalypt re-growth and an open canopy. Large, relatively undisturbed remnants are required for the species to persist in an area. | BBCC, 1 OEH | High | Ecosystem credit |
| *Circus assimilis* | Spotted Harrier | - | V | The Spotted Harrier occurs throughout the Australian mainland, except in densely forested or wooded habitats of the coast, escarpment and ranges, and rarely in Tasmania. Individuals disperse widely in NSW and comprise a single population. Occurs in grassy open woodland including Acacia and mallee remnants, inland riparian woodland, grassland and shrub steppe. It is found most commonly in native grassland, but also occurs in agricultural land, foraging over open habitats including edges of inland wetlands. | 5 OEH | High | |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Climacteris picumnus victoriae* | Brown Treecreeper (eastern subspecies) | - | V | Endemic to eastern Australia and occurs in eucalypt forests and woodlands of inland plains and slopes of the Great Dividing Range. It is less commonly found on coastal plains and ranges. Found in eucalypt woodlands (including Box-Gum Woodland) and dry open forest of the inland slopes and plains inland of the Great Dividing Range; mainly inhabits woodlands dominated by stringybarks or other rough-barked eucalypts, usually with an open grassy understorey, sometimes with one or more shrub species; also found in mallee and River Red Gum (Eucalyptus camaldulensis) Forest bordering wetlands with an open understorey of acacias, saltbush, lignum, cumbungi and grasses; usually not found in woodlands with a dense shrub layer; fallen timber is an important habitat component for foraging; also recorded, though less commonly, in similar woodland habitats on the coastal ranges and plains. | BBCC, 29 OEH | Confirmed (Observed in vegetated areas in the west of the Project Site) | Ecosystem credit |
| *Coracina lineata* | Barred Cuckoo-shrike | - | V | Coastal eastern Australia from Cape York to the Manning River in NSW. Barred Cuckoo-shrikes are generally uncommon in their range, and are rare in NSW. Rainforest, eucalypt forests and woodlands, clearings in secondary growth, swamp woodlands and timber along watercourses. They are usually seen in pairs or small flocks foraging among foliage of trees for insects and fruit. They are active birds, frequently moving from tree to tree. | BBCC | Moderate | Ecosystem credit |
| *Daphoenositta chrysoptera* | Varied Sittella | - | V | The Varied Sittella is sedentary and inhabits most of mainland Australia except the treeless deserts and open grasslands. Distribution in NSW is nearly continuous from the coast to the far west. The Varied Sittella's population size in NSW is uncertain but is believed to have undergone a moderate reduction over the past several decades. Inhabits eucalypt forests and woodlands, especially those containing rough-barked species and mature smooth-barked gums with dead branches, mallee and Acacia woodland. Feeds on arthropods gleaned from crevices in rough or decorticating bark, dead branches, standing dead trees and small branches and twigs in the tree canopy. | BBCC, 6 OEH | High | Ecosystem credit |
| *Dasyornis brachypterus* | Eastern Bristlebird | E | E | The distribution of the Eastern Bristlebird has contracted to three disjunct areas of south-eastern Australia. There are three main populations: Northern - southern Queensland/northern NSW, Central - Barren Ground NR, Budderoo NR, Woronora Plateau, Jervis Bay NP, Booderee NP and Beecroft | PMST | Unlikely | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | Peninsula and Southern - Nadgee NR and Croajingalong NP in the vicinity of the NSW/Victorian border. Habitat for central and southern populations is characterised by dense, low vegetation including heath and open woodland with a heathy understorey. In northern NSW the habitat occurs in open forest with dense tussocky grass understorey and sparse mid-storey near rainforest ecotone; all of these vegetation types are fire prone. | | | |
| *Dromaius novaehollandiae* (Endangered population) | Emu population in the New South Wales North Coast Bioregion and Port Stephens local government area | - | EP | Generally absent from densely settled regions and largely absent from south-eastern coastal and subcoastal regions. The species was formerly widespread in north-eastern NSW, but is now restricted to coastal and near-coastal areas between Evans Head and Red Rock and a potential small isolated population further west in the Bungawalbin area. On the NSW north coast, Emus occur in a range of predominantly open lowland habitats, including grasslands, heathland, shrubland, open and shrubby woodlands, forest, and swamp and sedgeland communities, as well as the ecotones between these habitats. They also occur in plantations of tea-tree and open farmland (sugar cane), and occasionally in littoral rainforest. Emu are known to regularly move across the whole study locality, particularly around Coldstream River east of the Project Site. | BBCC, 168 OEH | High | Species credit |
| *Ephippiorhynchus asiaticus* | Black-necked Stork | - | E | In Australia, Black-necked Storks are widespread in coastal and subcoastal northern and eastern Australia, as far south as central NSW (although vagrants may occur further south or inland, well away from breeding areas). In NSW, the species becomes increasingly uncommon south of the Clarence Valley, and rarely occurs south of Sydney. Since 1995, breeding has been recorded as far south as Bulahdelah. Floodplain wetlands (swamps, billabongs, watercourses and dams) of the major coastal rivers are the key habitat in NSW for the Black-necked Stork. Secondary habitat includes minor floodplains, coastal sandplain wetlands and estuaries. Storks usually forage in water 5-30cm deep for vertebrate and invertebrate prey. Eels regularly contribute the greatest biomass to their diet, but they feed on a wide variety of animals, including other fish, frogs and invertebrates (such as beetles, grasshoppers, crickets and crayfish). Black-necked Storks build large nests high in tall trees close to water. Trees usually provide clear observation of the surroundings and are at low elevation (reflecting the floodplain habitat). | BBCC, 394 OEH | Moderate | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Erythrotriorchis radiatus* | Red Goshawk | V | CE | This unique Australian endemic raptor is distributed sparsely through northern and eastern Australia, from the western Kimberley Division of northern Western Australia to north-eastern Queensland and south to far north-eastern NSW, and with scattered records in central Australia. The species is very rare in NSW, extending south to about 30°S, with most records north of this, in the Clarence River Catchment, and a few around the lower Richmond and Tweed Rivers. Formerly, it was at least occasionally reported as far south as Port Stephens. Red Goshawks inhabit open woodland and forest, preferring a mosaic of vegetation types, a large population of birds as a source of food, and permanent water, and are often found in riparian habitats along or near watercourses or wetlands. In NSW, preferred habitats include mixed subtropical rainforest, *Melaleuca* swamp forest and riparian *Eucalyptus* forest of coastal rivers. | BBCC, 1 OEH, PMST | Moderate | Species credit |
| *Grantiella picta* | Painted Honeyeater | V | V | The Painted Honeyeater is nomadic and occurs at low densities throughout its range. The greatest concentrations of the bird and almost all breeding occurs on the inland slopes of the Great Dividing Range in NSW, Victoria and southern Queensland. During the winter it is more likely to be found in the north of its distribution. Inhabits Boree, Brigalow and Box-Gum Woodlands and Box-Ironbark Forests.<br>A specialist feeder on the fruits of mistletoes growing on woodland eucalypts and acacias. Prefers mistletoes of the genus Amyema. | PMST | Low | Ecosystem species |
| *Grus rubicunda* | Brolga | - | V | The Brolga was formerly found across Australia, except for the south-east corner, Tasmania and the south-western third of the country. It is still abundant in the northern tropics, but very sparse across the southern part of its range. Though Brolgas often feed in dry grassland or ploughed paddocks or even desert claypans, they are dependent on wetlands too, especially shallow swamps, where they will forage with their head entirely submerged. | 23 OEH, PMST | Confirmed (A pair of Broglas was observed in the Project Site foraging in the north-eastern dam and over derived grasslands). | Ecosystem species |
| *Glossopsitta pusilla* | Little Lorikeet | - | V | Forages primarily in the canopy of open Eucalyptus forest and woodland, yet also finds food in apples (angophora sp.), paperbarks (melaleuca sp.) and other tree species. Riparian habitats are particularly used, due to higher soil | BBCC, 35 OEH | Confirmed (Numerous individuals were | Ecosystem species |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | fertility and hence greater productivity. Isolated flowering trees in open country (e.g. paddocks, roadside remnants) and urban trees also help sustain viable populations of the species. | | observed in feeding on flowering Pink Bloodwood through the Project Site) | |
| *Hieraaetus morphnoides* | Little Eagle | - | V | The Little Eagle is found throughout the Australian mainland excepting the most densely forested parts of the Dividing Range escarpment. It occurs as a single population throughout NSW. Occupies open eucalypt forest, woodland or open woodland. Sheoak or Acacia woodlands and riparian woodlands of interior NSW are also used. | BBCC, 1 OEH | High | Ecosystem species |
| *Irediparra gallinacea* | Comb-crested Jacana | - | V | Occurs on freshwater wetlands in northern and eastern Australia, mainly in coastal and subcoastal regions, from the north-eastern Kimberley Division of Western Australia to Cape York Peninsula then south along the east coast to the Hunter region of NSW, with stragglers recorded in south-eastern NSW (possibly in response to unfavourable conditions further north). Inhabit permanent freshwater wetlands, either still or slow-flowing, with a good surface cover of floating vegetation, especially water-lilies, or fringing and aquatic vegetation. | 18 OEH | Low | Species credit |
| *Ixobrychus flavicollis* | Black Bittern | - | V | The Black Bittern is found along the coastal plains within NSW, although individuals have rarely being recorded south of Sydney or inland. It inhabits terrestrial and estuarine wetlands such as flooded grasslands, forests, woodlands, rainforests and mangroves with permanent water and dense waterside vegetation. The Black Bittern typically roosts on the ground or in trees during the day and forages at night on frogs, reptiles, fish and invertebrates. The breeding season extends from December to March. Nests are constructed of reeds and sticks in branches overhanging the water. | BBCC | Low | Species credit |
| *Lathamus discolor* | Swift Parrot | E, M | E | On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp (from sap-sucking bugs) infestations. Favoured feed trees include winter flowering species such as Swamp Mahogany (*Eucalyptus robusta*), Spotted Gum (*Corymbia maculata*), Red Ironbark (*E. sideroxylon*), and White Box (*E. albens*). | BBCC, PMST | Moderate | Ecosystem species |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Lichenostomus fasciogularis* | Mangrove Honeyeater | - | V | The Mangrove Honeyeater is confined to the coastal fringe and offshore islands of eastern Australia, from Townsville, Queensland, south to the northern coast of NSW, where it may be expanding its range. The primary habitat of the species is mangrove woodlands and shrublands but Mangrove Honeyeaters also range into adjacent forests, woodlands and shrublands, including casuarina and paperbark swamp forests and associations dominated by eucalypts or banksias.<br>They occasionally forage in parks and gardens of coastal towns and villages. Mangrove Honeyeaters eat nectar, from flowers, and invertebrates, including marine snails and crabs. They generally forage in mangroves, mainly taking food from among the foliage but also feeding at flowers, and from the trunks and roots. They also sometimes forage among flowering trees and shrubs in adjacent habitats. | BBCC | Unlikely | Species credit |
| *Lophoictinia isura* | Square-tailed Kite | - | V | Typically inhabits coastal forested and wooded lands of tropical and temperate Australia. In NSW it is often associated with ridge and gully forests dominated by Eucalyptus longifolia, Corymbia maculata, E. elata, or E. smithii. Individuals appear to occupy large hunting ranges of more than 100 km2. They require large living trees for breeding, particularly near water with surrounding woodland /forest close by for foraging habitat. Nest sites are generally located along or near watercourses, in a tree fork or on large horizontal limbs. | BBCC, 16 OEH | Moderate | Ecosystem species |
| *Melanodryas cucullata cucullata* | Hooded Robin (south-eastern form) | - | V | The Hooded Robin is widespread, found across Australia, except for the driest deserts and the wetter coastal areas - northern and eastern coastal Queensland and Tasmania. However, it is common in few places, and rarely found on the coast. Prefers lightly wooded country, usually open eucalypt woodland, acacia scrub and mallee, often in or near clearings or open areas. Requires structurally diverse habitats featuring mature eucalypts, saplings, some small shrubs and a ground layer of moderately tall native grasses. | BBCC, 1 OEH | Moderate | Ecosystem species |
| *Melithreptus gularis gularis* | Black-chinned Honeyeater (eastern subsp.) | - | V | Extends south from central Queensland, through NSW, Victoria into south eastern South Australia, though it is very rare in the last state. In NSW it is widespread, with records from the tablelands and western slopes of the Great Dividing Range to the north-west and central-west plains and the Riverina. Occupies mostly upper levels of drier open forests or woodlands dominated | BBCC, 29 OEH | High | Ecosystem species |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | by box and ironbark eucalypts, especially Mugga Ironbark (*Eucalyptus sideroxylon*), White Box (*E. albens*), Inland Grey Box (*E. microcarpa*), Yellow Box (*E. melliodora*), Blakely's Red Gum (E. *blakelyi*) and Forest Red Gum (*E. tereticornis*). Also inhabits open forests of smooth-barked gums, stringybarks, ironbarks, river sheoaks (nesting habitat) and tea-trees. | | | |
| *Monarcha leucotis* (syn: *Carterornis leucotis*) | White-eared Monarch | - | V | The species is endemic to the coastal lowlands and eastern slopes of the Great Divide of eastern Australia, extending from Cape York Peninsula south to north-eastern NSW. In NSW, White-eared Monarchs are generally found from the Queensland border south to Iluka at the mouth of the Clarence River, and inland as far as the Richmond Range. In NSW, White-eared Monarchs occurs in rainforest, especially drier types, such as littoral rainforest, as well as wet and dry sclerophyll forests, swamp forest and regrowth forest. They appear to prefer the ecotone between rainforest and other open vegetation types or the edges of rainforest, such as along roads. | BBCC | Low | Species credit |
| Ninox connivens | Barking Owl | - | V | Found throughout continental Australia except for the central arid regions. Inhabits woodland and open forest, including fragmented remnants and partly cleared farmland. It is flexible in its habitat use, and hunting can extend in to closed forest and more open areas. | BBCC, 5 OEH | High | Ecosystem species |
| *Ninox strenua* | Powerful Owl | - | V | In NSW, it is widely distributed throughout the eastern forests from the coast inland to tablelands, with scattered records on the western slopes and plains suggesting occupancy prior to land clearing. Now at low densities throughout most of its eastern range, rare along the Murray River and former inland populations may never recover. The Powerful Owl inhabits a range of vegetation types, from woodland and open sclerophyll forest to tall open wet forest and rainforest. The Powerful Owl requires large tracts of forest or woodland habitat but can occur in fragmented landscapes as well. The species breeds and hunts in open or closed sclerophyll forest or woodlands and occasionally hunts in open habitats. It roosts by day in dense vegetation comprising species such as Turpentine *Syncarpia glomulifera*, Black She-oak *Allocasuarina littoralis*, Blackwood *Acacia melanoxylon*, Rough-barked Apple *Angophora floribunda*, Cherry Ballart *Exocarpus cupressiformis* and a number of eucalypt species. | BBCC, 15 OEH | High | Ecosystem species |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Pachyptila turtur subantarctica* | Fairy Prion (southern) | V, M | - | Fairy Prions (including other subspecies) are often beachcast on the south-eastern coast of Australia, and are commonly seen offshore over the continental shelf and over pelagic waters. The southern subspecies of the Fairy Prion is a marine bird, found mostly in temperate and subantarctic seas. On Macquarie Island and adjacent islets, the burrows of Fairy Prions are usually in crevices, in hollows beneath cushions of Colobanthus muscoides or in burrows in peaty soil held together by a thick cover of Cotula plumosa. | PMST | Unlikely | N/A |
| *Pandion cristatus* | Eastern Osprey | M | V | The Osprey has a global distribution with four subspecies previously recognised throughout its range. Favour coastal areas, especially the mouths of large rivers, lagoons and lakes. Feed on fish over clear, open water. | BBCC, 1 OEH | Moderate | Ecosystem species |
| *Petroica boodang* | Scarlet Robin | - | V | The Scarlet Robin lives in dry eucalypt forests and woodlands. The understorey is usually open and grassy with few scattered shrubs. This species lives in both mature and re-growth vegetation. It occasionally occurs in mallee or wet forest communities, or in wetlands and tea-tree swamps. | BBCC, 1 OEH | Moderate | Ecosystem species |
| *Pezoporus wallicus wallicus* | Ground Parrot (eastern subsp.) | - | V | In NSW populations have declined and contracted to islands of coastal or subcoastal heathland and sedgeland habitats. The species is found in small numbers on the north coast (Broadwater, Bundjalung, Yuraygir NPs) and Myall Lakes on the central coast. The largest populations occur on the NSW south coast, particularly Barren Grounds NR, Budderoo NP, the Jervis Bay area and Nadgee NR. The Ground Parrot occurs in high rainfall coastal and near coastal low heathlands and sedgelands, generally below one metre in height and very dense (up to 90% projected foliage cover). These habitats provide a high abundance and diversity of food, adequate cover and suitable roosting and nesting opportunities for the Ground Parrot, which spends most of its time on or near the ground. When flushed, birds fly strongly and rapidly for up to several hundred metres, at a metre or less above the ground. The coastal and subcoastal heathland and sedgeland habitats of the Ground Parrot are particularly fire-prone. Ground Parrots can re-colonise burnt habitat after 1-2 years and reach maximum densities after 15-20 years without fire. Therefore, it is recommended that habitat be protected from extensive and intense fires. | BBCC | Unlikely | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Pomatostomus temporalis temporalis* | Grey-crowned Babbler | - | V | In NSW, the eastern sub-species occurs on the western slopes of the Great Dividing Range, and on the western plains reaching as far as Louth and Balranald. It also occurs in woodlands in the Hunter Valley and in several locations on the north coast of NSW. It may be extinct in the southern, central and New England tablelands. Inhabits open Box-Gum Woodlands on the slopes, and Box-Cypress-pine and open Box Woodlands on alluvial plains. | BBCC, 53 OEH | Confirmed (Two family groups were observed occurring in the south west and east within the Project Site) | Ecosystem credit |
| *Ptilinopus regina* | Rose-crowned Fruit Dove | - | V | Coast and ranges of eastern NSW and Queensland, from Newcastle to Cape York. Vagrants are occasionally found further south to Victoria. Rose-crowned Fruit-doves occur mainly in sub-tropical and dry rainforest and occasionally in moist eucalypt forest and swamp forest, where fruit is plentiful. | 1 OEH | Low | Ecosystem species |
| *Rostratula australis* | Australian Painted Snipe | E | E | Most records are from the south east, particularly the Murray Darling Basin, with scattered records across northern Australia and historical records from around the Perth region in Western Australia. Prefers fringes of swamps, dams and nearby marshy areas where there is a cover of grasses, lignum, low scrub or open timber. Nests on the ground amongst tall vegetation, such as grasses, tussocks or reeds. | PMST | Moderate | Ecosystem species |
| *Stagonopleura guttata* | Diamond Firetail | - | V | Found in grassy eucalypt woodlands, including Box-Gum Woodlands and Snow Gum (*Eucalyptus pauciflora*) Woodlands. Also occurs in open forest, mallee, Natural Temperate Grassland, and in secondary grassland derived from other communities. Often found in riparian areas (rivers and creeks), and sometimes in lightly wooded farmland. | 9 OEH | High | Ecosystem credit |
| *Turnix melanogaster* | Black-breasted Button-quail | V | CE | The Black-breasted Button-quail is endemic to south-eastern Queensland and far north-eastern NSW, at scattered sites from the Byfield region south to the Border Ranges and mainly on and east of the Great Divide but extending inland to the inner western slopes, up to 300 km from the coast. There have been few recent records in north-eastern NSW, with only ten records, from six localities, in the 20 years to 2000, though there are many records directly adjacent to NSW across the Queensland border. There have been no published reports since 2000. Preferred habitat includes drier low closed forests, including dry rainforests, vine forest and vine thickets, often in association with Hoop Pine, and Bottletree scrubs. The understorey may be | PMST | Unlikely | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | dense or sparse, but a deep, moist leaf-litter layer, in which the birds forage, is an important component of habitat. Birds have been recorded using Lantana thickets at edges of rainforest or Lantana understorey of forest or rainforest, but it is not known if Lantana associations are suitable for sustaining breeding. During droughts, birds may move into wetter rainforests bordering dry rainforests. In NSW, as well as drier rainforests, may occupy wetter subtropical rainforests, sometimes in association with moist eucalypt forest. | | | |
| *Tyto novaehollandiae* | Masked Owl | - | V | Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Dry eucalypt forests and woodland, typically prefers open forest with low shrub density. Requires old trees for roosting and nesting. | BBCC, 8 OEH | High | Ecosystem credit |
| **MAMMALS** | | | | | | | |
| *Aepyprymnus rufescens* | Rufous Bettong | - | V | In NSW it has largely vanished from inland areas but there are sporadic, unconfirmed records from the Pilliga and Torrington districts. Rufous Bettongs inhabit a variety of forests from tall, moist eucalypt forest to open woodland, with a tussock grass understorey. A dense cover of tall native grasses is the preferred shelter. | BBCC, 140 OEH | Confirmed (A single individual was observed in derived grassland in the centre of the Project Site). | Species credit |
| *Cercartetus nanus* | Eastern Pygmy-possum | - | V | Found in a broad range of habitats from rainforest through to wet and dry sclerophyll forest and woodland to heath, but in most areas woodlands and heath appear to be preferred. | BBCC | Low | Species credit |
| *Chalinolobus dwyeri* | Large-eared Pied Bat | V | V | Forages over a broad range of open forest and woodland habitats, this species is a cave roosting bat which favours sandstone escarpment habitats for roosting, in the form of shallow overhangs, crevices and caves. | BBCC, PMST | Low | Species credit |
| *Chalinolobus nigrogriseus* | Hoary Wattled Bat | - | V | Widely distributed across northern Australia although absent from the arid centre. In north east NSW it extends from Port Macquarie in the south, north to the Queensland border. The species has been recorded as far west as Armidale and Ashford. In NSW the Hoary Wattled Bat occurs in dry open eucalypt forests, favouring forests dominated by Spotted Gum, boxes and | BBCC, 15 OEH | High | Ecosystem credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | ironbarks, and heathy coastal forests where Red Bloodwood and Scribbly Gum are common. Because it flies fast below the canopy level, forests with naturally sparse understorey layers may provide the best habitat. | | | |
| *Dasyurus maculatus* | Spotted-tailed Quoll | E | V | Wet and dry sclerophyll forests and rainforests, and adjacent open agricultural areas. Generally associated with large expansive areas of habitat to sustain territory size. Requires hollow-bearing trees, fallen logs, small caves, rock crevices, boulder fields and rocky-cliff faces as den sites. | BBCC, 6 OEH, PMST | Moderate | Ecosystem credit |
| *Miniopterus australis* | Little Bentwing-bat | - | V | East coast and ranges of Australia from Cape York in Queensland to Wollongong in NSW. Little Bentwing-bats roost in caves, tunnels, tree hollows, abandoned mines, stormwater drains, culverts, bridges and sometimes buildings during the day, and at night forage for small insects beneath the canopy of densely vegetated habitats. | 23 OEH | Confirmed | Species credit |
| *Miniopterus schreibersii oceanensis* | Eastern Bentwing-bat | - | V | Occurs on east and north west coasts of Australia. Caves are the primary roosting habitat, but also use derelict mines, storm-water tunnels, buildings and other manmade structures. | 1 OEH | High | Ecosystem and species credit |
| *Mormopterus beccarii* | Beccari's Freetail-Bat | - | V | Widely distributed across northern Australia from Western Australia to Queensland, extending south to the north-east corner of NSW. The only confirmed record in NSW is of a colony found in the roof of a house in Murwillumbah, however, calls have been detected from a few other locations in the far north east of the State. A range of vegetation types in northern Australia, from rainforests to open forests and woodlands, and are often recorded along watercourses. They can also occur in towns and cities. Roost mainly in tree hollows but relatively large colonies have been found under house roofs in urban areas in Queensland. | BBCC, 2 OEH | High | Ecosystem credit |
| *Mormopterus norfolkensis* | Eastern Freetail-bat | - | V | Occur in dry sclerophyll forest and woodland east of the Great Dividing Range. Roosts mainly in tree hollows but will also roost under bark or in human-made structures. | BBCC, 6 OEH | High | Ecosystem credit |
| *Myotis macropus (Myotis adversus)* | Southern Myotis | - | V | Generally roost in groups close to water in caves, mine shafts, hollow-bearing trees, and storm water channels, buildings, under bridges and in dense foliage. Forages over streams and pools catching insects and small fish. | 4 OEH | High | Ecosystem and species credit |
| *Petaurus australis* | Yellow-bellied | - | V | Found along the eastern coast to the western slopes of the Great Dividing | BBCC, 28 | High | Ecosystem |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | Glider | | | Range, from southern Queensland to Victoria. Occur in tall mature eucalypt forest generally in areas with high rainfall and nutrient rich soils. Forest type preferences vary with latitude and elevation; mixed coastal forests to dry escarpment forests in the north; moist coastal gullies and creek flats to tall montane forests in the south. Feed primarily on plant and insect exudates, including nectar, sap, honeydew and manna with pollen and insects providing protein. Extract sap by incising (or biting into) the trunks and branches of favoured food trees, often leaving a distinctive 'V'-shaped scar. | OEH | | credit |
| *Petaurus norfolcensis* | Squirrel Glider | - | V | The species is widely though sparsely distributed in eastern Australia, from northern Queensland to western Victoria. Inhabits mature or old growth Box, Box-Ironbark woodlands and River Red Gum forest west of the Great Dividing Range and Blackbutt-Bloodwood forest with heath understorey in coastal areas. Prefers mixed species stands with a shrub or *Acacia* midstorey. | BBCC, 8 OEH | Moderate | Species credit |
| *Petrogale penicillata* | Brush-tailed Rock-wallaby | V | E | Range extends from south-east Queensland to the Grampians in western Victoria, roughly following the line of the Great Dividing Range. Occupy rocky escarpments, outcrops and cliffs with a preference for complex structures with fissures, caves and ledges, often facing north. Browse on vegetation in and adjacent to rocky areas eating grasses and forbs as well as the foliage and fruits of shrubs and trees. | PMST | Unlikely | Species credit |
| *Phascogale tapoatafa* | Brush-tailed Phascogale | - | V | Patchy distribution around the coast of Australia. Prefer dry sclerophyll open forest with sparse groundcover of herbs, grasses, shrubs or leaf litter. Also inhabit heath, swamps, rainforest and wet sclerophyll forest. | BBCC, 33 OEH | High | Species credit |
| *Phascolarctos cinereus* | Koala | V | V | In NSW it mainly occurs on the central and north coasts with some populations in the west of the Great Dividing Range. Inhabit eucalypt woodlands and forests. Feed on the foliage of more than 70 eucalypt species and 30 non-eucalypt species, but in any one area will select preferred browse species. | BBCC, 43 OEH, PMST | High | Species credit |
| *Planigale maculata* | Common Planigale | - | V | Coastal north-eastern NSW, coastal east Queensland and Arnhem Land. The species reaches its confirmed southern distribution limit on the NSW lower north coast however there are reports of its occurrence as far south as the central NSW coast west of Sydney. Common Planigales inhabit rainforest, | BBCC | Moderate | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | eucalypt forest, heathland, marshland, grassland and rocky areas where there is surface cover, and usually close to water. They are active at night and during the day shelter in saucer-shaped nests built in crevices, hollow logs, beneath bark or under rocks. | | | |
| *Pseudomys gracilicaudatus* | Eastern Chestnut Mouse | - | V | In NSW the Eastern Chestnut Mouse mainly occurs north from the Hawkesbury River area as scattered records along to coast and eastern fall of the Great Dividing Range extending north into Queensland. There are however isolated records in the Jervis bay area. Mostly found, in low numbers, in heathland and is most common in dense, wet heath and swamps. In the tropics it is more an animal of grassy woodlands. Optimal habitat appears to be in vigorously regenerating heathland burnt from 18 months to four years previously. By the time the heath is mature, the larger Swamp Rat becomes dominant, and Eastern Chestnut Mouse numbers drop again. | BBCC | Low | Species credit |
| *Pseudomys novaehollandiae* | New Holland mouse | V | - | Distribution is fragmented across all eastern states of Australia, where it inhabits open heath lands, open woodlands with heath understorey and vegetated sand dunes. | PMST | Low | Ecosystem credit |
| *Pteropus poliocephalus* | Grey-headed Flying-fox | V | V | Generally found within 200 km of the eastern coast of Australia, from Rockhampton in Queensland to Adelaide in South Australia. In times of natural resource shortages, they may be found in unusual locations. Occur in subtropical and temperate rainforests, tall sclerophyll forests and woodlands, heaths and swamps as well as urban gardens and cultivated fruit crops. Roosting camps are generally located within 20 km of a regular food source and are commonly found in gullies, close to water, in vegetation with a dense canopy. Individual camps may have tens of thousands of animals and are used for mating, and for giving birth and rearing young. | PMST | High | Ecosystem credit |
| *Saccolaimus flaviventris* | Yellow-bellied Sheathtail-bat | - | V | Wide-ranging species found across northern and eastern Australia. Roosts singly or in groups of up to six, in tree hollows and buildings; in treeless areas they are known to utilise mammal burrows. | BBCC, 3 OEH | High | Ecosystem credit |
| *Scoteanax rueppellii* | Greater Broad-nosed Bat | - | V | Utilises a variety of habitats from woodland through to moist and dry eucalypt forest and rainforest, though it is most commonly found in tall wet forest. Although this species usually roosts in tree hollows, it has also been found in | BBCC, 4 OEH | High | Ecosystem credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | buildings. | | | |
| *Vespadelus troughtoni* | Eastern Cave Bat | - | V | Found in a broad band on both sides of the Great Dividing Range from Cape York to Kempsey, with records from the New England Tablelands and the upper north coast of NSW. A cave-roosting species that is usually found in dry open forest and woodland, near cliffs or rocky overhangs; has been recorded roosting in disused mine workings, occasionally in colonies of up to 500 individuals. | 1 OEH | Low | Ecosystem and species credit |
| **AMPHIBIANS** | | | | | | | |
| *Crinia tinnula* | Wallum Froglet | - | V | Wallum Froglets are found along the coastal margin from Litabella National Park in south-east Queensland to Kurnell in Sydney. Wallum Froglets are found in a wide range of habitats, usually associated with acidic swamps on coastal sand plains. They typically occur in sedgelands and wet heathlands. They can also be found along drainage lines within other vegetation communities and disturbed areas, and occasionally in swamp sclerophyll forests. The species breeds in swamps with permanent water as well as shallow ephemeral pools and drainage ditches. Breeding is thought to peak in the colder months, but can occur throughout the year following rain. Eggs of 1.1-1.2mm are deposited in water with a pH of <6 and tadpoles take 2-6 months to develop into frogs. Wallum Froglets shelter under leaf litter, vegetation, other debris or in burrows of other species. Shelter sites are wet or very damp and often located near the water's edge. Males may call throughout the year and at any time of day, peaking following rain. | BBCC, 6 OEH | Confirmed (Heard calling near degraded drainage line in the west of Project Site) | Species credit |
| *Litoria aurea* | Green and Golden Bell Frog | V | E | Since 1990 there have been approximately 50 recorded locations in NSW, most of which are small, coastal, or near coastal populations. These locations occur over the species' former range, however they are widely separated and isolated. Large populations in NSW are located around the metropolitan areas of Sydney, Shoalhaven and mid north coast (one an island population). There is only one known population on the NSW Southern Tablelands. Ephemeral and permanent freshwater wetlands, ponds, dams with an open aspect and fringed by Typha and other aquatics, free from predatory fish. | PMST | Unlikely | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Litoria brevipalmata* | Green-thighed Frog | - | V | Isolated localities along the coast and ranges from just north of Wollongong to south-east Queensland. Green-thighed Frogs occur in a range of habitats from rainforest and moist eucalypt forest to dry eucalypt forest and heath, typically in areas where surface water gathers after rain. It prefers wetter forests in the south of its range, but extends into drier forests in northern NSW and southern Queensland. | BBCC, 1 OEH | Moderate | Species credit |
| *Mixophyes balbus* | Stuttering Frog | E | V | Occur along the east coast of Australia from southern Queensland to north-eastern Victoria. Found in rainforest and wet, tall open forest in the foothills and escarpment on the eastern side of the Great Dividing Range. Outside the breeding season adults live in deep leaf litter and thick understorey vegetation on the forest floor. | PMST | Low | Species credit |
| *Mixophyes iteratus* | Giant Barred Frog | E | E | Forages and lives amongst deep, damp leaf litter in rainforests, moist eucalypt forest and nearby dry eucalypt forest, at elevations below 1000 m. They breed around shallow, flowing rocky streams from late spring to summer. | 1 OEH, PMST | Low | Species credit |
| **REPTILES** | | | | | | | |
| *Cacophis harriettae* | White-crowned Snake | - | V | Coastal and near-coastal areas from central eastern Queensland south to the vicinity of Coffs Harbour in north-east NSW. The western limit is the Legume area near the NSW-Queensland border; however, their stronghold appears to be the middle Clarence Valley. Favours low to mid-elevation dry eucalypt forest and woodland, particularly areas with a varied and well-developed litter layer, where their prey of small lizards may be more abundant. Also occasionally found in moist eucalypt forest and coastal heathland. | BBCC | Low | Species credit |
| *Coeranoscincus reticulatus* | Three-toed Snake-tooth Skink | V | V | The Three-toed Snake-tooth Skink occurs on the coast and ranges from the Macleay valley in NSW to south-eastern Queensland. It is very uncommon south of Grafton. Rainforest and occasionally moist eucalypt forest, on loamy or sandy soils. The Three-toed Snake-tooth Skink lives in loose soil, leaf litter and rotting logs, and feeds on earthworms and beetle grubs. | PMST | Low | Species credit |
| *Hoplocephalus bitorquatus* | Pale-headed Snake | - | V | A patchy distribution from north-east Queensland to the north-eastern quarter of NSW. In NSW it has historically been recorded from as far west as Mungindi and Quambone on the Darling Riverine Plains, across the north west slopes, and from the north coast from Queensland to Sydney. The Pale- | BBCC | Moderate | Species credit |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| | | | | headed Snake is a highly cryptic species that can spend weeks at a time hidden in tree hollows. Found mainly in dry eucalypt forests and woodlands, cypress forest and occasionally in rainforest or moist eucalypt forest. | | | |
| **INVERTEBRATES** | | | | | | | |
| *Arhyreus hyperbius* | Australian Fritillary | - | E | The Australian Fritillary is restricted to south-east Queensland and north-east NSW in open swampy coastal areas where the larval food plant Arrowhead Violet Viola betonicifolia occurs. The Australian Fritillary is found in open swampy coastal habitat. | BBCC | Low | Species credit |
| **MIGRATORY** | | | | | | | |
| *Apus pacificus* | Fork-tailed Swift | M | - | Recorded in all regions of NSW. The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. | PMST | Moderate | N/A |
| *Ardea alba* | Great Egret | M | - | Widespread in Australia. Reported in a wide range of wetland habitats (for example inland and coastal, freshwater and saline, permanent and ephemeral, open and vegetated, large and small, natural and artificial). | PMST | High | N/A |
| *Ardea ibis* | Cattle Egret | M | - | Widespread and common according to migration movements and breeding localities surveys. Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. | 5 OEH | High | N/A |
| *Calidris acuminata* | Sharp-tailed Sandpiper | M | - | The Sharp-tailed Sandpiper spends the non-breeding season in Australia with small numbers occurring regularly in New Zealand. Most of the population migrates to Australia, mostly to the south-east and are widespread in both inland and coastal locations and in both freshwater and saline habitats. Many inland records are of birds on passage. Prefers muddy edges of shallow fresh or brackish wetlands, with inundated or emergent sedges, grass, saltmarsh or other low vegetation. | 1 OEH | Low | N/A |
| *Cuculus optatus* | Oriental Cuckoo | M | - | Migrates from Eurasia as far south as Indonesia, New Guinea and North Australia. Some remain through Australia in the winter. Inhabits rainforest margins, monsoon forest, vine scrub and mangroves. | PMST | Low | N/A |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Gallinago hardwickii* | Latham's Snipe | M | - | Recorded along the east coast of Australia from Cape York Peninsula through to south-eastern South Australia. Occurs in permanent and ephemeral wetlands up to 2000 m above sea-level. | 4 OEH, PMST | Low | N/A |
| *Gelochelidon nilotica* | Gull-billed Tern | M | - | The Gull-billed Tern is a nomadic inland species occurring on all continents except Antarctica. They are found in freshwater swamps, brachish and salt lakes, beaches, estuaries, floodwaters, farms and grasslands. When not breeding this species prefers coastal habitats such as saltmarshes and lagoons (Birdlife Australia, 2016). | 1 OEH | Unlikely | N/A |
| *Haliaeetus leucogaster* | White-bellied Sea-Eagle | M | - | Distributed along the coastline (including offshore islands) of mainland Australia and Tasmania. Found in coastal habitats (especially those close to the sea-shore) and around terrestrial wetlands in tropical and temperate regions of mainland Australia and its offshore islands. The habitats occupied by the sea-eagle are characterised by the presence of large areas of open water (larger rivers, swamps, lakes, and the sea). | 7 OEH, PMST | Moderate | N/A |
| *Hirundapus caudacutus* | White-throated Needletail | M | - | Widespread in eastern and south-eastern Australia. Almost exclusively aerial, from heights of less than 1 m up to more than 1000 m above the ground. They also commonly occur over heathland but less often over treeless areas, such as grassland or swamps. | 3 OEH, PMST | Moderate | N/A |
| *Limosa lapponica* | Bar-tailed Godwit | M | - | The Bar-tailed Godwit has been recorded in the coastal areas of all Australian states. The Bar-tailed Godwit is found mainly in coastal habitats such as large intertidal sand flats, banks, mudflats, estuaries, inlets, harbours, coastal lagoons and bays. | PMST | Unlikely | N/A |
| *Merops ornatus* | Rainbow Bee-eater | M | - | Distributed across much of mainland Australia, and occurs on several near-shore islands. Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation. | PMST | Confirmed (Abundant across entire Project Site, particularly in open forest) | N/A |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Monarcha melanopsis* | Black-faced Monarch | M | - | Widespread in eastern Australia. Mainly occurs in rainforest ecosystems, including semi-deciduous vine-thickets, complex notophyll vine-forest, tropical (mesophyll) rainforest, subtropical (notophyll) rainforest, mesophyll (broadleaf) thicket/shrubland, warm temperate rainforest, dry (monsoon) rainforest and (occasionally) cool temperate rainforest. | PMST | Low | N/A |
| *Monarcha trivirgatus* | Spectacled Monarch | M | - | Occurs along the entire east coast of Australia. Breeds in dense scrub in gullies of coastal ranges. | PMST | Low | N/A |
| *Motacilla flava* | Yellow Wagtail | M | - | Rare but regular visitor around Australian coast, especially in the NW coast Broome to Darwin. Found in open country near swamps, salt marshes, sewage ponds, grassed surrounds to airfields, bare ground; occasionally on drier inland plains. | PMST | Moderate | N/A |
| *Myiagra cyanoleuca* | Satin Flycatcher | M | - | Widespread in eastern Australia and vagrant to New Zealand. Inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests. | PMST | Confirmed (on the western border in open forest with *Allocasuarina* sp. understorey) | N/A |
| *Plegadis falcinellus* | Glossy Ibis | M | - | Preferred habitat for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. | 5 OEH | High | N/A |
| *Rhipidura rufifrons* | Rufous Fantail | M | - | Occurs in coastal and near coastal districts of northern and eastern Australia. In east and south-east Australia, the Rufous Fantail mainly inhabits wet sclerophyll forests, often in gullies dominated by eucalypts such as Tallow-wood (*Eucalyptus microcorys*), Mountain Grey Gum (*E. cypellocarpa*), Narrow-leaved Peppermint (*E. radiata*), Mountain Ash (E. regnans), Alpine Ash (*E. delegatensis*), Blackbutt (*E. pilularis*) or Red Mahogany (*E. resinifera*); usually with a dense shrubby understorey often including ferns. | PMST | Moderate | N/A |
| *Tringa nebularia* | Common Greenshank | M | - | The Common Greenshank does not breed in Australia, however, the species occurs in all types of wetlands and has the widest distribution of any shorebird in Australia. | PMST | Low | N/A |

| Scientific name | Common name | EPBC Act | TSC Act | Distribution and habitat features* | Source+ | Likelihood of occurrence | Class of credit |
|---|---|---|---|---|---|---|---|
| *Tringa stagnatilis* | Marsh Sandpiper | M | - | Fresh or brackish (slightly salty) wetlands such as rivers, water meadows, sewage farms, drains, lagoons and swamps. | 1 OEH | Moderate | N/A |
| An additional four migratory species are previously mentioned listed as threatened under the EPBC Act and TSC Act. These include: Magpie Goose, Swift Parrot, Osprey and Australian Painted Snipe. | | | | | | | |
| * Distribution and habitat requirement information adapted from:<br>Australian Government Department of the Environment http://www.environment.gov.au/biodiversity/threatened/index.html<br>NSW Office of Environment and Heritage http://www.environment.nsw.gov.au/threatenedspecies/<br>Department of Primary Industries – Threatened Fish and Marine Vegetation http://pas.dpi.nsw.gov.au/Species/All_Species.aspx<br>+ Data source includes<br>BBCC = BioBanking Credit Calculator from the NSW Office of Environment and Heritage website (Accessed January 2016) https://www.environment.nsw.gov.au/ASMSLightProfileAPP<br>OEH = Number of records from the NSW Office of Environment and Heritage Wildlife Atlas record data (Accessed January 2016); and<br>PMST = Identified from the Protected Matters Search Tool (PMST) Australian Government Department of Environment<br>http://www.environment.gov.au/epbc/pmst/index.html<br>Key:<br>CE = critically endangered<br>E = endangered<br>V = vulnerable<br>M = migratory | | | | | | | |

# Appendix B. Flora and fauna species recorded

Table B-1 Flora species recorded

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| NYMPAEACEAE | *Nymphaea capensis* | Cape Waterlily | i | | | | | | | | | | | | | | ü |
| ADIANTACEAE | *Cheilanthes sieberi* subsp. *sieberi* | Slender Cloak-fern | | | | | | | | | | | | | | 1 | |
| MARSILEACEAE | *Marsilea mutica* | Nardoo | | | | | | | | | | | | | | | ü |
| ACANTHACEAE | *Brunoniella australis* | Blue Trumpet | | 1 | | 2 | 1 1 | | | | 1 | | 1 | 1 | | | |
| ACANTHACEAE | *Pseuderanthemum variable* | Pseuderanthemum | | | | | | 1 | 1 | | | | | | | | |
| AMARANTHACEAE | *Alternanthera denticulata* | Lesser Joyweed | | | | | | 1 | | | | | | | | | |
| AMARANTHACEAE | *Alternanthera pungens* | Khaki Weed | i | | | | | | | | | | | | | | ü |
| APIACEAE | *Centella asiatica* | Swamp Pennywort | | | 1 | 1 | | 1 | | 2 | 2 2 | 2 2 | | | | 2 | |
| APIACEAE | *Cyclospermum leptophyllum* | Slender Celery | i | | | | | | | | 1 | | | | | | |
| APIACEAE | *Hydrocotyle laxiflora* | Stinking Pennywort | | | | | | | | | | | | | 2 | | |
| APIACEAE | *Hydrocotyle peduncularis* | Hairy Pennywort | | | | | | | | | | | | | | 1 | |
| APIACEAE | *Hydrocotyle tripartita* | Tre-foil Pennywort | | | | | | | | | | | | | | | ü |
| APOCYNACEAE | *Gomphocarpus fruticosus* | Narrow-leaved Cotton Bush | i | 1 | 1 2 | 1 1 1 | 1 1 | | | | | 1 | 1 | 1 | | 1 | |
| APOCYNACEAE | *Gomphocarpus physocarpus* | Balloon Cotton Bush | i | | | | | | | | | 1 | | | | | |
| APOCYNACEAE | *Parsonsia straminea* | Common Silkpod | | | | | | 2 | | | | | | | | | |
| ASTERACEAE | *Ambrosia artemisiifolia* | Annual Ragweed | i | | | | | | | | | | | | | | ü |
| ASTERACEAE | *Aster subulatus* | Wild Aster | i | | | | | | | | | | | | 1 | | |
| ASTERACEAE | *Baccharis halimifolia* | Groundsel Bush | i | | | | | | | | | | | | | | ü |
| ASTERACEAE | *Bidens pilosa* | Cobblers Peg | i | | | | | | | | | | | | | | ü |
| ASTERACEAE | *Centipeda minima* subsp. *minima* | Spreading Sneeze Weed | | | | | | | | | | | | | | | ü |
| ASTERACEAE | *Chrysocephalum apiculatum* | Yellow Buttons | | | | | | | | 1 | | | | | | | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| ASTERACEAE | *Cirsium vulgare* | Spear Thistle | i | | | | | 1 | | 1 | | 1 | 1 | | | | |
| ASTERACEAE | *Conyza spp.* | Fleabane | i | | 1 | | | 1 | | | | | | | | | |
| ASTERACEAE | *Eclipta platyglossa* | Eclipta | | | | 1 | | | | | 1 | | | | | | |
| ASTERACEAE | *Epaltes australis* | Spreading Nut-heads | | | | | 1 | | | | | | | | | | |
| ASTERACEAE | *Euchiton gymnocephalus* | | | 2 | 2 | 1 | | 1 | | 2 | 1 | | | 1 | | | |
| ASTERACEAE | *Gamochaeta purpurea* | Cudweed | i | | 1 | | | | | | | | | | | | |
| ASTERACEAE | *Hypochaeris radicata* | Catsear | i | | 1 | 1 | | | | | 1 | 1 1 | 1 | | | 1 | |
| ASTERACEAE | *Lagenophora stipitata* | Bottle-daisy | | | | 1 | | | | | | | | | | | |
| ASTERACEAE | *Ozothamnus diosmifolius* | Tall Paperdaisy | | | | | | | | | | | | | | | ü |
| ASTERACEAE | *Senecio madagascariensis* | Fireweed | i | 1 | 1 1 | 1 1 1 | 1 1 | | | | | 1 | 2 | 1 | | 1 | |
| ASTERACEAE | *Sonchus oleraceus* | Common Sow-thistle | i | | 1 | | | | | | 1 | | | | | | |
| ASTERACEAE | *Vernonia cinerea* var. *cinerea* | Vernonia | | 2 | 2 2 | | 2 | 1 1 | 2 2 | | | 1 | | 2 | | 2 | |
| CAMPANULACEAE | *Wahlenbergia gracilis* | Sprawling Bluebell | | | 1 | | | | | | | | 1 | 1 | | 1 | |
| CASUARINACEAE | *Allocasuarina littoralis* | Black She-oak | | | | | | | | | | | | | | | ü |
| CASUARINACEAE | *Casuarina glauca* | Swamp Oak | | | | | | | | | | | | | | | ü |
| CLUSIACEAE | *Hypericum gramineum* | Narrow-leaf St. Johns Wort | | | | | | | | 1 | | | | | | | |
| CONVOLVULACEAE | *Dichondra repens* | Kidney Weed | | 3 | 3 2 | 3 3 2 | 3 3 | | | | | 3 | 3 | 3 | | 3 | |
| CONVOLVULACEAE | *Polymeria calycina* | Woodland Bindweed | | 2 | 1 | 2 | 2 | | 1 | 2 | 2 | 2 | | 1 | | | |
| DILLENIACEAE | *Hibbertia vestita* | Hairy Guinea-flower | | | | | | | 1 | 1 | | | | | | | |
| PHYLLANTHACEAE | *Breynia oblongifolia* | Breynia | | | | | | | | | | | | 1 | | | |
| PHYLLANTHACEAE | *Phyllanthus virgatus* | Small-leaf Spurge | | 2 | 1 1 | 1 1 1 | 2 1 | | | | | 2 | 1 | 1 | | 1 | |
| PHYLLANTHACEAE | *Poranthera microphylla* | Small Poranthera | | | | | | | | | | | | | | | ü |
| PHYLLANTHACEAE | *Suaropus hirtellus* | | | | | | | | 1 | 1 | | | | | | | |
| FABACEAE-FABOIDEAE | *Aeschynomene villosa* | Villose Jointvetch | i | | | | | | | | | 1 | 1 | | | | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| FABACEAE-FABOIDEAE | *Daviesia ulicifolia* | Gorse Bitter-pea | | | | | | | 1 | 1 | | | | | | | |
| FABACEAE-FABOIDEAE | *Desmodium gunnii* | Slender Tick Trefoil | | 1 | | | | 1 | | 1 | | | | 1 | | 1 | |
| FABACEAE-FABOIDEAE | *Desmodium rhytidophyllum* | Rusty Tick-trefoil | | | | | | | | | | | | | | | |
| FABACEAE-FABOIDEAE | *Desmodium varians* | Slender Tick-trefoil | | 2 | 2 2 | 1 1 1 | 1 2 | | | | | 2 | 2 | 2 | | 1 | |
| FABACEAE-FABOIDEAE | *Galactia tenuiflora* var. *lucida* | | | | | | | | | | | | | | | | ü |
| FABACEAE-FABOIDEAE | *Glycine clandestina* | Twining Glycine | | | | | | | | | | | 1 | | | 1 | |
| FABACEAE-FABOIDEAE | *Glycine tabacina* | | | 2 | 1 2 | 2 1 1 | | | | | 1 | 1 1 | 2 | | | | |
| FABACEAE-FABOIDEAE | *Glycine tomentella* | Wooly Glycine | | | | 1 | | | | | | | | | | | |
| FABACEAE-FABOIDEAE | *Lespedeza juncea* | | | | | | | | | | 2 | | | | | | |
| FABACEAE-FABOIDEAE | *Lespedeza striata* | Japanese Clover | i | | | | | | | | 2 | | 1 | 1 | | 1 | |
| FABACEAE-FABOIDEAE | *Lupinis sp.* | Lupin | i | | | | | | | | | 1 | | | | | |
| FABACEAE-FABOIDEAE | *Podolobium scandens* | Netted Shaggy-pea | | | | | | | 2 | 2 | | | | | | | |
| FABACEAE-FABOIDEAE | *Trifolium repens* | White Clover | i | | | | | | | | | 2 | 2 | | | | |
| FABACEAE-FABOIDEAE | *Vigna vexillata* var. *angustifolia* | Wild Cow Pea | | | | | | | | | 2 | | | | | | |
| FABACEAE-MIMOSOIDEAE | *Acacia concurrens* | Curracabah | | | | | | | | 2 | | | | | | 1 | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| GENTIANACEAE | *Centaurium erythraea* | Common Centaury | i | | | | | | | | | | | | | | ü |
| GOODENIACEAE | *Goodenia heterophylla* | Variable-leaf Goodenia | | 1 | | 1 | | | 3 | 3 | | | | 1 | | 2 | |
| GOODENIACEAE | *Goodenia paniculata* | Panicled Goodenia | | | | | | | | | | | | | 2 | | |
| GOODENIACEAE | *Velleia paradoxa* | Spur Vellia | | | | 1 | | | | 1 | | | | | | | |
| HALORAGACEAE | *Haloragis heterophylla* | Variable Raspwort | | | | | | | | | | | | | | | ü |
| HALORAGACEAE | *Myriophyllum latifolium* | Water-milfoil | | | | | | | | | | | | | | | ü |
| LAMIACEAE | *Ajuga australis* | Austral Bugle | | | | | | | | | 1 | | | | | 1 | |
| LAMIACEAE | *Mentha satureioides* | Creeping Mint | | | | | | | | | | | | | | | ü |
| LAMIACEAE | *Plectranthus parviflorus* | Cockspur Flower | | | | | | 2 | | | | | | | | | |
| LAURACEAE | *Cinnamomum camphora* | Camphor Laurel | i | | | | | | | | | | | | | | ü |
| LENTIBULARIACEAE | *Utricularia gibba* | Floating Bladderwort | | | | | | | | | | | | | | | ü |
| LOBELIACEAE | *Lobelia alata* | Angled Lobelia | | | | | | | | | | | | | 2 | | |
| LOBELIACEAE | *Pratia purpurascens* | White Root | | 1 | 1 1 | 2 1 1 | 1 2 | | | | | | 1 | 1 | | 1 | |
| LOGANIACEAE | *Mitrasacme alsinoides* | | | | | | | | | | | | | | | | ü |
| MALVACEAE | *Sida rhombifolia* | Paddys Lucerene | i | 1 | | 1 | 1 1 | | | | | 1 | | | | | |
| MENYANTHACEAE | *Nymphoides indica* | White Marshwort | | | | | | | | | | | | | | | ü |
| MENYANTHACEAE | *Villarsia reniformis* | | | | | | | | | | | | | | 2 | | |
| MORACEAE | *Maclura cochinchinensis* | Cockspur Thorn | | | | | | | | | | | | | | | ü |
| MYOPORACEAE | *Eremophila debilis* | Winter Apple | | 1 | | | 1 | | 1 | | | | | | | | |
| MYRTACEAE | *Angophora subvelutina* | Broad-leaved Apple | | | | | | | | | | | | | | | ü |
| MYRTACEAE | *Corymbia henryi* | Spotted Gum | | | | 4 | 3 1 | | | | 4 | | | | | | |
| MYRTACEAE | *Corymbia intermedia* | Pink Bloodwood | | | 3 | | | | 4 | 3 | | | | 3 | | 3 | |
| MYRTACEAE | *Eucalyptus eugenioides* | Thin-leaved Stringybark | | | | | | | | | | | | 1 | | 2 | |
| MYRTACEAE | *Eucalyptus fibrosa* | Broad-leaf Ironbark | | | | | | | 1 | | | | | | | | |
| MYRTACEAE | *Eucalyptus moluccana* | Grey Box | | 4 | | | 3 | 3 | | | 1 | 3 | | | | | |
| MYRTACEAE | *Eucalyptus propinqua* | Small-fruited Grey Gum | | | | | 4 | | 4 | | | | | | | 3 | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| MYRTACEAE | *Eucalyptus seeana* | Narrow-leaved Red Gum | | | | | | | | | | | | | | | ü |
| MYRTACEAE | *Eucalyptus siderophloia* | Northern Grey Ironbark | | | 4 | | | | 1 | 1 | | | | 3 | | | |
| MYRTACEAE | *Eucalyptus tereticornis* | Forest Red Gum | | | | | | 1 | | 1 | 1 3 | 3 1 | | | | | |
| MYRTACEAE | *Lophostemon suaveolens* | Swamp Turpentine | | | | | | | | 2 | | | | | | | |
| MYRTACEAE | *Melaleuca irbyana* | | t | | | | | | | | | | | | | | ü (Adjacent to site) |
| OLEACEAE | *Jasminum suavissimum* | | | | | | | | | | | | | | | | ü |
| ONAGRACEAE | *Ludwigia peploides* subsp. *montevidensis* | Water Primrose | | | | | | | | | | | | | | | ü |
| OXALIDACEAE | *Oxalis perennans* | | | 2 | 1 | 1 | | 1 | | | 1 | 2 1 | 1 | | | 1 | |
| PLANTAGINACEAE | *Plantago debilis* | Slender Plantain | | 2 | 2 | | 1 | 2 | | | 1 | 1 | | | | | |
| PLANTAGINACEAE | *Plantago lanceolata* | Plantain | i | | 1 | | | | | | | | 1 | | | | |
| POLYGALACEAE | *Polygala japonica* | Dwarf Milkwort | | | | | | | | 1 | | | | 1 | | | |
| POLYGONACEAE | *Persicaria decipiens* | Slender Knotweed | | | | | | | | | | | | | | | ü |
| POLYGONACEAE | *Persicaria hydropiper* | Water Pepper | | | | | | | | | | | | | | | ü |
| POLYGONACEAE | *Persicaria strigosa* | Spotted Knotweed | | | | | | | | | | | | | | | ü |
| RANUNCULACEAE | *Ranunculus lappaceus* | Common Buttercup | | | | | | | | | | | | | | | ü |
| RHAMNACEAE | *Alphitonia excelsa* | Red Ash | | 1 | | 1 | | 1 | 1 | 1 | 1 | | | 1 | | 1 | |
| RUBIACEAE | *Asperula gemella* | Twin-leaved Bedstraw | | 1 | | | | | | | 2 | 1 | | 1 | | | |
| RUBIACEAE | *Opercularia diphylla* | Stinkweed | | | | | | | | | | | | | | | ü |
| RUBIACEAE | *Richardia stellaris* | | i | 1 | | | | | | | | | | | | | |
| SCROPHULARIACEAE | *Gratiola pedunculata* | | | | | | | | | | | | | | 2 | | |
| SCROPHULARIACEAE | *Veronica plebeia* | Trailing Speedwell | | | 1 | | 1 | 1 | 2 | | | | | 1 | | | |
| SOLANACEAE | *Solanum chenopodioides* | Whitetip Nightshade | i | 1 | 1 | 1 | | | | | | 1 | 1 | | | | |
| SOLANACEAE | *Solanum prinophyllum* | Forest Nightshade | | 1 | 1 | | | | | | | | | | | 1 | |
| THYMELEACEAE | *Pimelea linifolia* subsp. *linifolia* | Slender Rice Flower | | | | | | | | | | | | 1 | | | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| VERBENACEAE | *Lantana camara* | Lantana | i | | | | | | 1 | | | | | 1 | | | |
| VERBENACEAE | *Verbena bonariensis* | Purple Top | i | | | | | | | | | | | | | | ü |
| VERBENACEAE | *Verbena rigidus* | Creeping Verbena | i | | | | | | | | | | | | | | ü |
| VIOLACEAE | *Hybanthus stellarioides* | | | 1 | | | 1 | 1 | 2 | 1 | | | | 1 | | 1 | |
| VIOLACEAE | *Viola betonicifolia* | Showy Violet | | 1 | | | | | | | | | | | | | |
| ANTHERICACEAE | *Arthropodium milleflorum* | Vanilla Lily | | | | | 1 | 1 | | | | | | 1 | | 1 | |
| ANTHERICACEAE | *Dichopogon strictus* | Chocolate Lily | | | 1 | 2 | | | | 1 | 2 | | 1 | | | | |
| ANTHERICACEAE | *Laxmannia gracilis* | Grass Wire-lily | | | 1 | 1 | | | 2 | 1 | | | | 1 | | | |
| ANTHERICACEAE | *Tricoryne elatior* | Yellow Rush-lily | | 1 | 1 | | | | | 1 | | | | | | 1 | |
| COMMELINACEAE | *Commelina cyanea* | Scurvy Weed | | 2 | 2 2 | 1 2 1 | | | | | 1 | | | 1 | | | |
| COMMELINACEAE | *Murdannia graminea* | Grass Lily | | 1 | 1 | 1 | | 2 | | | 1 | | | | | | |
| CYPERACEAE | *Carex inversa* | Knob Tassel-sedge | | | 1 | 1 | | 1 | | | 1 | 1 1 | 2 | | | | |
| CYPERACEAE | *Cyperus brevifolius* | Mullumbimy Couch | | | | | | | 1 | | | 1 | | | | | |
| CYPERACEAE | *Cyperus difformis* | Dirty Dora | | | | | | | | | | | | | | | ü |
| CYPERACEAE | *Cyperus flaccidus* | Lax Flat-sedge | | | | | | | | | | | | | 1 | | |
| CYPERACEAE | *Cyperus fulvus* | Sticky Sedge | | 1 | 1 | | | | | | | | | | | | |
| CYPERACEAE | *Cyperus gracilis* | Slender Flat Sedge | | 3 | 3 1 | 2 1 | | | | | 1 | 1 2 | 1 | | | | |
| CYPERACEAE | *Cyperus haspan* | | | | | | | | | | | | | | 2 | | |
| CYPERACEAE | *Cyperus polystachyos* | Bunchy Flat-sedge | | | | | 2 | | | | | | | | 2 | 1 | |
| CYPERACEAE | *Cyperus trinervis* | | | | | | | | | | | | | | | | ü |
| CYPERACEAE | *Eleocharis acuta* | Common Spike-rush | | | | | | | | | | | | | | | ü |
| CYPERACEAE | *Eleocharis dietrichiana* | Spike-rush | | | | | | | | | | | | | 1 | | |
| CYPERACEAE | *Eleocharis equisetina* | Spike-rush | | | | | | | | | | | | | 3 | | |
| CYPERACEAE | *Eleocharis gracilis* | Slender Spike-rush | | | | | | | | | | | | | 3 | | |
| CYPERACEAE | *Eleocharis sphacelata* | Tall Spike-rush | | | | | | | | | | | | | | | ü |
| CYPERACEAE | *Fimbristylis dichotoma* | Common Fringe-rush | | | 2 | 1 | 1 | 2 2 | 2 | | 1 | | 1 | 2 | | 1 | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| CYPERACEAE | *Schoenoplectiella mucronata* | Angled Club-rush | | | | | | | | | | | | | 2 | | |
| CYPERACEAE | *Scleria mackaviensis* | | | 1 | | 1 | | | | | 1 | | | | | 1 | |
| HYPOXIDACEAE | *Hypoxis hygrometrica* var. *villosisepala* | Yellow Weather-grass | | | | | | | | | | | | | | | ü |
| JUNCACEAE | *Juncus polyanthemus* | Many-flowered Rush | | | | | | 1 | | | | | 1 | | | | |
| JUNCACEAE | *Juncus prismatocarpus* | Branching Rush | | | | | | | | | | | | | 2 | | |
| JUNCACEAE | *Juncus usitatus* | Common Rush | | | | | | | | | 1 | | | 1 | | | |
| LOMANDRACEAE | *Lomandra filiformis* subsp. *coriacea* | Wattle Mat-rush | | 1 | 1 | | | 1 | 2 | | | | 1 | 1 | | 1 | |
| LOMANDRACEAE | *Lomandra filiformis* subsp. *filiformis* | Wattle Mat-rush | | | | | | | | | | | | | | | ü |
| LOMANDRACEAE | *Lomandra longifolia* subsp. *longifolia* | Spiny Mat-rush | | | | | | | | | | | | | | | ü |
| LOMANDRACEAE | *Lomandra multiflora* subsp. *multiflora* | Many-flowered Mat-rush | | 1 | 1 | | | | | | | | | | | | |
| LUZURIAGACEAE | *Eustrephus latifolius* | Wombat Berry | | 2 | 2 2 | 2 1 1 | 1 2 | | | | | | | | | | |
| LUZURIAGACEAE | *Geitonoplesium cymosum* | Scrambling Lily | | | | | | | | | | | | | | | ü |
| ORCHIDACEAE | *Spiranthes sinensis* var. *australis* | Austral Ladies Tresses | | | | | | | | | | | | | | | ü |
| PHILYDRACEAE | *Philydrum lanuginosum* | Frogsmouth | | | | | | | | | | | | | 3 | | |
| PHORMIACEAE | *Dianella caerulea* var. *caerulea* | Leafy Blue Flax Lily | | | | | | | 1 | | | | | | | | |
| PHORMIACEAE | *Dianella longifolia* var. *longifolia* | Long-leaf Flax Lily | | | 1 | | | | 1 | 1 | | | | | | | |
| PHORMIACEAE | *Dianella revoluta* var. *revoluta* | Black-anther Flax Lily | | | | | | | | | | | | | | | ü |
| POACEAE | *Alloteropsis semialata* | Cockatoo Grass | | | | | | | | | | | | 2 | | | |
| POACEAE | *Andropogon virginicus* | Whisky Grass | i | | | | | | 1 | 1 | | | | | | 1 | |
| POACEAE | *Aristida benthamii* | Three-awned spear grass | | | | | | 2 | | | | | | | | | |
| POACEAE | *Aristida ramosa* | Three-awned Spear Grass | | 3 | 3 3 | 3 3 | | | | | 3 | 2 3 | 3 | | | 3 | |
| POACEAE | *Aristida vagans* | Three-awned Spear Grass | | 2 | 1 | 3 | 2 | | 3 | 3 | 1 | 1 | | 2 | | 3 | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| POACEAE | *Axonopus compressus* | Broad-leaved Carpet Grass | i | 3 | 1 3 | 3 3 2 | 3 3 4 | 4 3 2 | 3 | | | | | | | | |
| POACEAE | *Axonopus fissifolius* | Narrow-leaved Carpet Grass | i | | | | | | | | | | | | | | ü |
| POACEAE | *Bothriochloa macra* | Red-leg Grass | | 2 | 2 2 | 3 3 2 | 2 2 | | | | | 2 | 3 | 1 | | 1 | |
| POACEAE | *Capillipedium spicigerum* | Scented-top Grass | | | | | | | | 1 | | | | | | | |
| POACEAE | *Chloris gayana* | Rhodes Grass | i | | | | | | | | | | | | | | ü |
| POACEAE | *Chloris ventricosa* | Tall Windmill Grass | | 2 | 3 | | | 2 | | | 2 | 2 2 | | | | | |
| POACEAE | *Cymbopogon refractus* | Barbed Wire Grass | | 3 | 3 3 | 3 3 3 | 3 | | | | 3 | 2 3 | | | | 3 | |
| POACEAE | *Cynodon dactylon* | Common Couch | | | | 1 | | | | | | 1 | | | | | |
| POACEAE | *Deyeuxia quadriseta* | Reed Bent-grass | | | | | | | | | | | | | | | ü |
| POACEAE | *Dichelachne micrantha* | Short-hair Plume Grass | | | 1 | | | | 1 | | | | 1 | 1 | | | |
| POACEAE | *Digitaria didactyla* | Queensland Blue Couch | | | | | | | | | | 3 | | | | | |
| POACEAE | *Digitaria diffusa* | Open Summer-grass | | | 1 | | 3 | | 1 | | | | | | | 2 | |
| POACEAE | *Digitaria parviflora* | Small-flower Finger Grass | | | | | | | | | | | | 1 | | | |
| POACEAE | *Echinopogon caespitosus* | Hedgehog Grass | | | | | 1 | | 2 | | | | | 1 | | 3 | |
| POACEAE | *Echinopogon ovatus* | Hedgehog Grass | | | | | | | | | | | | | | | ü |
| POACEAE | *Entolasia marginata* | Margined Panic | | | | | | | | | | | | | | | ü |
| POACEAE | *Entolasia stricta* | Wiry Panic | | | | | | | 2 | | | | | | | | |
| POACEAE | *Eragrostis brownii* | Brown's Lovegrass | | 1 | 1 | | | | 1 | 2 | 2 | | | | | | |
| POACEAE | *Eragrostis curvula* | African Lovegrass | i | | | 1 | | | | | | | | | | | |
| POACEAE | *Eragrostis elongata* | Narrow Lovegrass | | | | | | | | | | | | | | | ü |
| POACEAE | *Eragrostis leptostachya* | Paddock Lovegrass | | 1 | 1 | | 1 | 2 | | 1 | 2 2 | 2 2 | | | | 2 | |
| POACEAE | *Imperata cylindrica* | Blady Grass | | 3 | 3 | 3 | | | 3 | 4 | 5 | | | 4 | | | |
| POACEAE | *Lachnagrostis filiformis* | Blown Grass | | | | | | | | | | | | | | | ü |
| POACEAE | *Microlaena stipoides* var. *stipoides* | Weeping Grass | | 2 | | 1 | 2 | 2 | 2 | 2 | 2 | 3 3 | | | | 1 | |
| POACEAE | *Oplismenus aemulus* | Broad-leaf Beard-grass | | 2 | 1 | 1 | | 3 | | | 2 | | | 1 | | 2 | |

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |
| POACEAE | *Oplismenus imbecillis* | Narrow-leaf Beard-grass | | 1 | | | | | | | 2 | | | | | 1 | |
| POACEAE | *Panicum decompositum* | Native Millet | | | | | | | | 1 | | | | | | | |
| POACEAE | *Panicum effusum* | Hairy Panic | | | | | | | | | | | | | | | ü |
| POACEAE | *Panicum simile* | Two-colour panic | | | | | | | 1 | | | | | | | | |
| POACEAE | *Paspalidium criniforme* | Paspalidium | | 1 | 1 2 | 2 1 | | | | 2 | | 2 | 1 | 2 2 | | 1 | |
| POACEAE | *Paspalidium distans* | Paspalidium | | | | | | | | | | | | | | | ü |
| POACEAE | *Paspalum dilatatum* | Paspalum | i | 2 | 1 | 2 | 1 | | 1 | 2 2 | | 4 | 2 | | 2 | 2 | |
| POACEAE | *Paspalum distichum* | Water Couch | | | | | | | | | | | | | 2 | | |
| POACEAE | *Paspalum orbiculare* | Ditch Millet | | | | | | | | 2 | | | | | | | |
| POACEAE | *Paspalum urvillei* | Vasey Grass | i | | | | | | | | | | | | | | ü |
| POACEAE | *Setaria sphacelata* | South African Pigeon Grass | i | | | | | | | | | | | | | | ü |
| POACEAE | *Sporobolus africanus* | Parramatta Grass | i | 2 | | 1 | 1 | 1 | 2 | | 1 | | | | | | |
| POACEAE | *Sporobolus creber* | Slender Rats Tail Grass | | | 2 | | | 1 | | 2 | | | 1 | 1 | | | |
| POACEAE | *Sporobolus elongatus* | Slender Rats Tail Grass | | | | | | | | | | | | | | | ü |
| POACEAE | *Sporobolus fertilis* | Giant Parramatta Grass | i | | | | | | | | | | | | | | ü |
| POACEAE | *Stenotaphrum secundatum* | Buffalo Grass | i | | | | | | | | | | | | | | ü |
| POACEAE | *Themeda australis* | Kangaroo Grass | | | 1 | 2 2 | | | 2 | 2 | | | | 2 | | | |

KEY
ABBREVIATIONS:
i = introduced (i.e. not indigenous to Australia)
n = native Australian species not considered to be indigenous to the site
c = cultivated (i.e. planted on the site)
t = listed as a threatened species under State and/or Commonwealth legislation
spp. = unidentified species2
sp. aff. = unidentified species with characteristics similar to the indicated species or genus2
? = unconfirmed species2
r = RoTAP species (Briggs and Leigh 1996)

| Family | Scientific Name | Common name | Status | Number of plots and cover of abundance | | | | | | | | | | | | | Incidental records |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | |

var. = variety
subsp. = subspecies
cv. = cultivar (i.e. a anthropogenic form of the species)
agg. = an aggregate of several yet to be defined species

NOTES:
1. A sample flora assemblage obtained from a short term survey, such as the present one, cannot be considered to be comprehensive, but rather indicative of the actual flora assemblage. It can take many years of flora surveys to record all of the plant species occurring within any area, especially species that are only apparent in some seasons.
2. Not all species can be accurately identified in a 'snapshot' survey due to absence of flowering or fruiting material, etc.

SCIENTIFIC NAMES & AUTHORITIES:
Scientific names & families are those used in the Flora of New South Wales as maintained by the Royal Botanic Gardens (http://.plantnet.rbgsyd.gov.au).
Orders and higher taxa are based on Angisperm Phylogeny Group (2003).
For sake of simplicity, scientific names in this list do not include authorities. These can be found in the Flora of New South Wales.

Table B-2 Fauna species recorded

| Family / Scientific name | Common Name | Status / Credit class+ | Sites | | | | | | | | | | | | | | | Incidental |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | FD1 | FD2 | FD3 | FD4 | DL1 | DL2 | |
| BIRDS | | | | | | | | | | | | | | | | | | |
| **Phasianidae** | | | | | | | | | | | | | | | | | | |
| *Coturnix ypsilophora* | Brown Quail | P | | | | | | | | | x | | | | | | | |
| **Anatidae** | | | | | | | | | | | | | | | | | | |
| *Chenonetta jubata* | Australian Wood Duck | P | | | | | | | | | | x | | | | | | |
| *Anas superciliosa* | Pacific Black Duck | P | | | x | | | | | | | | | x | x | | | |
| **Phalacrocoracidae** | | | | | | | | | | | | | | | | | | |
| *Phalacrocorax melanoleucos* | Little Pied Cormorant | P | | | | | | | | | | | | x | | | | |
| **Accipitridae** | | | | | | | | | | | | | | | | | | |
| *Aquila audax* | Wedge-tailed Eagle | P | x | | | | | | | | | | | | | | | |
| **Gruidae** | | | | | | | | | | | | | | | | | | |
| *Grus rubicunda* | Brolga | V (TSC Act) / Ecosystem Credit | | | | | | | | | | | | | x | | | |
| **Rallidae** | | | | | | | | | | | | | | | | | | |
| *Porphyrio porphyrio* | Purple Swamphen | P | | | | | | | | | | x | | | | | | |
| **Charadriidae** | | | | | | | | | | | | | | | | | | |
| *Vanellus miles* | Masked Lapwing | P | | | | | | | | | | | | | x | | | |
| **Cacatuidae** | | | | | | | | | | | | | | | | | | |
| *Calyptorhynchus lathami* | Glossy Black-Cockatoo | V (TSC Act) / Ecosystem Credit | | | | x | | | | | | | | | | | | |
| **Psittacidae** | | | | | | | | | | | | | | | | | | |
| *Alisterus scapularis* | Australian King Parrot | P | x | | | | | | | | | | | | | | | |
| *Trichoglossus haematodus* | Rainbow Lorikeet | P | x | x | x | x | | | | | x | | | x | x | | | |
| *Trichoglossus chlorolepidotus* | Scaly-breasted Lorikeet | P | | x | | | x | | | | | | | | | | | |
| *Glossopsitta pusilla* | Little Lorikeet | V (TSC Act) / Ecosystem Credit | | x | | | | | | | | | | | | | | |

| Family / Scientific name | Common Name | Status / Credit class+ | Sites | | | | | | | | | | | | | | | Incidental |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | FD1 | FD2 | FD3 | FD4 | DL1 | DL2 | |
| *Platycercus adscitus eximius* | Eastern Rosella | P | | | | x | | | | | | | | | | | | |
| **Cuculidae** | | | | | | | | | | | | | | | | | | |
| *Cacomantis variolosus* | Brush Cuckoo | P | x | | | | | | | | x | | | | | | | |
| **Centropodidae** | | | | | | | | | | | | | | | | | | |
| *Centropus phasianinus* | Pheasant Coucal | P | x | | | | | | | | | | | | | | | |
| **Strigidae** | | | | | | | | | | | | | | | | | | |
| *Ninox boobook* | Southern Boobook | P | x | | x | | | | | | | | | | | | | |
| **Podargidae** | | | | | | | | | | | | | | | | | | |
| *Podargus strigoides* | Tawny Frogmouth | P | | | | | | | | | | | | | | | | |
| **Apodidae** | | | | | | | | | | | | | | | | | | |
| *Aerodramus terraereginae* | White-rumped Swiftlet | P | | | | | | | | | x | | | | | | | |
| **Alcedinidae** | | | | | | | | | | | | | | | | | | |
| *Dacelo novaeguineae* | Laughing Kookaburra | P | x | | x | | | | | | x | | | | | | | |
| *Todiramphus sanctus* | Sacred Kingfisher | P | x | x | x | | | | | | x | | | | x | | | |
| **Meropidae** | | | | | | | | | | | | | | | | | | |
| *Merops ornatus* | Rainbow Bee-eater | P, M | | | x | | | | | | x | | | | | | | |
| **Climacteridae** | | | | | | | | | | | | | | | | | | |
| *Climacteris picumnus* | Brown Treecreeper | V (TSC Act) / Ecosystem Credit | | | | | | | | | x | | | | | | | x |
| **Maluridae** | | | | | | | | | | | | | | | | | | |
| *Malurus cyaneus* | Superb Fairy-wren | P | | | x | x | | | | | | | | | | | | |
| *Malurus melanocephalus* | Red-backed Fairy-wren | P | x | x | x | | | | | | x | | | | | | | |
| **Pardalotidae** | | | | | | | | | | | | | | | | | | |
| *Pardalotus striatus* | Striated Pardalote | P | | | | | | | | | x | | | | | | | |
| **Acanthizidae** | | | | | | | | | | | | | | | | | | |

| Family / Scientific name | Common Name | Status / Credit class+ | Sites | | | | | | | | | | | | | | | Incidental |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | FD1 | FD2 | FD3 | FD4 | DL1 | DL2 | |
| *Gerygone olivacea* | White-throated Gerygone | P | | | x | | x | | | | | | | | | | | |
| *Acanthiza pusilla* | Brown Thornbill | P | | | x | | | | | | | | | | | | | |
| **Meliphagidae** | | | | | | | | | | | | | | | | | | |
| *Myzomela sanguinolenta* | Scarlet Honeyeater | P | | | x | | | | | | | | | | | | | |
| *Lichenostomus fuscus* | Fuscous Honeyeater | P | x | x | x | | | | | | x | | | | | | | |
| *Manorina melanocephala* | Noisy Miner | P | | | | | | | x | | x | | | | | | | |
| *Entomyzon cyanotis* | Blue-faced Honeyeater | P | | | | x | x | | | | | | | | | | | |
| *Philemon corniculatus* | Noisy Friarbird | P | x | x | x | x | | | | | x | | | | | | | |
| *Philemon citreogularis* | Little Friarbird | P | | x | | | | | | | x | | | | | | | |
| **Petroicidae** | | | | | | | | | | | | | | | | | | |
| *Microeca fascinans* | Jacky Winter | P | x | | | | x | | | | x | | | | | | | |
| *Eopsaltria australis* | Eastern Yellow Robin | P | | | | x | | | | | | | | | | | | |
| **Pomatostomidae** | | | | | | | | | | | | | | | | | | |
| *Pomatostomus temporalis temporalis* | Grey-crowned Babbler (eastern subspecies) | V (TSC Act) / Ecosystem Credit | x | | | | | | | | | | | | | | | x |
| **Pachycephalidae** | | | | | | | | | | | | | | | | | | |
| *Pachycephala pectoralis* | Golden Whistler | P | | | | x | | | | | | | | | | | | |
| *Pachycephala rufiventris* | Rufous Whistler | P | | | x | | | | | | | | | | | | | |
| *Colluricincla harmonica* | Grey Shrike-thrush | P | | | | | x | | | | | | | | | | | |
| **Dicruridae** | | | | | | | | | | | | | | | | | | |
| *Rhipidura albiscapa* | Grey Fantail | P | | | | x | | | | | | | | | | | | |
| *Rhipidura leucophrys* | Willie Wagtail | P | x | | x | | | | | | x | | | | | | | |
| *Myiagra cyanoleuca* | Satin Flycatcher | P, M | | | | x | | | | | | | | | | | | |
| *Myiagra inquieta* | Restless Flycatcher | P | | | | | | | | | x | | | | | | | |
| **Campephagidae** | | | | | | | | | | | | | | | | | | |

| Family / Scientific name | Common Name | Status / Credit class+ | Sites | | | | | | | | | | | | | | | Incidental |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | FD1 | FD2 | FD3 | FD4 | DL1 | DL2 | |
| *Coracina novaehollandiae* | Black-faced Cuckoo-shrike | P | x | x | | | | | | | | | | x | | | | |
| *Coracina tenuirostris* | Cicadabird | P | | x | x | | | | | | | | | x | x | | | |
| *Lalage tricolor* | White-winged Triller | P | x | | | | | | | | | | | | | | | |
| **Artamidae** | | | | | | | | | | | | | | | | | | |
| *Cracticus nigrogularis* | Pied Butcherbird | P | x | | x | | | | | | x | | | x | | | | |
| *Gymnorhina tibicen* | Australian Magpie | P | x | x | x | | | | | | x | | | x | | | | |
| **Corvidae** | | | | | | | | | | | | | | | | | | |
| *Corvus orru* | Torresian Crow | P | x | x | x | | | | | | | | | x | | | | |
| **Motacillidae** | | | | | | | | | | | | | | | | | | |
| *Anthus australis* | Australian Pipit | P | | | | | | | | | | x | | | | | | |
| **Estrildidae** | | | | | | | | | | | | | | | | | | |
| *Taeniopygia bichenovii* | Double-barred Finch | P | | | | | | | | | x | | | | | | | x |
| *Neochmia temporalis* | Red-browed Finch | P | | | x | | | | | | x | | | | | | | |
| **Hirundinidae** | | | | | | | | | | | | | | | | | | |
| *Petrochelidon nigricans* | Tree Martin | P | x | | | x | | | | | x | | | | | | | |
| **Cisticolidae** | | | | | | | | | | | | | | | | | | |
| *Cisticola exilis* | Golden-headed Cisticola | P | x | | | | | | | | | | | x | | | | |
| **MAMMALS** | | | | | | | | | | | | | | | | | | |
| **Dasyuridae** | | | | | | | | | | | | | | | | | | |
| *Antechinus flavipes* | Yellow-footed Antechinus | P | x | x | | | | | | | | | | | | | | |
| *Antechinus stuartii* | Brown Antechinus | P | x | x | | | | | | | | | | | | | | |
| **Phalangeridae** | | | | | | | | | | | | | | | | | | |
| *Trichosurus vulpecula* | Common Brushtail Possum | P | x | x | x | | | | | | | | | | | | | |
| **Potoroidae** | | | | | | | | | | | | | | | | | | |

| Family / Scientific name | Common Name | Status / Credit class+ | Sites | | | | | | | | | | | | | | | Incidental |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | FD1 | FD2 | FD3 | FD4 | DL1 | DL2 | |
| *Aepyprymnus rufescens* | Rufous Bettong | V (TSC Act) / Species Credit | | | x | | | | | | | | | | | | | |
| **Macropodidae** | | | | | | | | | | | | | | | | | | |
| *Macropus rufogriseus* | Red-necked Wallaby | P | x | | | | | | | | | x | | | | | | |
| *Macropus giganteus* | Eastern Grey Kangaroo | P | x | x | x | | x | x | x | x | x | | | | | | | |
| **Pteropodidae** | | | | | | | | | | | | | | | | | | |
| *Pteropus poliocephalus* | Grey-headed Flying-fox | V (TSC Act & EPBC Act) / Ecosystem Credit | x | x | x | x | | | | x | x | | | | | | | |
| **Molossidae** | | | | | | | | | | | | | | | | | | |
| *Mormopterus* sp. 1* | | P | | | | | | | | | | | | | | | | |
| *Mormopterus* sp. 2* | | P | | | | | | | | | | | | | | | | |
| *Tadarida australis* | White-striped Freetail-bat | P | | | x | | | | | | | x | | | | | | |
| **Vespertilionidae** | | | | | | | | | | | | | | | | | | |
| *Nyctophilus* sp.^ | | P | | | | | | | | | | | | | | | | |
| *Miniopterus schreibersii oceanensis** | Eastern Bentwing-bat | V (TSC Act) Ecosystem Credit | | | | | | | | | | | | | | | | |
| *Miniopterus australis* | Little Bentwing-bat | V (TSC Act) / Species Credit | | | | | | | | | | x | | | | x | | |
| *Chalinolobus gouldii* | Gould's Wattled Bat | P | | | | | | | | | | | | | | | | |
| *Chalinolobus nigrogriseus*^ | Hoary Wattled Bat | V (TSC Act) Ecosystem Credit | | | | | | | | | | | | | | | | |
| *Scoteanax rueppellii*^ | Greater Broad-nosed Bat | V (TSC Act) Ecosystem Credit | | | | | | | | | | | | | | | | |
| *Scotorepens orion*^ | Eastern Broad-nosed Bat | P | | | | | | | | | | | | | | | | |
| *Falsistrellus tasmaniensis** | Eastern False Pipistrelle | V (TSC Act) Ecosystem Credit | | | | | | | | | | | | | | | | |
| *Vespadelus pumilus*^ | Eastern Forest Bat | P | | | | | | | | | | | | | | | | |
| **Muridae** | | | | | | | | | | | | | | | | | | |
| *Rattus fuscipes* | Bush Rat | P | x | | | | | | | | | | | | | | | |
| *Rattus rattus* | Black Rat | U | | | | | | | | | | | | | | | x | |

| Family / Scientific name | Common Name | Status / Credit class+ | Sites | | | | | | | | | | | | | | | Incidental |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | FD1 | FD2 | FD3 | FD4 | DL1 | DL2 | |
| **Felidae** | | | | | | | | | | | | | | | | | | |
| *Felis catus* | Cat | U | | | | | | | | | | | | x | | | | |
| **AMPHIBIANS** | | | | | | | | | | | | | | | | | | |
| **Myobatrachidae** | | | | | | | | | | | | | | | | | | |
| *Limnodynastes peronii* | Brown-striped Frog | P | | | | | | | | | | x | x | x | x | x | x | |
| *Limnodynastes tasmaniensis* | Spotted Grass Frog | P | x | | | | | | | | | | x | | | | x | |
| *Crinia parinsignifera* | Eastern Sign-bearing Froglet | P | | | | | | | | | | | | | | x | | |
| *Crinia signifera* | Common Eastern Froglet | P | | | | | | | | | | | | | | | x | |
| *Crinia tinnula* | Wallum Froglet | V (TSC Act) / Species Credit | | | | | | | | | | | | | | | x | |
| **Hylidae** | | | | | | | | | | | | | | | | | | |
| *Litoria caerulea* | Green Tree Frog | P | | | | | | | | | | | | x | | | | |
| *Litoria dentata* | Bleating Tree Frog | P | | x | x | | | | | x | | | | | | | | |
| *Litoria fallax* | Eastern Dwarf Tree Frog | P | | | | | | | | | | x | x | x | x | | | |
| *Litoria nasuta* | Rocket Frog | P | | | | | | | | | | | | x | | x | | |
| **REPTILES** | | | | | | | | | | | | | | | | | | |
| **Chelidae** | | | | | | | | | | | | | | | | | | |
| *Chelodina longicollis* | Eastern Snake-necked Turtle | P | | | | | | | | | | | | | x | | | |
| **Varanidae** | | | | | | | | | | | | | | | | | | |
| *Varanus varius* | Lace Monitor | P | | | | | | | | | | | | | x | | | |
| **Scincidae** | | | | | | | | | | | | | | | | | | |
| *Egernia striolata* | Tree Skink | P | | | | x | | | | | | | | | | | | |
| *Lampropholis delicata* | Dark-flecked Garden Sunskink | P | x | x | x | x | x | | x | x | x | | | | | | | |
| **Elapidae** | | | | | | | | | | | | | | | | | | |
| *Cryptophis nigrescens* | Eastern Small-eyed Snake | P | | | | | | | | | | | | | | | x | |

| Family / Scientific name | Common Name | Status / Credit class+ | Sites | | | | | | | | | | | | | | | Incidental |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | FD1 | FD2 | FD3 | FD4 | DL1 | DL2 | |
| *Hemiaspis damelii* | Grey Snake | P | | | | | | | | | | | x | | | | | |
| **FISH** | | | | | | | | | | | | | | | | | | |
| **Poeciliidae** | | | | | | | | | | | | | | | | | | |
| *Gambusia holbrooki* | Plague Minnow | | | | | | | | | | | | | | | | x | |

+V=vulnerable, P=protected, U=Unprotected.

^Possible detection from Anabat ultrasonic recording

*Probable detection from Anabat ultrasonic recording

# Appendix C. Biodiversity credit report

# *Biodiversity credit report*

**This report identifies the number and type of biodiversity credits required for a major project.**

Date of report: 22/06/2016 Time: 6:54:16PM Calculator version: v4.0

## Major Project details

| | |
|---|---|
| **Proposal ID:** | 214/2016/2382MP |
| **Proposal name:** | New Grafton Correctional Centre |
| **Proposal address:** | 313 Avenue Road Lavadia NSW 2460 |
| **Proponent name:** | |
| **Proponent address:** | 64 Allara Street Canberra ACT 2601 |
| **Proponent phone:** | |
| **Assessor name:** | Jonathan Carr |
| **Assessor address:** | PO BOX 237 Civic Square NSW 2608 |
| **Assessor phone:** | 02 6246 2736 |
| **Assessor accreditation:** | 214 |

## Summary of ecosystem credits required

| Plant Community type | Area (ha) | Credits created |
|---|---|---|
| Coastal freshwater meadows and forblands of lagoons and wetlands | 0.70 | 42.05 |
| Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | 15.00 | 539.29 |
| Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | 14.60 | 654.40 |
| **Total** | 30.30 | 1,236 |

## Credit profiles

**1. Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244)**

| | |
|---|---|
| Number of ecosystem credits created | 131 |
| IBRA sub-region | Clarence Lowlands |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|---|
| Grey Box - Grey Ironbark grassy open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR169)<br><br>Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171)<br><br>Orange Gum (Eucalyptus bancroftii) open forest of the NSW North Coast Bioregion, (NR216)<br><br>Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221)<br><br>Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244)<br><br>Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245)<br><br>Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)<br><br>Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250) | Clarence Lowlands<br>and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

**2. Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244)**

| | |
|---|---|
| Number of ecosystem credits created | 408 |
| IBRA sub-region | Clarence Lowlands |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|---|
| Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244)<br><br>Grey Box - Grey Ironbark grassy open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR169)<br><br>Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171)<br><br>Orange Gum (Eucalyptus bancroftii) open forest of the NSW North Coast Bioregion, (NR216)<br><br>Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221)<br><br>Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245)<br><br>Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)<br><br>Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250) | Clarence Lowlands<br>and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

**3. Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)**

| | |
|---|---|
| Number of ecosystem credits created | 59 |
| IBRA sub-region | Clarence Lowlands |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|---|
| Grey Box - Grey Ironbark grassy open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR169)<br><br>Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171)<br><br>Orange Gum (Eucalyptus bancroftii) open forest of the NSW North Coast Bioregion, (NR216)<br><br>Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221)<br><br>Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244)<br><br>Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245)<br><br>Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)<br><br>Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250) | Clarence Lowlands<br>and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

**4. Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)**

| | |
|---|---|
| Number of ecosystem credits created | 595 |
| IBRA sub-region | Clarence Lowlands |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|---|
| Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR246)<br><br>Grey Box - Grey Ironbark grassy open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR169)<br><br>Grey Box - Small-fruited Grey Gum shrubby forest of the far north of the NSW North Coast Bioregion, (NR171)<br><br>Orange Gum (Eucalyptus bancroftii) open forest of the NSW North Coast Bioregion, (NR216)<br><br>Red Ironbark open forest of the coastal lowlands of the NSW North Coast Bioregion, (NR221)<br><br>Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion, (NR244)<br><br>Spotted Gum - Grey Box grassy open forest of the Richmond Range of the NSW North Coast Bioregion, (NR245)<br><br>Spotted Gum dry grassy open forest of the foothills of the northern NSW North Coast, (NR250) | Clarence Lowlands<br>and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

**5. Coastal freshwater meadows and forblands of lagoons and wetlands, (NR150)**

| | |
|---|---|
| Number of ecosystem credits created | 42 |
| IBRA sub-region | Clarence Lowlands |

| Offset options - Plant Community types | Offset options - IBRA sub-regions |
|---|---|
| Coastal freshwater meadows and forblands of lagoons and wetlands, (NR150) | Clarence Lowlands<br>and any IBRA subregion that adjoins the IBRA subregion in which the development occurs |

## Summary of species credits required

| Common name | Scientific name | Extent of impact Ha or individuals | Number of species credits created |
|---|---|---|---|
| Rufous Bettong | Aepyprymnus rufescens | 30.30 | 788 |
| Wallum Froglet | Crinia tinnula | 0.70 | 9 |
| Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area | Dromaius novaehollandiae - endangered population | 30.30 | 788 |
| Little Bentwing-bat | Miniopterus australis | 30.30 | 394 |
| Black-necked Stork | Ephippiorhynchus asiaticus | 0.70 | 54 |
| Brolga | Grus rubicunda | 0.70 | 9 |
| Brush-tailed Phascogale | Phascogale tapoatafa | 29.60 | 592 |
| Squirrel Glider | Petaurus norfolcensis | 29.60 | 651 |
| Common Planigale | Planigale maculata | 29.60 | 770 |
| Koala | Phascolarctos cinereus | 0.00 | 770 |
| Koala | Phascolarctos cinereus | 29.60 | 770 |

# Appendix D. Biodiversity offset strategy

# New Grafton Correctional Centre

Infrastructure New South Wales

## Biodiversity Offset Strategy

Final | V07

1 August 2016

# New Grafton Correctional Centre

| | |
|---|---|
| Project No: | IA101200 |
| Document Title: | Biodiversity Offset Strategy |
| Document No.: | Final |
| Revision: | V07 |
| Date: | 1 August 2016 |
| Client Name: | Infrastructure New South Wales |
| Client No: | NGCC EIS Support |
| Project Manager: | Rachel Vazey |
| Author: | Chris Thomson, Andrew Carty, Jon Carr |
| File Name: | \\Jacobs.com\ANZ\IE\Projects\04_Eastern\IA101200\02 Documents_Final Report_20160801\ToIssue\NGCC_BOS_Stage1_Final_V07_2016801_ToIssue.docx |

Jacobs Australia Pty Limited

710 Hunter Street
Newcastle West NSW 2302 Australia
PO Box 2147 Dangar NSW 2309 Australia
T +61 2 4979 2600
F +61 2 4979 2666
www.jacobs.com

© Copyright 2016 Jacobs Australia Pty Limited. The concepts and information contained in this document are the property of Jacobs. Use or copying of this document in whole or in part without the written permission of Jacobs constitutes an infringement of copyright.

Limitation: This Report has been prepared by Jacobs Group (Australia) Pty Ltd (Jacobs) for the sole use of Infrastructure New South Wales (INSW) in the preparation of the Environmental Impact Assessment for the New Grafton correctional facility, in accordance with the scope of services described in the Consultancy Agreement between Jacobs and INSW. Jacobs has undertaken all investigations and prepared this report in accordance with the usual care and thoroughness of the consulting profession and by reference to applicable procedures and practice at the date of issue of the report. This report remains subject to the following limitations:

- This report should only be presented in full and should not be used to support any purpose other than that for which it has been prepared, as outlined in the Consultancy Agreement. Jacobs accepts no liability to INSW or any third party for any loss and/or damage incurred as a result of reliance of this report for any purpose other than that articulated in the Consultancy Agreement.
- The report only considers the site conditions current at the time of investigation. These conditions may change due to natural forces and/or activities or operations undertaken on or near the Site. Any decisions based on the findings of the report must take into account any subsequent changes in Site conditions and/or developments in legislative and regulatory requirements. Jacobs accepts no liability to INSW or any third party for any loss and/or damage incurred as a result of a change in the site conditions and/or regulatory/legislative framework since the date of the report.
- The report is based on an interpretation of factual information available and the professional opinion and judgement of Jacobs. Unless stated to the contrary, Jacobs has not verified the accuracy or completeness of any information received from INSW or a third party during the performance of the services under the Consultancy Agreement, and Jacobs accepts no liability to INSW or any third party for any loss and/or damage incurred as a result of any inaccurate or incomplete information.
- Any reliance on this report by a third party shall be entirely at such party's own risk. Jacobs provides no warranty or guarantee to any third party, express or implied, as to the information and/or professional advice indicated in the report, and accepts no liability for or in respect of any use or reliance upon the report by a third party."

Cover page graphic courtesy of NBRS

## Document history and status

| Revision | Date | Description | By | Review | Approved |
|---|---|---|---|---|---|
| Draft | 29/02/2016 | Practice Review | C.Thomson | Andrew Spinks | Andrew Spinks |
| Draft | 05/04/2016 | Edits | J.Carr | J.Carr | R.Vazey |
| Final | 30/05/2016 | Edits | J.Carr | C.Thomson | R.Vazey |
| Final v 2 | 22/06/2016 | Edits | R.Vazey | C.Thomson | R.Vazey |
| Final v 3 | 07/07/2016 | Edits | R.Vazey | C.Thomson | R.Vazey |
| Final v 4 | 01/08/2016 | Edits | R.Vazey | C.Thomson | R.Vazey |

## Contents

**1. Introduction ..... 1**
1.1 Background ..... 1
1.2 Offset requirements under the Framework for Biodiversity Assessment ..... 5
1.3 Offset requirements ..... 5
**2. Offset approach ..... 7**
2.1 Stage 1 ..... 7
2.2 Stage 2 ..... 8
**3. Assessment of offset availability ..... 9**
3.1 Preliminary offset investigations ..... 9
3.1.1 BioBanking public registers ..... 9
3.2 Credits wanted register ..... 11
**4. Preliminary offset outcomes ..... 12**
4.1 Ecosystem credits ..... 12
4.2 Species credits ..... 12
**5. Purchasing and retiring credits ..... 13**
5.1 Cost of ecosystem credits ..... 13
5.2 Cost of species credits ..... 14
**6. Conclusion and next steps ..... 15**
**7. References ..... 16**

# Terms and acronyms used in this document

| Acronym | Definition |
|---|---|
| APZ | Asset Protection Zone |
| BAR | Biodiversity Assessment Report |
| BBCC | BioBanking Credit Calculator |
| BOS | Biodiversity Offset Strategy |
| BVT | Biometric Vegetation Types |
| CEEC | Critically Endangered Ecological Community |
| CSNSW | Correctional Services New South Wales |
| DPE | Department of Planning and the Environment |
| EEC | Endangered Ecological Community |
| EIS | Environmental Impact Statement |
| EOI | Expression of interest |
| EPBC | *Environment Protection and Biodiversity Conservation Act 1999* |
| FBA | Framework of Biodiversity Assessment |
| IBRA | Interim Biogeographic Regionalisation for Australia |
| INSW | Infrastructure New South Wales |
| LGA | Local Government Area |
| MNES | Matters of National Environmental Significance |
| NGCC | New Grafton Correctional Centre |
| NP&W Act | *National Parks and Wildlife Act 1974* |
| NPWS | National Parks and Wildlife Services |
| NSW | New South Wales |
| OEH | Office of Environment and Heritage |
| PCT | Plant Community Types |
| PMST | Protected Matters Search Tool |
| Project | Comprises the New Grafton Correctional Centre which will provide up to 1,700 new prison beds, within a maximum and minimum security correctional centre with relevant support services and facilities. |
| Project Site | Comprised of two properties Lot 26 DP 751376 and Lot 1 DP 1190399 and is located at 313 Avenue Road, Lavadia. |
| Proposal | Comprises the concept proposal and the Stage 1 works development application. |
| SEARS | Secretary's Environmental Assessment Requirement |
| SEPP | State Environmental Planning Policy |
| SSD | State Significant Development |
| TEC | Threatened ecological community |
| TSC Act | *Threatened Species Conservation Act 1*995 |

# Executive Summary

Infrastructure NSW (INSW) on behalf of Corrective Services NSW (CSNSW), a division of the Department of Justice, is seeking approval under Division 4.1, Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for the concept proposal and Stage 1 Development Application (DA) for the New Grafton Correctional Centre (the Project). The Project will be located on a 195 ha site (the Project Site), approximately 12.5 kilometres (km) south-east of Grafton in the Clarence Valley local government area. The concept proposal and the Stage 1 works application comprise the Proposal.

The Project will provide up to 1,700 new prison beds, within a maximum and minimum security correctional centre with relevant support services and facilities. The first stage of the development would involve site clearance and preparatory works for the Project. Subsequent stages would involve the construction of the facility and would be subject to further planning approvals.

The Project is a State Significant Development and is subject to the requirements of the NSW *Biodiversity Offsets Policy for Major Projects* (OEH 2014b). Under the policy, biodiversity impacts and offsets are assessed via the *Framework for Biodiversity Assessment* (FBA) and the production of a Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS). The BOS outlines the offsets required for unavoidable impacts to biodiversity, that is, those residual impacts which remain after impacts have been avoided, minimised and mitigated to the extent that is reasonable and feasible (OEH 2014b). The BOS also demonstrates that appropriate offsets are available and can be delivered.

The BAR has identified the number and type of credits that are required to be offset in accordance with the BioBanking Credit Calculator (BBCC) and provides a BioBanking credit report. This relates to:

- 42 ecosystem credits for Coastal freshwater meadows and forblands or lagoons and wetland (NR150).
- 539 ecosystem credits for Spotted Gum – Grey Box – Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (NR244).
- 654 ecosystem credits for Spotted Gum - Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North coast Bioregion (NR246).
- Species credits for 10 threatened fauna species either identified on the site or potentially impacted from clearing for the Proposal.

This report presents the first stage of offset investigations by identifying the Project impact and offset requirements in accordance with the NSW Major Project Offsets Policy. The report does not provide background or site survey data for prospective offset properties. The first stage does present the results of initial investigations into the availability of offsets to meet the requirements of the policy. Stage 2 investigations will follow Proposal approval and will include

- An updated search of the BioBanking public database to investigate offset availability.
- Desktop investigation of potential offset opportunities to develop a short-list of priority sites.
- Approaching owners of priority sites to identify interest in offsetting.
- Undertaking rapid field assessment on priority sites to confirm ecological values and habitat condition to ensure the offset areas provide equivalent or greater values – i.e. improve or maintain biodiversity values.
- Progressing negotiations with owners and complete detailed BioBanking Assessments at priority sites, or securing offset properties under an appropriate conservation mechanism.
- Consideration of options for supplementary measures.

# 1. Introduction

## 1.1 Background

Infrastructure NSW (INSW), on behalf of Corrective Services NSW, a division of the Department of Justice, is preparing an Environmental Impact Statement to inform a State Significant Development (SSD) application under Division 4.1, Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) for the concept proposal and Stage 1 site clearance and preparatory works (the Proposal) for the New Grafton Correctional Centre (NGCC) (the Project). This Biodiversity Offset Strategy (BOS) accompanies the Technical Working Paper: Biodiversity Assessment Report (BAR) for the proposed New Grafton Correctional Centre Environmental Impact Statement (EIS). This BOS (stage 3 of the Framework for Biodiversity Assessment) should be read in conjunction with the BAR, which outlines in detail the impacts assessed and the rationale for assessment under the Framework for Biodiversity Assessment (FBA) (stages 1 and 2). This BOS has been prepared to assess the offset requirements of the proposed the Project.

The Project is located approximately 12.5 kilometres (km) southeast of Grafton, within the Clarence Valley Local Government Area (LGA) at 313 Avenue Road, Lavadia (refer to **Figure 1-1**) Requirements for offsetting under the project are outlined in the NSW *Biodiversity Offsets Policy for Major Projects* (OEH 2014b), which includes State Significant Development (SSD) and State Significant Infrastructure (SSI). As part of an application for a Major Project under the *Environmental Planning & Assessment Act 1979* (EP&A Act), a proponent must prepare an EIS that addresses the Secretary's Environmental Assessment Requirements (SEARs) provided by the NSW Department of Planning and Environment (DPE).

Under the NSW *Biodiversity Offsets Policy for Major Projects*, the SEARs require the *Framework for Biodiversity Assessment* (FBA) to be applied to assess impacts on biodiversity. The FBA (OEH 2014a) outlines the assessment methodology to quantify and describe the biodiversity values on the development site, and the biodiversity offsets required for any unavoidable impacts.

The FBA requires proponents to provide offsets on a like for like basis, such that the biodiversity impacted at the development site should be the same type as the biodiversity present at the offset site. This applies to the ecological community type in the case of a Threatened Ecological Community (TEC), or the same habitat type and values in the case of a threatened species offset.

Some flexibility to the "like for like" rule is available for species and communities which are not listed on the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) as a nationally listed threatened species or ecological community, provided they are not listed as a Critically Endangered Ecological Community (CEEC) or Critically Endangered species under the *Threatened Species Conservation Act* 1995 (TSC Act).

In addition, both NSW and Commonwealth offset policies (DSEWPaC 2012) allow other conservation measures to be used in lieu of offsets in some instances. Under the NSW offsets policy, these are referred to as supplementary measures and are defined as: another measure undertaken as part of the BOS that is likely to lead to improvements in biodiversity or other environmental values that are not on an offset site (FBA 2014a). The NSW policy also requires that supplementary measures be of an equivalent cost to the provision of offsets.

Under Commonwealth policy, these are known as other compensatory measures and there is a limit on how much offsetting can be provided using these measures. However, all efforts are being made to offset all Matters of National Environmental Significance (MNES) in ways that are consistent with Commonwealth offsetting policy and in consultation with the Commonwealth.

This BOS documents the process of identifying and evaluating offset options that will be required for the development of the NGCC.

Ecosystem credits and species credits are used to measure the loss of biodiversity values that remains following all reasonable measures to avoid and minimise the impacts of the development in accordance with Chapter 8 of the FBA. Ecosystem credits measure the value of Endangered Ecological Communities (EECs), Critically Endangered Ecological Communities (CEECs) and threatened species habitat for species that can be

reliably predicted to occur with a Plant Community Type (PCT). Species credits measure the biodiversity value of threatened species individuals or habitat (using the appropriate unit of measurement). Ecosystem credits and species credits are together referred to as 'biodiversity credits'.

## 1.2 Offset requirements

The process of an informed site selection and documented mitigation strategy has meant that impacts to biodiversity have been avoided and minimised in the first instance. Although avoidance and mitigation measures have been applied, impacts on biodiversity, including threatened ecological communities and known threatened species habitat will result from construction and operation of the Project. In accordance with the FBA these impacts are required to be offset and the quantum of biodiversity credits required have been calculated using the BioBanking Credit Calculator (BBCC).

Cleared grazing land dominated by exotic grasses and exotic vegetation comprise 84 % of the Project Site, these areas do not require assessment of site value or offsetting.

The outcomes of the BBCC measure the impact of the Project on landscape values and biodiversity values in biodiversity offset credits referred to as ecosystem and species credits. Three PCTs require ecosystem credits (refer to **Table 1-1**) and 10 species require species credits (refer to **Table 1-2**).

The outputs of the biodiversity credit report from the BBCC are provided in **Appendix C**.

Table 1-1 Ecosystem credits summary

| Plant community type | BVT code | Zone / Loss in site value score | Offset multiplier | Area impacted (ha) | Ecosystem credits required |
|---|---|---|---|---|---|
| Coastal freshwater meadows and forblands of lagoons and wetland (EEC – TSC Act) | NR150 | (1) 76.09 | 3.0 | 0.7 | 42 |
| Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR244 | (2) 64.06<br>(3) 63.02 | 1.0 | 15.0 | 539 |
| Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR246 | (4) 70.83<br>(5) 47.40 | 1.0 | 14.6 | 654 |
| Total | | | | 30.3 | 1,235 |

Table 1-2 Species credits summary

| Species | Offset multiplier | Loss of potential habitat (ha) | Species credits required |
|---|---|---|---|
| Black-necked Stork (Ephippiorhynchus asiaticus) | 7.7 | 0.7 | 54 |
| Brolga (Grus rubicunda) | 1.3 | 0.7 | 9 |
| Brush-tailed Phascogale (Phascogale tapoatafa) | 2.0 | 29.6 | 592 |
| Common Planigale (Planigale maculata) | 2.6 | 29.6 | 770 |
| Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area (Dromaius novaehollandiae) | 2.6 | 30.3 | 788 |
| Koala (Phascolarctos cinereus) | 2.6 | 29.6 | 770 |
| Little Bentwing-bat (Miniopterus australis) | 1.3 | 30.3 | 394 |

| Species | Offset multiplier | Loss of potential habitat (ha) | Species credits required |
|---|---|---|---|
| Rufous Bettong (Aepyprymnus rufescens) | 2.6 | 30.3 | 788 |
| Squirrel Glider (Petaurus norfolcensis) | 2.2 | 29.6 | 651 |
| Wallum Froglet (*Crinia tinnula*) | 1.3 | 0.7 | 9 |
| Total | | 211.5 | 4,825 |

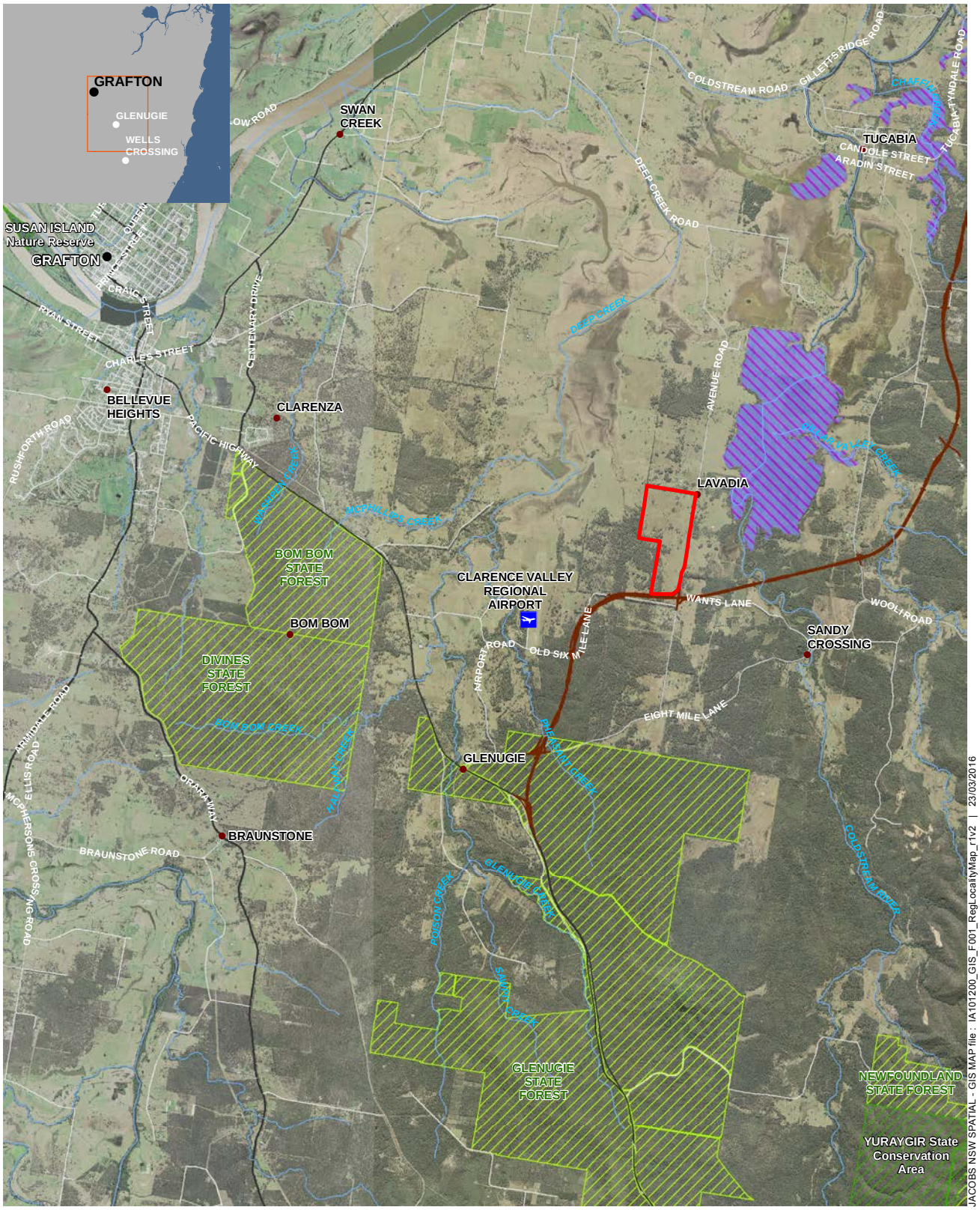
(the Project Site). The Project Site includes two properties comprised of Lot 26 DP 751376 and Lot 1 DP 1190399 and is 195 hectares (ha) in size (refer to **Figure 1-2)**.

The NGCC requires a staged development application that sets out a concept proposal for a new correctional centre that provides maximum and minimum security facilities and includes a total of 1,700 beds. The concept proposal includes a maximum built form height of 12 metres (approximately three storeys) with a gross floor area of approximately 100,000 square metres. The building envelope including the configuration, location and number of building structures required for the Project would not be determined until the detailed design is completed as part of future development applications. Consequently, the construction works for the NGCC could occur anywhere within the development zone shown in **Figure 1-3**.

The staged development application also seeks concurrent Stage 1 approval for site clearance and preparatory works. The Stage 1 (early works) would occur within the cadastral boundaries of Lot 26 DP 751376 and Lot 1 DP 1190399. This would involve:

- Vegetation clearance and biodiversity management activities.
- Construction of access roads including fire access roads to the extent required to conduct Stage 1 works.
- Construction of auxiliary facilities such as construction compound, construction staff parking facilities and stockpiles sites.
- Temporary provisions of water, power and communication services within the site to the extent required for Stage 1 works.
- Demolition of the existing house and sheds.
- Bulk excavation and site stabilisation works.
- Landscaping.

Future works regarding the design, construction and servicing of the Project will be based on the final design and layout of the facilities and will be the subject of future staged development application(s).




JACOBS NSW SPATIAL - GIS MAP file : IA101200_GIS_F001_RegLocalityMap_r1v2 | 23/03/2016

## Legend

- The Project
- Grafton Bypass (proposed)
- SEPP 14 Wetlands
- National Park Reserves
- State Forests

0 2 4 Km

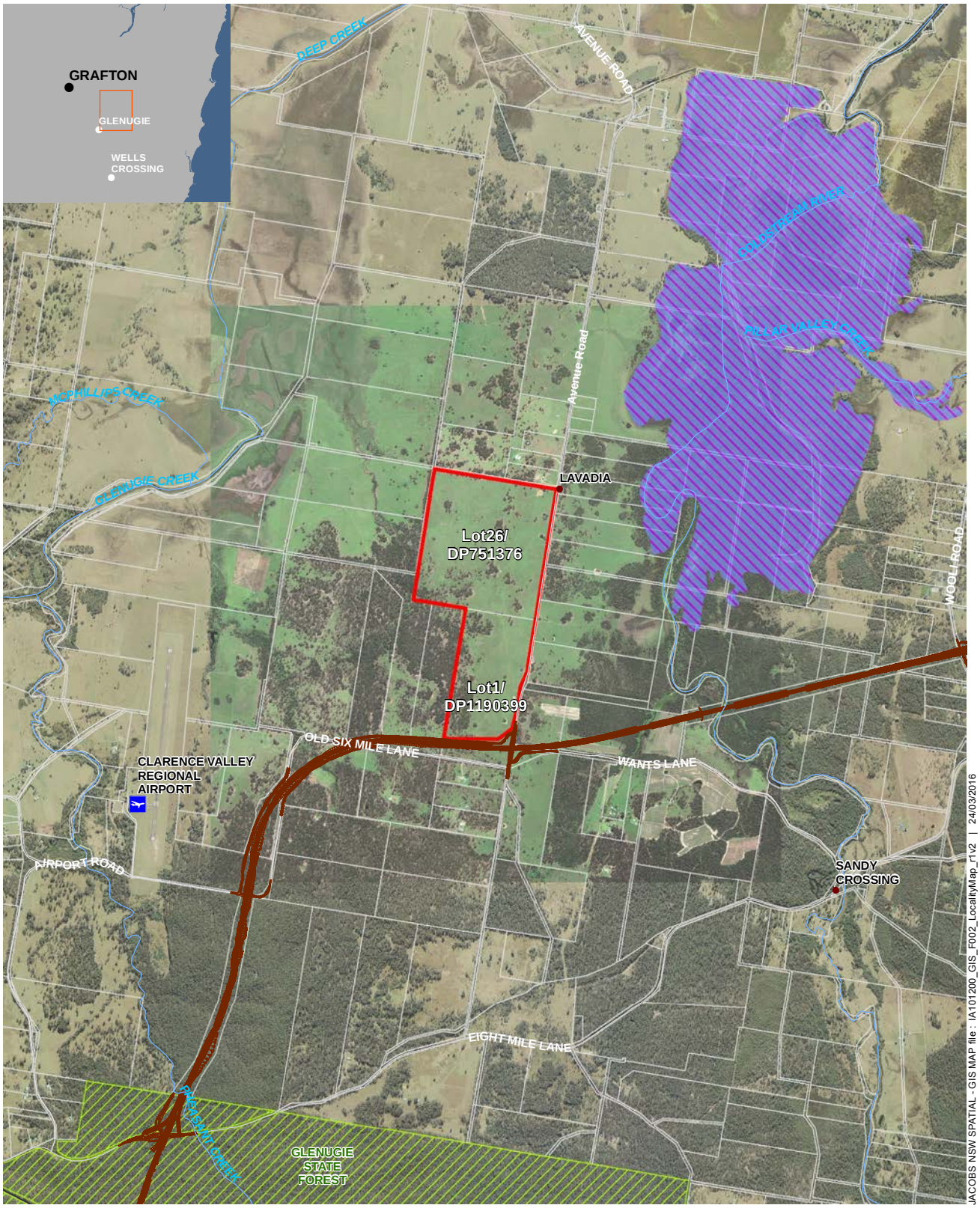
1:125,000 @ A4

N

## Data sources

Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

**Figure 1-1** | Regional Locality




## Legend

- The Project
- Grafton Bypass (proposed)
- SEPP 14 Wetlands
- State Forests

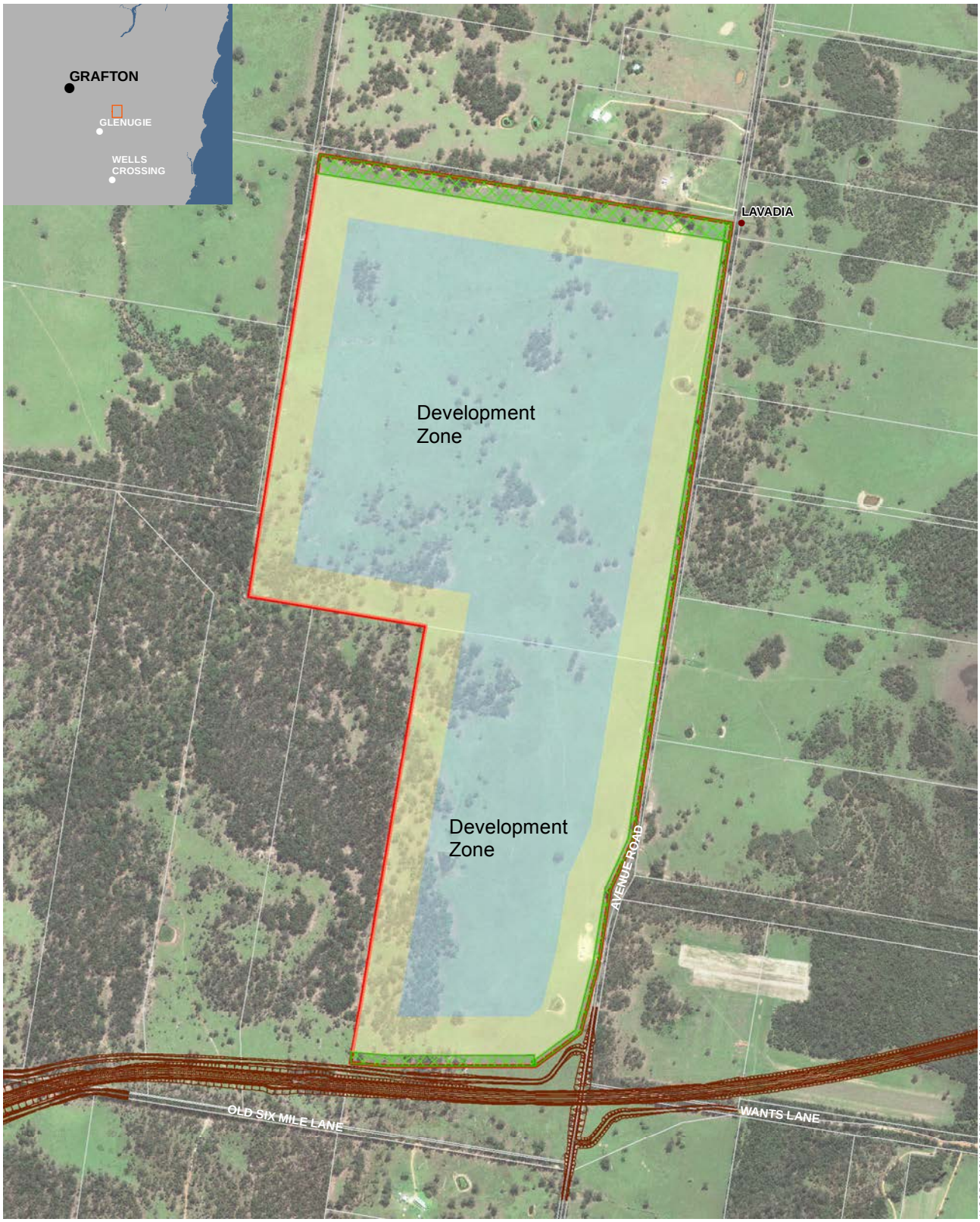
0 1 2 Km

1:50,000 @ A4

N

**Data sources**
Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

**Figure 1-2** | The Project




## Legend

- The Project
- Landscaping zone
- Asset Protection Zone
- Development Zone
- Grafton Bypass (proposed)

0 250 500 Metres

1:15,000 @ A4

N

**Data sources**

Jacobs 2015
LPI 2015
NSW DPE 2015
RMS 2013 (W2B Alliance)

**Figure 1-3** | The Project

This BOS has assessed a worst case scenario, i.e. in accordance with the development zones shown on **Figure 1-3**, and impacts to biodiversity may be reduced and re-assessed in the in future stages.

## 1.3 Offset requirements under the Framework for Biodiversity Assessment

Requirements for offsetting under the project are outlined in the NSW *Biodiversity Offsets Policy for Major Projects* (OEH 2014b), which includes State Significant Development (SSD) and State Significant Infrastructure (SSI). As part of an application for a Major Project under the *Environmental Planning & Assessment Act 1979* (EP&A Act), a proponent must prepare an EIS that addresses the Secretary's Environmental Assessment Requirements (SEARs) provided by the NSW Department of Planning and Environment (DPE).

Under the NSW *Biodiversity Offsets Policy for Major Projects*, the SEARs require the *Framework for Biodiversity Assessment* (FBA) to be applied to assess impacts on biodiversity. The FBA (OEH 2014a) outlines the assessment methodology to quantify and describe the biodiversity values on the development site, and the biodiversity offsets required for any unavoidable impacts.

The FBA requires proponents to provide offsets on a like for like basis, such that the biodiversity impacted at the development site should be the same type as the biodiversity present at the offset site. This applies to the ecological community type in the case of a Threatened Ecological Community (TEC), or the same habitat type and values in the case of a threatened species offset.

Some flexibility to the "like for like" rule is available for species and communities which are not listed on the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) as a nationally listed threatened species or ecological community, provided they are not listed as a Critically Endangered Ecological Community (CEEC) or Critically Endangered species under the *Threatened Species Conservation Act* 1995 (TSC Act).

In addition, both NSW and Commonwealth offset policies (DSEWPaC 2012) allow other conservation measures to be used in lieu of offsets in some instances. Under the NSW offsets policy, these are referred to as supplementary measures and are defined as: another measure undertaken as part of the BOS that is likely to lead to improvements in biodiversity or other environmental values that are not on an offset site (FBA 2014a). The NSW policy also requires that supplementary measures be of an equivalent cost to the provision of offsets.

Under Commonwealth policy, these are known as other compensatory measures and there is a limit on how much offsetting can be provided using these measures. However, all efforts are being made to offset all Matters of National Environmental Significance (MNES) in ways that are consistent with Commonwealth offsetting policy and in consultation with the Commonwealth.

This BOS documents the process of identifying and evaluating offset options that will be required for the development of the NGCC.

Ecosystem credits and species credits are used to measure the loss of biodiversity values that remains following all reasonable measures to avoid and minimise the impacts of the development in accordance with Chapter 8 of the FBA. Ecosystem credits measure the value of Endangered Ecological Communities (EECs), Critically Endangered Ecological Communities (CEECs) and threatened species habitat for species that can be reliably predicted to occur with a Plant Community Type (PCT). Species credits measure the biodiversity value of threatened species individuals or habitat (using the appropriate unit of measurement). Ecosystem credits and species credits are together referred to as 'biodiversity credits'.

## 1.4 Offset requirements

The process of an informed site selection and documented mitigation strategy has meant that impacts to biodiversity have been avoided and minimised in the first instance. Although avoidance and mitigation measures have been applied, impacts on biodiversity, including threatened ecological communities and known threatened species habitat will result from construction and operation of the Project. In accordance with the FBA these impacts are required to be offset and the quantum of biodiversity credits required have been calculated using the BioBanking Credit Calculator (BBCC).

Cleared grazing land dominated by exotic grasses and exotic vegetation comprise 84 % of the Project Site, these areas do not require assessment of site value or offsetting.

The outcomes of the BBCC measure the impact of the Project on landscape values and biodiversity values in biodiversity offset credits referred to as ecosystem and species credits. Three PCTs require ecosystem credits (refer to **Table 1-1**) and 10 species require species credits (refer to **Table 1-2**).

The outputs of the biodiversity credit report from the BBCC are provided in **Appendix C**.

Table 1-1 Ecosystem credits summary

| Plant community type | BVT code | Zone / Loss in site value score | Offset multiplier | Area impacted (ha) | Ecosystem credits required |
|---|---|---|---|---|---|
| Coastal freshwater meadows and forblands of lagoons and wetland (EEC – TSC Act) | NR150 | (1) 76.09 | 3.0 | 0.7 | 42 |
| Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR244 | (2) 64.06<br>(3) 63.02 | 1.0 | 15.0 | 539 |
| Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR246 | (4) 70.83<br>(5) 47.40 | 1.0 | 14.6 | 654 |
| Total | | | | 30.3 | 1,235 |

Table 1-2 Species credits summary

| Species | Offset multiplier | Loss of potential habitat (ha) | Species credits required |
|---|---|---|---|
| Black-necked Stork (Ephippiorhynchus asiaticus) | 7.7 | 0.7 | 54 |
| Brolga (Grus rubicunda) | 1.3 | 0.7 | 9 |
| Brush-tailed Phascogale (Phascogale tapoatafa) | 2.0 | 29.6 | 592 |
| Common Planigale (Planigale maculata) | 2.6 | 29.6 | 770 |
| Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area (Dromaius novaehollandiae) | 2.6 | 30.3 | 788 |
| Koala (Phascolarctos cinereus) | 2.6 | 29.6 | 770 |
| Little Bentwing-bat (Miniopterus australis) | 1.3 | 30.3 | 394 |
| Rufous Bettong (Aepyprymnus rufescens) | 2.6 | 30.3 | 788 |
| Squirrel Glider (Petaurus norfolcensis) | 2.2 | 29.6 | 651 |
| Wallum Froglet (*Crinia tinnula*) | 1.3 | 0.7 | 9 |
| Total | | 211.5 | 4,825 |

# 2. Offset approach

This BOS aims to identify and match offset requirements for the Project in accordance with the FBA. Ecosystem and species credit requirements can be offset in a number of ways, including

- Retiring credits via a BioBanking agreement.
- Financial contribution to supplementary measures.
- Financial contribution to a BioBanking Fund (the BioBanking Fund has not been established and was not an option for this project at the time of writing).

Where possible, the BOS will need to match ecosystem and species credits on a 'like for like' basis through the retirement of biodiversity credits, in accordance with the credit profiles provided in the projects credit report (refer to Appendix C of the BAR). Where this is not possible, supplementary measures will need to be investigated in consultation with DPE and Office of Environment and Heritage (OEH).

## 2.1 Stage 1

The *Biodiversity Offsets Policy for Major Projects* (OEH 2014b) outlines four key steps that are to be considered by the proponent before considering supplementary measures. This includes:

a) Checking the BioBanking public register and placing an expression of interest for credits wanted on it for at least six months.

b) Liaising with an OEH office and relevant local councils to obtain a list of potential offset sites that meet the requirements for offsetting.

c) Considering properties for sale in the required area.

d) Providing evidence of why offsets are not feasible, suitable evidence may include:

- The unwillingness of a landowner to sell or establish a BioBank site.
- The cost of an offset site itself should not be a factor unless it can be demonstrated the landowner is charging significantly above market rates.

**Table 2-1** summarises the process in more detail.

Table 2-1 Description of steps required to secure a matching ecosystem / species credit

| Step | Required actions | Completed |
|---|---|---|
| a) Check the BioBanking public register and place and expression of interest for credits wanted on it for at least six months | · For the relevant item, check the OEH biodiversity credits register to determine if matching credits have been issued and are available.<br>· Check the OEH BioBank site expression of interest (EOI) register to determine if a landholder may have matching credits that are not yet issued.<br>· Place a 'credits wanted' request on the OEH credits wanted register for the approximate number and types of credits. | Yes, described in **Section 3** |
| b) Seek candidate properties | · Liaise with local OEH office and relevant local councils to obtain a list of potential sites that meet the requirements for offsetting.<br>· Undertake a desktop assessment of vegetation types, tenure and patch size to shortlist potential sites and landholders. | No |

| Step | Required actions | Completed |
|---|---|---|
| c) Test landholder interest | · Use the shortlist to contact landholders to determine interest in entering into a BioBanking agreement and selling credits to INSW. | No |
| d) Provide evidence of why offset sites are not feasible | · This action would be required after evidence of the above steps has been exhausted. | No |
| e) Investigate options for supplementary measures and estimate costs | · The indicative cost of supplementary measures is estimated using similar credits already sold as part of the BioBanking scheme as a surrogate. | No |

## 2.2 Stage 2

The proposed key activities associated with the second stage are:

- Following Project approval, review the availability of credits to purchase on the open market.
- Seek candidate properties through a desktop analysis to develop a short-list of priority sites.
- Approach owners of priority sites to identify interest in offsetting.
- Undertake rapid field assessments on priority sites to confirm the ecological values and habitat condition, to ensure the offset areas provide equivalent or greater values – i.e. improve or maintain biodiversity values.
- Progress negotiations with owners and complete detailed BioBanking Assessment at priority sites.
- Identify site specific management actions for long-term management of the biodiversity offsets.
- Obtain agreement and approval from OEH for the proposed offset package.
- Secure offset properties under an appropriate conservation mechanism.

# 3. Assessment of offset availability

## 3.1 Preliminary offset investigations

### 3.1.1 BioBanking public registers

A search of relevant BioBanking public registers was undertaken on the 28 April 2016 to determine if credits are available for required ecosystem credits and species credits for the North Coast Bioregion. BioBanking public registers included:

- Biodiversity credits register (finds buyers and sellers information in relation to each credit).
- Expression of Interest (EOI) register (finds landowners interested in establishing a BioBank site but have not entered into a BioBank agreement). These credits have not been verified by OEH, and are only an estimation of the type and number of credits that could be generated at the site if a BioBank site was established.

A summary of the results of the searches are included in **Table 3-1 and Table 3-2**.

Table 3-1 Ecosystem credits BioBanking public register search

| Plant community type | BVT code | Credits required | Credits available | |
|---|---|---|---|---|
| | | | Biodiversity credits register | EOI register / IBRA subregion / ha |
| Coastal freshwater meadows and forblands of lagoons and wetland (EEC – TSC Act) | NR150 | 48 | None (including PCT offset options) | - EOI ID: 4 (Clarence Lowlands – 95 ha)<br>- EOI ID: 12 (Clarence Lowlands – 965 ha) |
| Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR244 | 569 | None (including PCT offset options) | - EOI ID: 12 (NR246 offset option: Clarence Lowlands – 965 ha)<br>- EOI ID: 17 (NR244: Clarence Lowlands – 1569 ha)<br>- EOI ID: 83 (NR246 and NR216 offset option: Clarence Lowlands / Clarence Sandstones – 818 ha) |
| Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | NR246 | 654 | None (including PCT offset options) | - EOI ID: 12 (NR246 Clarence Lowlands – 965 ha)<br>- EOI ID: 17 (NR244 offset option: Clarence Lowlands – 1569 ha)<br>- EOI ID: 83 (NR246 and NR216 offset option: Clarence Lowlands / Clarence Sandstones – 818 ha) |

Table 3-2 Species credits BioBanking public register search

| Species | Credits required | Credits available | |
|---|---|---|---|
| | | Biodiversity credits register | EOI register / IBRA subregion / ha |
| Black-necked Stork (*Ephippiorhynchus asiaticus*) | 54 | None | - EOI ID: 12 (Clarence Lowlands – 965 ha)<br>- EOI ID 80 (Macleay Hastings - Northern Rivers – 57 ha) |
| Brolga (*Grus rubicunda*) | 9 | None | None |
| Brush-tailed Phascogale (*Phascogale tapoatafa*) | 592 | Partially – 180 credits issued and available (Agreement ID : 167 – Macleay Hastings) | - EOI ID: 4 (Clarence Lowlands – 95 ha)<br>- EOI ID: 184 (Upper Hunter - 223 ha) |
| Common Planigale (*Planigale maculata*) | 770 | None | - EOI ID: 7 (Clarence Sandstones – 90ha)<br>- EOI ID: 57 (Macleay Hastings – 79ha)<br>- EOI ID: 157 (Clarence Sandstones - 159 ha) |
| Emu population, NSW North Coast Bioregion and Port Stephens LGA (*Dromaius novaehollandiae*) | 788 | None | - EOI ID: 12 (Clarence Lowlands – 965 ha) |
| Koala (*Phascolarctos cinereus*) | 770 | None - some issued (Agreement ID: 158) but not available | - EOI ID: 29 (Coffs Coast & Escarpment – 50ha)<br>- EOI ID:30 (Sydney Cataract – 16 ha)<br>- EOI ID: 32 Walcha Plateau – 150ha)<br>- EOI ID:57 (Macleay Hastings – 79ha)<br>- EOI ID: 61 (Tomalla – 800 ha)<br>- EOI ID: 128 (Peel – 1,948 ha)<br>- EOI ID: 160 (Burragorang – 95 ha)<br>- EOI ID: 171 (Macleay Hastings – 137 ha)<br>- EOI ID: 184 (Upper Hunter - 223 ha)<br>- EOI ID: 187 (Illawarra – 94 ha)<br>- EOI ID:222 (Cumberland – 38ha) |
| Little Bentwing-bat (*Miniopterus australis*) | 394 | None | - EOI ID: 4 (Clarence Lowlands – 95 ha)<br>- EOI ID: 12 (Clarence Lowlands – 965 ha)<br>- EOI ID: 16 (Karuah Manning – 436 ha)<br>- EOI ID:17 (Clarence Lowlands – 1,569 ha)<br>- EOI ID: 23 (Upper Hunter – 355 ha)<br>- EOI ID: 30 (Sydney Cataract – 16 ha) |
| Rufous Bettong (*Aepyprymnus rufescens*) | 788 | None | - EOI ID: 4 (Clarence Lowlands – 95 ha)<br>- EOI ID: 7 (Clarence Sandstones – 90ha)<br>- EOI ID: 23 (Upper Hunter – 355 ha)<br>- EOI ID: 157 (Clarence Sandstones - 159 ha) |
| Squirrel Glider (*Petaurus norfolcensis*) | 651 | Partially – 180 credits issued and available (Agreement ID : 167 – Macleay Hastings) | - EOI ID: 4 (Clarence Lowlands – 95 ha)<br>- EOI ID: 56 (Monaro – 180 ha)<br>- EOI ID: 61 (Tomalla – 800 ha)<br>- EOI ID: 128 (Peel – 1,948 ha)<br>- EOI ID: 166 (Cumberland – 1,424 ha) |
| Wallum Froglet (*Crinia tinnula*) | 9 | Yes – 196 credits issued and available (Agreement ID : 167 – Macleay Hastings) | - EOI ID: 4 (Clarence Lowlands – 95 ha)<br>- EOI ID: 12 (Clarence Lowlands – 965 ha)<br>- EOI ID: 42 (Macleay Hastings – 80 ha)<br>- EOI ID:57 (Macleay Hastings – 79ha)<br>- EOI ID: 79 (Wyong – 40ha)<br>- EOI 122 (Wyong – 44 ha) |

## 3.2 Credits wanted register

The NSW *Biodiversity Offsets Policy for Major Projects* states that *reasonable steps to secure offsets* must include a request on the OEH credits wanted register to advertise credits for at least six months.

# 4. Preliminary offset outcomes

## 4.1 Ecosystem credits

The search of the BioBanking Credit Register for the availability of the required ecosystem credits confirmed that the required credits are not currently available for purchase in the Clarence Lowland IBRA subregion and wider North Coast bioregion. There is possible adequate land area as evidenced on the EOI Register for all PCTs in the Clarence Lowland IBRA subregion, however liaison with OEH and the registered landholder is required to confirm if site investigations have been undertaken and the relevant PCTs are present on the registered site.

## 4.2 Species credits

A search of the BioBanking Credit Register for the availability of the required species credits confirmed that there are species credits currently available in the Macleay Hastings IBRA subregion for Wallum Froglet and partially available for the Brush-tailed Phascogale and Squirrel Glider.

The BioBanking EOI register identified potential sites for nine species, although does not include an estimate of the likely credits available, but does include the property size. These threatened species are assumed to be present by the landowner and have not been verified by a threatened species survey. The outcome of the OEH registers did not identify any sites suitable for the Brogla.

# 5. Purchasing and retiring credits

The price of ecosystem and species credits is set by the market. As such, an estimate of the likely cost of offsetting has been calculated based on a search of the most recent data from the OEH ecosystem and species credit transaction reports. The draft Offsets Payment Calculator was also used to predict offset costs for both ecosystem and species credits based on a Trade Model. The credit figures quoted should be treated as indicative only which are subject to change. It should be understood that the credit prices provided here are an estimate based off historical trading data and that credit prices are subject to an open market with the price per credit ultimately set by the seller which can fluctuate depending on demand. The price per credit also includes money required to manage the site in perpetuity, fund search costs, management costs, risk margins, and profit to the credit seller.

## 5.1 Cost of ecosystem credits

Of the three PCTs to be offset, none have been traded in the market. Results from the draft Offsets Payment Calculator for ecosystem credits equate to an indicative cost of **$2,719,447.60**. A breakdown of indicative costs for each PCT is shown in Table 5-1.

Table 5-1 Total indicative cost for purchasing ecosystem credits based on the Offsets Payment Calculator

| PCT | TEC | Price per credit (excluding GST) | Number of credits required | Total indicative cost of credits |
|---|---|---|---|---|
| PCT 782 Coastal freshwater meadows and forblands of lagoons and wetland | Freshwater Wetlands on Coastal Floodplains of the NSW North Coast, Sydney Basin and South East Corner bioregions (Endangered, TSC Act) | $3,443.56 | 42 | $144,629.52 |
| PCT 1209 Spotted Gum - Grey Box - Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | Not listed | $2,266.76 | 539 | $1,221,783.64 |
| PCT 1211 Spotted Gum - Grey Ironbark - Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion | Not listed | $2,068.86 | 654 | $1,353,034.44 |
| Total | | | 1,235 | $2,719,447.60 |

## 5.2 Cost of species credits

There has been no relevant species credits transferred or retired in the current species credit transaction report. Results from the draft Offsets Payment Calculator for species credits equate to an indicative cost of **$4,648,197.43**. A breakdown of indicative costs for each species is shown in Table 5-2.

Table 5-2 Total indicative cost for purchasing species credits based on the Offsets Payment Calculator

| Species credit species (Profile ID) | Price per credit (excluding GST) | Credits required | Total indicative cost of credits |
|---|---|---|---|
| Black-necked Stork (Ephippiorhynchus asiaticus) | $634.63 | 54 | $34,270.02 |
| Brolga (Grus rubicunda)^ | $634.63 | 9 | $5,711.67 |
| Brush-tailed Phascogale (Phascogale tapoatafa) | $1,258.10 | 592 | $744,795.20 |
| Common Planigale (Planigale maculata) | $1,258.10 | 770 | $968,737.00 |
| Emu population, NSW North Coast Bioregion and Port Stephens Local Government Area (Dromaius novaehollandiae) | $1,258.10 | 788 | $991,382.80 |
| Koala (Phascolarctos cinereus) (10616) | $634.63 | 770 | $488,665.10 |
| Little Bentwing-bat (Miniopterus australis) | $1,258.10 | 394 | $495,691.40 |
| Rufous Bettong (Aepyprymnus rufescens) | $634.63 | 788 | $500,088.44 |
| Squirrel Glider (Petaurus norfolcensis) | $634.63 | 651 | $413,144.13 |
| Wallum Froglet (Crinia tinnula) (10183) | $634.63 | 9 | $5,711.67 |
| Total | | 4,825 | $4,648,197.43 |
| ^no data was available on draft Offsets Payment Calculator for Brolga and assumes the same cost as Black-necked Stork (another wading wetland bird) | | | |

# 6. Conclusion and next steps

The BAR and BOS has identified the number and type of credits that are required to be offset as a result of the proposal and provided a BioBanking credit report. The following biodiversity credits are being sought for the residual unavoidable impacts resulting from the Project:

- 42 ecosystem credits for Coastal freshwater meadows and forblands or lagoons and wetland (NR150)
- 539 ecosystem credits for Spotted Gum – Grey Box – Grey Ironbark dry open forest of the Clarence Valley lowlands of the NSW North Coast Bioregion (NR244)
- 654 ecosystem credits for Spotted Gum - Grey Ironbark – Pink Bloodwood open forest of the Clarence Valley lowlands of the NSW North coast Bioregion (NR246)
- Species credits for 10 threatened fauna species identified on the site and predicted to be impacted from clearing for the proposal.

This report presents the first stage of offset investigations by identifying the worst case Project impact and offset requirements in accordance with the *NSW Major Project Offsets Policy* and a search of relevant public BioBanking registers.

The search of the BioBanking Credit Register and BioBanking EOI register identified locations that may be suitable as part of the offset strategy for most of the credits required.

The indicative cost of purchasing ecosystem (1,235) and species (4,825) credits to offset residual impacts equates to a total of **$7,367,645.03**. It should be understood that this price is an estimate based off historical trading data and that credit prices are subject to an open market with the price per credit ultimately set by the seller which can fluctuate depending on demand.

The report does not provide background or site survey data for prospective offset properties. Stage 2 investigations will follow project approval and will include:

- An updated search of the BioBanking public database to investigate offset availability.
- Desktop investigation of potential offset opportunities to develop a short-list of priority sites.
- Approaching owners of priority sites to identify interest in offsetting.
- Undertaking rapid field assessment on priority sites to confirm ecological values and habitat condition to ensure the offset areas provide equivalent or greater values – i.e. improve or maintain biodiversity values.
- Progressing negotiations with owners and complete detailed BioBanking Assessments at priority sites, or securing offset properties under an appropriate conservation mechanism.
- Consideration of options for supplementary measures.

# 7. References

Department of Sustainability, Environment, Water, Population and Communities (2012). *Environment Protection and Biodiversity Conservation Act 1999. Environmental Offsets Policy*, Canberra.

Office of Environment and Heritage (2014). *Framework for Biodiversity Assessment: NSW Biodiversity Offsets Policy for Major Projects*. State of NSW and Office of Environment and Heritage, Sydney.

Office for Environment and Heritage, (2014). *NSW Biodiversity Offsets Policy for Major Projects*, Office for Environment and Heritage NSW, Sydney.

# Appendix E. Assessment of Significance - MNES (EPBC Act)

For threatened species and communities listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 an assessment of significance has been completed in accordance with the *Matters of National Environmental Significance Significant Impact Guidelines 1.1* (Department of the Environment, 2013)

## E.1 Grey-headed Flying-fox (*Pteropus poliocephalus*)

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

There have been no roost camps identified in the Project Site to date and would not directly impact on any known breeding / maternity site.

Grey-headed Flying Fox was observed in large numbers feeding on nectar from flowering Pink Bloodwood in the Project Site. Native vegetation on the Project Site is likely to have productive flowering periods year round where a diversity of Eucalyptus and Corymbia tree species are present. According to Eby (2008), Pink Bloodwood, Forest Red Gum, Grey Box, Northern Grey Ironbark and Narrow-leaved Red Gum are recognised as significant food tree species in the blossom diet for the Grey-headed Flying Fox.

Therefore it is likely that the impacts of construction and operation of the project would be confined to loss of feeding habitat caused by direct clearing or damage to native vegetation during the construction phase.

The project would directly remove up to 29.6 hectares of foraging habitat. The impact to habitat is considered to be a small portion of the occupancy for feeding life-cycle attributes of the population and represents a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the Project Site. Given the relative widespread nature of similar high quality foraging habitat in the locality within the feeding range of regional populations, the project is not expected to lead to a long-term decrease in the size of an important population.

*Reduce the area of occupancy of an important population*

The project would directly remove up to 29.6 hectares of foraging habitat. Foraging habitat mainly comprises nectar producing *Eucalyptus* and *Corymbia* tree species with a combined annual flowering period. This area of habitat is considered to be a small portion of the occupancy for feeding life-cycle attributes of the population and represents a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the Project Site. The project will reduce the area of habitat available to the species.

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

The project is unlikely to fragment existing native vegetation where clearing of 29.6 hectares of foraging habitat would occur on the fringes of a large vegetation patch. Highly mobile species such as bats are expected to be less impacted by fragmentation and the Grey-headed Flying-fox is particularly well adapted to accessing widely spaced habitat resources given its mobility and preference for seasonal fruits and blossom. The project would not fragment an important population of the Grey-headed Flying-fox.

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

The draft recovery plan for the Grey-headed Flying-fox (DECCW 2009) identifies critical foraging habitat for this species as:

- Productive during winter and spring, when food bottlenecks have been identified
- Known to support populations of >30,000 individuals, within an area of 50 kilometre radius
- Productive during the final weeks of gestation, and during the weeks of birth, lactation and conception (Sept-May)

- Productive during the final stages of fruit development and ripening in commercial crops affected by Grey-headed Flying-foxes
- Known to be continuously occupied as a camp site.

The Project Site is considered to have critical foraging habitat for the Grey-headed Flying-fox, given that highly productive nectar food trees are available during most of the year, including important lifecycle stages of the Grey-headed Flying-fox.

The project would directly remove up to 29.6 hectares of foraging habitat. This area of habitat is considered to be a small portion of the occupancy for feeding life-cycle attributes of the population and represents a small percentage of the total extent of important foraging vegetation types present within a 50 kilometre radius of the Project Site. Given the relative widespread nature of similar high quality foraging habitat in the locality within the feeding range of regional populations, the project is not expected to adversely affect this critical habitat area.

*Disrupt the breeding cycle of an important population*

As stated above there would be a minor impact on critical foraging habitat identified as important during the breeding cycle of the species. However, the project would not directly impact on a known roost camp / breeding or maternity site.

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

The project would directly remove up to 29.6 hectares of quality foraging habitat, however it is highly unlikely that the Grey-headed Flying-fox would decline. Suitable habitat is largely widespread and would remain surrounding the Project Site.

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

There are no recognised invasive species that are harmful to the Grey-headed Flying-fox. The potential for weed invasion into habitat of the species is considered possible with a project of this nature and appropriate controls are required during construction and operation to reduce this threat. The management of invasive species would be managed during the construction.

*Introduce disease that may cause the species to decline*

There are no known disease issues affecting this species in relation to the project. Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the project has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the project. This can be mitigated through the development and implementation of suitable control measures.

*Interferes substantially with the recovery of the species*

The project would not conflict with the recovery plans for this species. Although the project would remove 29.6 hectares of critical foraging habitat, similar high quality foraging habitat would remain and is widespread in the locality and within the feeding range of regional populations. Mitigation and offset measures would target the recovery of lost foraging habitat. There are no priority sites for conservation of this species within the project boundary.

## E.2 Swift Parrot (*Lathamus discolor*) and Regent Honeyeater (*Anthochaera phrygia*)

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

**Swift Parrot**

The Swift Parrot only breeds in Tasmania during spring and summer, migrating in the autumn and winter months to south-eastern Australia from Victoria and the eastern parts of South Australia to south-east Queensland. In NSW mostly occurs on the coast and south west slopes. Swift Parrots will return to some foraging sites on a cyclic basis depending on food availability. Key feed trees include winter flowering species such as *Eucalyptus robusta*, *Corymbia maculata* and *E. tereticornis*. Commonly used lerp infested trees include *E. moluccana* and *E. pilularis*. Although there are a low proportion of key feed trees on the Project Site, the Swift Parrot could forage on occasion within *E. tereticornis*, *Eucalyptus moluccana* as well as *E. siderophloia* on its winter migration.

The species may forage on occasion in the Project Site, but is not likely to depend on the resources present. The project would remove 30.3 hectares of potential foraging habitat for this species. Given that similar foraging habitat is present in the locality, the project is unlikely to impact the foraging cycle of the species such that a viable local population is placed at risk of extinction.

**Regent Honeyeater**

The Regent Honeyeater is a semi-nomadic species that has three known key breeding areas, two of them in NSW - Capertee Valley and Bundarra-Barraba regions. There are also minor and sporadic records of breeding in Clarence Valley (Roderick, Ingwersen and Tzaros, 2013). Records from the Clarence Valley are relatively continuous extending over the last 30 years indicating that the region may constitute seasonally important foraging and refuge habitat for transient populations of these species, particularly during inland droughts.

Key habitats for the species in NSW are present on the coast and coastal plains and include *Corymbia maculata*, *C. gummifera*, *Eucalyptus robusta* and *E. tereticornis* forests. Commonly used lerp infested trees include *E. moluccana* and *E. pilularis*.

The Regent Honeyeater does not breed in the locality. The species may forage on occasion on *E. tereticornis* and *E. moluccana* in the Project Site.

The species may forage on occasion in the Project Site, but is not likely to depend on the resources present. The project would remove 30.3 hectares of potential foraging habitat for this species. No breeding habitat would be impacted. The project is unlikely to impact the lifecycle of the species such that a viable local population is placed at risk of extinction.

*Reduce the area of occupancy of the species*

Both species are wide ranging and highly mobile, semi-nomadic species with patchy and sporadic distribution across coastal NSW. Their presence in the Project Site is seasonally dependent and influenced by drought and rain periods affecting the flowering of preferred tree species. Therefore there is no defined area of occupancy in the Project Site. The project would have minor impacts on a relatively small area of potential foraging habitat for these species, given that there is widespread foraging habitat in the locality.

*Fragment an existing population into two or more populations*

Both species are highly mobile and semi-nomadic, capable of accessing patchy food resources. There are no defined areas of habitat in the Project Site that are exclusively occupied by these species and the project would not fragment a population of the Swift Parrot and Regent Honeyeater.

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

Up to 84 percent of the Project Site has already been cleared, and remaining dry open forest align with the potential foraging habitat of the species. The impacts to vegetation in these areas would directly remove

30.3 hectares of potential habitat along the edges of large vegetation patches, where potential foraging habitat is very widespread through the surrounding locality. The project is unlikely to adversely affect habitat critical to the survival of the Swift Parrot and Regent Honeyeater.

*Disrupt the breeding cycle of a population*

The Project Site would constitute non-breeding habitat for a proportion of the population of both species

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

The project would directly remove up to 30.3 hectares of potential foraging habitat; however it is highly unlikely that the Swift Parrot and Regent Honeyeater would decline. Suitable habitat is largely widespread and would remain surrounding the Project Site.

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

There are no recognised invasive species that are harmful to the assessed species. The potential for weed invasion into habitat of the species is considered possible with a project of this nature and appropriate controls are required during construction and operation to reduce this threat. The management of invasive species would be managed during the construction.

*Introduce disease that may cause the species to decline*

There are no currently no diseases affecting this species. Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the project has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the project. This can be mitigated through the development and implementation of suitable control measures.

*Interfere with the recovery of the species.*

The project would not conflict with the recovery plans for the Swift Parrot and Regent Honeyeater. Although the project would remove 30.3 hectares of potential foraging habitat, similar habitat would remain and is widespread in the locality. Mitigation and offset measures would target the recovery of lost foraging habitat. There are no priority sites for conservation of the Swift Parrot and Regent Honeyeater within the project boundary.

## E.3 Koala (*Phascolarctos cinereus*)

Koalas are known to occur throughout the Clarence Valley with recent records at two sites within five kilometres of the Project Site. Although there was no evidence of Koala using the habitats in the Project Site, the habitat assessment tool (DoE 2013) identified the presence of habitat critical to the survival of koalas. Any existing populations are considered to be at a low-density.

In the Project Site there is one primary koala food tree *E. tereticornis* at low proportions, as well as three secondary food tree species at moderate proportions *E. moluccana E. seeana, E. propinqua*.

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

The Koala has been recorded within the five kilometres of the Project Site. Potential habitat is present throughout the locality. These communities include a combination of primary, secondary and supplementary feed trees. The project would directly remove 30.3 hectares of potential koala habitat in the Project Site which is considered to be habitat critical to the survival of koalas. However given the widespread areas of habitat containing feed trees (*E. tereticornis* forests) Koalas would still be able to move through the area despite the loss of some habitat along the edge of these large patches. Given the small area of potential foraging and

breeding habitat that would be impacted, and the continued presence of movement corridors in the area, the project is unlikely to lead to a long-term decrease in the size of an important population of the Koala.

*Reduce the area of occupancy of an important population*

The project would result in the loss of about 30.3 hectares of potential foraging and breeding habitat. The habitat loss is confined to one location and would involve the loss of all vegetation and potential foraging habitat within the Project Site. Existing connectivity would not be severed. The Project is unlikely to reduce the area of occupancy of an important population of Koalas.

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

The project is unlikely to fragment existing native vegetation where clearing of 30.3 hectares of foraging habitat would occur on the fringes of a large vegetation patch. Opportunities for movement across the landscape will remain. The project would not fragment an important population of the Koala.

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

According to the Draft Koala Referral Guidelines (DoE 2013), habitat critical to the survival of the Koala includes habitat that is considered to be important for the species' long-term survival and recovery. An impact area that scores five or more using the habitat assessment tool is highly likely to contain habitat critical to the survival of the koala. The assessment tool considers five contributing factors for scoring potential habitat critical to the survival of the Koala, this includes:

- Koala occurrence.
- Vegetation structure and composition.
- Habitat connectivity.
- Key existing threats.
- Recovery value.

The habitat assessment tool has reported a score of 6 on the Project Site which confirms the presence of habitat critical to the survival of koalas, although the population is considered a low-density.

Up to 84 percent of the Project Site has already been cleared, and remaining dry open forest align with the habitat critical to the survival of Koala. The impacts to vegetation in these areas would directly remove 30.3 hectares of potential habitat along the edges of large vegetation patches, where potential foraging habitat is very widespread through the surrounding locality. Most potential Koala habitat in the locality is dominated by a combination of primary, secondary and supplementary feed trees, with primary feed trees likely to be present to the west of the Project Site. The project is unlikely to adversely affect habitat critical to the survival of the Koala.

*Disrupt the breeding cycle of an important population*

The proposed area of habitat clearing represents a small portion of the potential habitat for the species and any impacts to breeding individuals would be limited to a small proportion of the population given the extensive areas of potential habitat in this location. Furthermore, potential habitat on the Project Site is considered to be in poorer condition compared to surrounding native vegetation, particularly in regards to structural properties of the forest where the Project Site lacks a mid-storey and / or sub-canopy. This may discourage breeding activity on the Project Site.

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

The project would directly remove up to 30.3 hectares of potential foraging habitat; however it is highly unlikely that the Koala would decline. Suitable habitat is largely widespread and would remain surrounding the Project Site.

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

There are no recognised invasive species that are harmful to the assessed species. The potential for weed invasion into habitat of the species is considered possible with a project of this nature and appropriate controls are required during construction and operation to reduce this threat. The management of invasive species would be managed during the construction.

*Introduce disease that may cause the species to decline*

The project is unlikely to introduce diseases affecting koalas, such as Chlamydia. Infection of native plants by *Phytophthora cinnamomi* has been identified as being spread by construction machinery. This water-borne fungus infects the roots of plants and has the potential to cause dieback. Machinery associated with vegetation clearance and subsequent construction for the project has the potential to transmit the fungus to remaining native vegetation remnants of the species. This is a potential indirect impact to the species through the transmission of pathogens into retained habitat near the Project. This can be mitigated through the development and implementation of suitable control measures.

*Interferes substantially with the recovery of the species*

The project would not conflict with the recovery plans for the Koala. Although the project would remove 30.3 hectares of potential foraging habitat, similar or better quality habitat would remain and is widespread in the locality. Mitigation and offset measures would target the recovery of lost foraging habitat. There are no priority sites for conservation of the Koala within the project boundary.

# Appendix F. Field survey records

| BioBanking plots | Easting | Northing |
|---|---|---|
| Plot 1 | 505737 | 6709710 |
| Plot 2 | 505979 | 6709930 |
| Plot 3 | 506101 | 6709820 |
| Plot 4 | 505921 | 6709370 |
| Plot 5 | 505753 | 6708460 |
| Plot 6 | 505740 | 6708810 |
| Plot 7 | 505601 | 6708700 |
| Plot 8 | 506027 | 6710340 |
| Plot 9 | 506116 | 6710560 |
| Plot 10 | 506424 | 6710380 |
| Plot 11 | 505379 | 6709730 |
| Plot 12 | 505754 | 6708930 |
| Plot 13 | 505724 | 6709190 |

| Fauna Survey sites | Easting | Northing |
|---|---|---|
| Site 1 | 505705 | 6708880 |
| Site 2 | 505351 | 6709718 |
| Site 3 | 505850 | 6709381 |
| Site 4 | 505311 | 6709905 |
| Site 5 | 506313 | 6710667 |
| Site 6 | 506010 | 6710313 |
| Site 7 | 505946 | 6709911 |
| Site 8 | 505721 | 6709735 |
| Site 9 | 505669 | 6708580 |
| Site DL1 | 505710 | 6709343 |
| Site DL2 | 505459 | 6710327 |
| Site FD1 | 506061 | 6708592 |
| Site FD2 | 505773 | 6708968 |